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**MINING PLAN  
AND  
MINE CLOSURE PLAN  
FOR  
BALRAM OC EXPANSION (15 MTY)  
REVISION - 1  
TALCHER COALFIELD  
MAHANADI COALFIELDS LIMITED  
(TEXT & PLATES)**

RQP: GUNTUR SRINIVAS, NO. 34012/(01)/2015-CPAM, Dtd. 05.10.2017  
Under Rule 22(C) of Mineral Concession Rules 1960



JULY, 2020

  
गुंतूर श्रीनिवास  
वरिष्ठ अभियंता (खनन)  
सी.एम.पी.डी.आर, को.स.-7  
Ref. No. 34012/(01)/2015-CPAM dt. 05.10.2017

**CENTRAL MINE PLANNING & DESIGN INSTITUTE LIMITED**  
(A Subsidiary of Coal India Ltd.)  
REGIONAL INSTITUTE-VII  
BHUBANESWAR - 751013.

# MINING PLAN AND MINE CLOSURE PLAN FOR BALARAM OC EXPANSION (15 MTY), REVISION-1

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## GENERAL INFORMATION

- |   |  |  |
|---|--|--|
| 1 | NAME AND ADDRESS OF THE APPLICANT                | : MAHANADI COALFIELDS LIMITED,<br>JAGRUTI VIHAR, BURLA,<br>SAMBALPUR-768020 (ORISSA)   |
| 2 | STATUS OF THE APPLICANT                          | : CENTRAL PUBLIC SECTOR UNDERTAKING<br>(A SUBSIDIARY OF COAL INDIA LTD.)<br>A GOVT. OF INDIA UNDERTAKING<br>REGISTERED UNDER COMPANIES ACT, 1956   |
| 3 | MINERAL WHICH THE APPLICANT INTENDS TO MINE      | : COAL   |
| 4 | NAME, ADDRESS OF PERSON WHO PREPARED MINING PLAN | : SHRI GUNTUR SRINIVAS<br>CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED,<br>REGIONAL INSTITUTE-VII, PLOT NO. E4<br>NEAR GANDHI PARK, SAMANTAPURI,<br>BHUBANESWAR-751013 (ODISHA).<br><br>RQP REF.NO.-No. 34012/(01)/2015-CPAM, DTD. 05.10.2017<br>UNDER RULE 22(C) OF MINERAL CONCESSION RULES 1960 |
| 5 | NAME AND ADDRESS OF PROSPECTING AGENCY           | : CENTRAL MINE PLANNING & DESIGN INSTITUTE LIMITED,<br>REGIONAL INSTITUTE-VII, PLOT NO. E4<br>NEAR GANDHI PARK, SAMANTAPURI,<br>BHUBANESWAR-751013 (ODISHA).   |

## DOCUMENTS ENCLOSED

| Sl No    | Description   | Page  |
|----------|---|---|
| A.       | Copy of the Allotment Order   | The proposed Balaram OC. Expansion lies in the Kalinga East & West geological blocks which belongs to MCL and where opencast mine is being operated. Sanction letter of Project report enclosed in Annexure-5 |
| <b>B</b> | <b>LIST OF ANNEXURE</b>   |   |
| 1        | Copy of Approval letter of Project report ( 15 Mty)   | (Annexure-5)  |
| 2        | Copy of approval of earlier Mining Plan/Mine Closure Plan (15 Mty)  | (Annexure-4)  |
| 3        | Copy of environment clearance (8 Mty)   | (Annexure-2)  |
| 4        | Letter from MCL to CMPDI for preparation of Mining Plan (15 Mty)  | (Annexure-1)  |
| 5        | Copy of grant of recognition to executives of CMPDI as competent to prepare mining plan of coal/ lignite blocks   | (Annexure-6)  |
| 6        | Certificate from Technically qualified person from CMPDI  | (Annexure-7)  |
| C        | INDEX of chapters contained in MP&MCP   | Enclosed in contents  |
| D        | List of plates contained in MP&MCP  | Enclosed in contents  |
| E        | TEXT & PLATES   | Page as mentioned in contents   |
| F        | 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. | This is to confirm that the proposed area has been verified with the relevant plans available in CMPDI and the area under consideration is under jurisdiction of MCL.   |
| G        | Copy of the document to establish that the Geological Report has been duly purchased from CMPDI, GSI/MECL as the case may be.   | The Geological Report was prepared by CMPDI.  |

**H. List of Abbreviations used:**

- MoC : Ministry of Coal
- MoEF : Ministry of Environment and Forest
- EC : Environmental Clearance
- FC: Forestry Clearance
- CMPDIL : Central Mine Planning and Design Institute Limited.
- MCL : Mahanadi Coalfields Limited.
- NCDC: National Coal Development Corporation.
- OC : Opencast
- IBM : Indian Bureau of Mines
- MECL: Mineral development Corporation Limited
- RH- Relative Humidity
- UHV- Useful Heat Value
- PR : Project Report
- CBA (A&D) Act- Coal Bearing Areas (Acquisition & Development) Act.
- Yr 1,2,- Production year 1,2
- Mt- Million tonnes
- Mty- Million tonnes per year
- OB- Overburden
- TPD- Tonnes per day
- kW- kilo watt
- kV-kilo volt
- FLP- Flame Proof
- lps-liters per second
- CO- Carbon Monoxide
- CH<sub>4</sub> Methane
- CHP- Coal Handling Plant
- MTK room- Mine Time Keeper Room
- RPM- Rounds per Minute
- SPM- Suspended Particulate Matter
- NO<sub>x</sub> Nitrogen Oxide/s
- EMP- Environmental Management Plan
- PP - Project Proponent

## SUMMARISED DATA

|                   |  |   |
|-------------------|--|---|
| <b>1. General</b> |  |   |
| a)                | Name and address of the Applicant Company  | Mahanadi Coalfields Ltd. ( MCL)<br>Jagriti Vihar, Burla<br>Dist: Sambalpur (Odisha) - 768020  |
| b)                | Name and address of the Block Allottee   | Mahanadi Coalfields Ltd.( MCL)  |
| c)                | Relationship between the applicant and allottee company  | MCL is a subsidiary of Coal India Ltd. which is a Govt. of India Undertaking  |
| d)                | Status of the Applicant Company :<br>Central /Public Sector Undertaking/State Government Undertaking/JV Company/ Pvt. Company/Public Co/Others (Specify)                 | Central Public Sector Undertaking   |
| e)                | Name of the Coal Block together with name of Coalfield & State where located   | Balram OC Expansion, Rev-1 (15 Mty) is located over Kalinga east & west blocks in Hingula area, Talcher Coalfield, Odisha.  |
| f)                | Date of allotment  | Block is being worked by Mahanadi Coalfields Limited, A subsidiary of Coal India Limited (Govt. of India undertaking)   |
| g)                | End Use of Coal/Lignite as per Approval by the Competent Authority   | APGENCO, Basket linkage.  |
| h)                | ROM Quantity proposed to be produced as per Mining Plan  | 15 Million Te per annum   |
| i)                | Norms adopted for calculating ROM quantity requirement in case it differs from the quantity indicated in the Allotment Order.  | Not Applicable  |
| j)                | Beneficiation required – Yes/No  | NO  |
| k)                | Requirement of Beneficiated Coal & expected availability thereof.  | N/A   |
| l)                | Period for which Mining Lease has been granted/is to be renewed/ is to be applied for.   | Land acquired under CBA(A&D), Act, 1957   |
| m)                | Date of Expiry of earlier Mining Lease, if any   | N/A   |
| n)                | RQP who has prepared the Mining Plan<br>Name<br>Address<br>Phone No/Fax/Email ID<br>Registration No & date till valid<br>Date of grant/Renewal of RQP Status<br>Validity | GUNTUR SRINIVAS<br><br>Central Mine Planning and Design Institute limited, Plot No E4 (Near Gandhi Park), At: Samantapuri<br>Bhubaneswar-751013<br>Phone No. 0674-2391962<br><br>E-Mail- guntur.srinivas@coalindia.in<br><br>RQP NO. 34012/1/2015-CPAM Dtd. 05.10.2017. |

**D. Information regarding earlier approved Mining Plans, if any.**

|       |  |   |                   |           |
|-------|--|---|-------------------|-----------|
| a)    | Approval Letter no. and Date   | MP of Balram OC Extension (8 Mty)<br>Lt no.-43012/1/2008-CPAM, Dt.28/08/2009<br>MP&MCP of Balram OC Expn (15 Mty)<br>34012/(4)/2011-CPAM dtd. 9 <sup>th</sup> March 2016. |                   |           |
| b)    | Lease Area -----   | 2558.02 Ha as per MP&MCP of Balram OC Expn. (15 Mty)  |                   |           |
| c)    | Date of grant of Lease -----   |   |                   |           |
| d)    | Date of Expiry of Lease -----  |   |                   |           |
| e)    | Targeted Production -----  | 15.00 Mty   |                   |           |
| f)    | Proposed date of start of Production -----   | Already started.  |                   |           |
| g)    | Proposed date of achieving the targeted production level -----   | Yet to achieve.   |                   |           |
| h)    | Envisaged life of the mine (in years) -----  | 54 (as on 01.04.2010)   |                   |           |
| i)    | Date of actual commencement of Mining Operations, if operations already started                              | 1992-93   |                   |           |
| j)    | Likely date of Mining Operations, if operations not yet started & reasons for non-commencement of operations | Not applicable.   |                   |           |
| k)    | Planned production and actual levels achieved in last 3 years  |   |                   |           |
| l)    | Coal :- U/G<br>O/Cast<br>OB  |   | COAL (Mt)         | OB (Mcum) |
|       |  | 2017-18   | 2.379             | 6.967     |
|       |  | 2018-19   | 3.632             | 8.371     |
|       |  | 2019-20   | 5.234             | 9.973     |
| m)    | Reasons for difference between the planned and actual production levels                                      | Delay in land acquisition   |                   |           |
| n)    | Reason for revision of the Mining Plan   | Change in Forest land and Total lease area.   |                   |           |
| o)    | Details of changes in the new mining plan compared to earlier approval                                       | Old Plan  | New Plan          |           |
| (i)   | Total Lease Area (Ha) -----  | 2558.02   | 2779.00           |           |
| (ii)  | Mining Lease area (Ha) -----   | 2507.42   | 2574.00           |           |
| (iii) | Forest Area (Ha) -----   | 250.61  | 278.855           |           |
| (iv)  | Excavation Area (Ha)   | 1866.52   | 1863.70           |           |
| (v)   | Production level (Mty) -----   | 15.0  | 15.0              |           |
| (vi)  | Life (Years) -----   | 54<br>(01.4.2010)   | 49<br>(01.4.2020) |           |
| (vii) | Reserves (Mineable)-----   | 756.37  | 712.134           |           |

| <b>E LOCATION</b>  |   |
|--|---|
| a) Location of the Block<br>Taluka/ Village/ Khasra/ Plot / Block Range / etc.<br>District / State   | Angul district,<br>Odisha   |
| b) Name of the Coalfield/ Coal belt  | Talcher Coalfield   |
| c) Particulars of adjacent blocks: North, South, East, West  | North- Konark block<br>South-Natraj block.<br>East- Western boundary of<br>Bharatpur expansion OCP<br>(Bharatpur north, south and Padma<br>blocks)<br>West- Hingula                           |
| d) Area of the Allotted Block  |   |
| i Geological block area  | → 3050 Ha   |
| ii Excavation Area   | → 1863.70 Ha  |
| e) Reference no. of plan of block boundary issued by<br>CMPDI/ SCCL/ NLC (A copy of the Plan also to be<br>annexed)  | The Mining Plan is based on the<br>Geological Reports on Kalinga east<br>& Kalinga west Blocks, Talcher<br>Coalfield of Odisha, prepared by<br>CMPDI.   |
| f) Whether the lease boundary/ required boundary is<br>same as demarcated by CMPDI/ SCCL/ NLC for<br>delineating block/sub- block  | No  |
| g) Existing mining Lease Area in case of existing mines.   | 2507.42 Ha  |
| h) Applied/ required Lease Area as per the Mining Plan<br>under consideration (hectares)   | Land acquired under CBA Act.  |
| i) Whether the applied lease area falls within the allotted<br>block   | Yes   |
| j) Area (hectares) of lease which falls outside the<br>block/sub- block delineated by CMPDI/SCCL/NLC.  | The proposed area is under the<br>leasehold of MCL.   |
| k) Details of outside area:<br>- Whether forms part of any other coal block<br>- Whether it contains any coal/lignite reserves<br>- Purpose for which it is required, e.g. roads/<br>OB dumps/ service buildings/ colony/<br>safety zone/ others (specify) | Ext. dump area falls under non coal<br>bearing area.<br>Infrastructure is on non coal bearing<br>area towards rise side of the block.<br>Colony & resettlement area is<br>outside block area. |
| l) Whether some part(s) of the allotted block has not been<br>applied for mining lease.<br>- Total area in Ha. of such part(s).<br>- Total reserves in such part(s).<br>- Brief reasoning for leaving such part(s).  | No. Not applicable.   |
| m) Type of Land involved in Hectares (Total lease)   |   |
| - Forest Land  | Forest land - 278.855 ha  |
| - Non Forest Land  | Non-forest land - 2500.145 ha   |
|  | Total : 2779.000 ha   |



|  |   |
|--|---|
| n) Broad Land Use Pattern (Forest, Township, Industrial, Agricultural, Grazing, Barren etc.) | Agriculture, forest, Barren and village area  |
| o) Proximity of public road / railway line/major water body if any and approximate distance  | Nearest rail head Angul—16km by road<br>Talcher town is at a distance of 19km by road.  |
| p) Latitude and Longitude  | Kalinga East<br>Lat - 20°53'33" : 20°59'05" (N)<br>Long - 85°03'56" : 85°06'57" (E)<br>Kalinga West-<br>Lat - 20°56'02" : 20°59'05" (N)<br>Long - 85°02'52" : 85°03'56" (E) |

| <b>F GEOLOGY AND EXPLORATION</b>   |  |                        |                   |
|--|--|------------------------|-------------------|
| a) Name of the Geological Block and area in hectares   | Kalinga East & West blocks- 3050 Ha  |                        |                   |
| b) Name of the Geological Report (GR) with year of preparation   | "Geological Report on Kalinga east & west blocks, Talcher coalfield" Odisha, prepared by CMPDI, in 2009. |                        |                   |
| c) Name of the agency which conducted exploration and prepared GR  | CMPDI  |                        |                   |
| d) Period of conducting exploration  | 1979-2005  |                        |                   |
| e) Details of drilling (by all agencies)   | <b>Block</b>   | <b>Agency</b>          | <b>No. of BHs</b> |
|  | Kalinga East & West  | CMPDI                  | 438               |
|  |  | MECL                   | 102               |
|  |  | <b>Total</b>           | <b>540</b>        |
| f) No. of boreholes drilled within the block   | 540  |                        |                   |
| g) Overall borehole density within the block (no./ sq. km)   | 17.7 BH/ Sq.Km   |                        |                   |
| h) Area covered by 'detailed' exploration within the block (hectares)                                    | Totally explored (3050Ha)  |                        |                   |
| i) Area covered by 'detailed' exploration outside the block (hectares)                                   | Not Applicable   |                        |                   |
| - No. of boreholes drilled outside the block.  |  |                        |                   |
| - Bore hole density for outside area (no./sq. km)  |  |                        |                   |
| j) Whether entire lease area has been covered by 'detailed' exploration.                                 | Yes  |                        |                   |
| k) Whether any further exploration is required or suggested and timeframe in which it is to be completed | No   |                        |                   |
| l) Number of coal/lignite seams/horizons   | 19 seams including splits  |                        |                   |
| - thickness range of coal seams  | <b>Seam</b>  | <b>Range in meters</b> |                   |
|  | IIC  | 2 - 4                  |                   |
|  | IID  | 2 - 4                  |                   |
|  | IIE  | 10 - 12                |                   |
|  | II(D+E)  | 15 - 17                |                   |
|  | IIIA   | 1 - 2                  |                   |
|  | IIIB   | 0.4 - 0.85             |                   |
|  | IIIC   | 0.3 - 0.8              |                   |

|   |                                      |                |
|---|--------------------------------------|----------------|
| - Minimum & maximum depth of coal seams   | IIID                                 | 0.5 - 2        |
|   | IIIE                                 | 4 - 8          |
|   | IVA                                  | 1 - 3          |
|   | IVB                                  | 2 - 6          |
|   | IV(A+B)                              | 2 - 5          |
|   | VA                                   | 1.5 - 2.5      |
|   | VB                                   | 2 - 3          |
|   | VIB                                  | 1.5 - 2.5      |
|   | VIIA                                 | 1 - 1.5        |
|   | VIIIB                                | 1 - 2          |
|   | VIII                                 | 7 - 9          |
|   | IX                                   | 20 - 22        |
| IIC is the lowest coal seam considered as per G.R<br>Minimum depth - 10m<br>Maximum depth - 270m                |                                      |                |
| m) Gross Calorific Value (GCV in K Cal/kg) and Useful Heat Value(UHV in K.Cal/Kg), of coal as per GR :<br>Range | Coal Seam                            | UHV (K.cal/kg) |
|   | seam II C                            | 2150 - 3050    |
|   | seam II(D+E)                         | 2450-3250      |
|   | seam IIIA                            | 2500-3900      |
|   | seam IIIC                            | 2300-3550      |
|   | seam IIID                            | 2100-3700      |
|   | seam IIIE                            | 2700-3550      |
|   | seam IVA                             | 1850-3200      |
|   | seam IVB                             | 1350-1950      |
|   | seam VA                              | 2100-4000      |
|   | seam VB                              | 1350-2350      |
|   | seam VIB                             | 1350-2250      |
|   | seam VII                             | 1400-2600      |
|   | seam VIII                            | 1350-2450      |
|   | seam IX                              | 1450-2000      |
| n) Quality (Grade) of coal as per GR :<br>Range<br>Mean   | D To G<br>F                          |                |
| o) Total geological reserves in the block for Balram OC Expn.(15Mty) as on 01.04.2018                           | 746.21 million tonnes                |                |
| p) Depletion of reserves (in case of running mine) since inception  | 105.74 million tonne till 31.03.2020 |                |
| q) Additional reserves established (if any for running mine)  | N/A                                  |                |
| r) Geological reserves considered for mining: by Opencast as on 01.04.2018                                      | 746.21 Mt                            |                |
| s) Corresponding Extractable reserves: by Opencast mining as on 01.04.2018<br>as on 01.04.2020                  | 721.00 Mt<br>712.134 Mt              |                |
| t) Percentage of recovery w.r.t. geological reserves: by Opencast   | 96.6                                 |                |



|   |   |                         |   |                             |
|---|---|-------------------------|---|-----------------------------|
| <b>G. MINING</b>  |   |                         |   |                             |
| a)  | Existing and proposed method of mining (Opencast for OB & coal separately with dragline/ shovel/ surface miners/ manual/ etc.)                  |                         | Shovel-Dumper in OB & surface miner in coal.  |                             |
| b)  | Targeted capacity in mtpa when the mine is fully developed and the year in which proposed to be achieved<br>By Opencast :<br>Year :             |                         | 15 Mty<br>Year- 4   |                             |
| c)  | Life of the mine (as on 01.04.2020)   |                         | 49 Years  |                             |
| d)  | Indicate quantum of production and expected grade as in table below :   |                         |   |                             |
|   | <b>Year</b>   | <b>OC Production Mt</b> | <b>Grade</b>  | <b>Washery rejects (Mt)</b> |
|   | Yr-1 (2020-21)  | 8                       | D<br>to G<br><br>Grade ( non-coking)  | Not Applicable              |
|   | Yr-2 (2021-22)  | 10.0                    |   |                             |
|   | Yr-3 (2022-23)  | 13.63                   |   |                             |
|   | Yr-4 (2023-24)  | 15.0                    |   |                             |
|   | Yr-5 to Yr-48 (44 years @ 15Mty)  | 660.0                   |   |                             |
|   | Yr-49   | 5.50                    |   |                             |
| Detailed calendar programme of coal production year wise and seam wise along with OB removal have been furnished in the relevant chapter. |   |                         |   |                             |
| e)  | Whether the proposed external OB dump site is coal/ lignite bearing:<br>- If so, whether coal/lignite below waste disposal area is extractable. |                         | Not applicable  |                             |
| f)  | Whether negative proving for coal / lignite in the proposed site for OB dump/ infrastructure has been done.                                     |                         | N/A   |                             |
| g)  | Proposed configuration of HEMM for OC (Coal & OB) & Major Equipment for OC.   |                         | Suggested HEMM to be used:<br>Shovel & Dumper for Ob and surface miner for coal.<br>Other major equipment details given in chapter-5. |                             |
| h)  | Mode of entry for underground mines (shaft, incline, adit,):  |                         | N/A   |                             |
| i)  | Operations that are proposed to be outsourced   |                         | Partial coal production & OB removal, Haul road maintenance, Drilling etc.  |                             |

|    |   |   |
|----|---|---|
| j) | Proposed coal evacuation facilities<br>Face to Surface<br>Surface to end use plants | Reclaim feeders – conveyers<br>And coal body rear dumpers |
|----|---|---|

|                                    |  |  |
|------------------------------------|--|--|
| <b>H. END USE OF COAL/ LIGNITE</b> |  |  |
| a)                                 | Capacity of the approved end use plants  |  |
| b)                                 | Coal/ lignite requirement for end use plant with grade/quality   | Basket Linkage<br>APGENCO Washery<br>Local consumers |
| c)                                 | %age of end use requirement to be met from this mine   |  |
| d)                                 | If washing / beneficiation of the coal/ lignite is planned to be conducted on site or adjacent to the extraction area, briefly describe the nature of the beneficiation and recovery rate. | N/A  |
| e)                                 | Proposed Use of Rejects/Middlings  | N/A  |

| I. ENVIRONMENTAL MANAGEMENT       |   |  |                 |  |                                |   |                                   |  |                 |   |
|-----------------------------------|---|--|-----------------|--|--------------------------------|---|-----------------------------------|--|-----------------|---|
| a)                                | Existing land use pattern   | Forest land - 278.855 ha<br>Non-forest land - 2500.145 ha<br><b>Total : 2779.000 ha</b>  |                 |  |                                |   |                                   |  |                 |   |
| b)                                | Land area indicating the area likely to be degraded due to mining, dumping, roads, workshop, washery, township etc.   | All fig. in Ha<br><br>EXCAVATION AREA 1863.70<br>EXT.OB DUMP 32.2<br>BLASTING SAFETY ZONE (300m) 370.00<br>SAFETY BARRIER OF 7.5 Mt. 9.30<br>INFRASTRUCTURE 74.80<br>OTHERS (MAGZINE+ROAD Etc.) 224.00<br><b>TOTAL MINING LEASE AREA 2574.00</b>   |                 |  |                                |   |                                   |  |                 |   |
| c)                                | Surface features over the block area  | CHP, Workshop, Washery etc.  |                 |  |                                |   |                                   |  |                 |   |
| d)                                | No. of villages/Houses to be shifted  | Eight villages will be affected due to this Expansion project.   |                 |  |                                |   |                                   |  |                 |   |
| e)                                | Additional PAFs to be affected by   | 2985   |                 |  |                                |   |                                   |  |                 |   |
| f)                                | Monitoring schedules for different environmental components after the commencement of mining and other related activities.                                      | <table><tr><td>For air quality</td><td>Two days in a month at each station (once in a fortnight).</td></tr><tr><td>For water and effluent quality</td><td>Once in a month for each station (for drinking water quality), once in a fortnight (for 4 parameters) and once in a year (23 parameters) (for effluent quality)</td></tr><tr><td>For ground water level monitoring</td><td>4 times in a year (i.e. April/May, August, November &amp; January)</td></tr><tr><td>For noise level</td><td>Once in a day-time and once in a night-time in fortnight from each station.</td></tr></table> | For air quality | Two days in a month at each station (once in a fortnight). | For water and effluent quality | Once in a month for each station (for drinking water quality), once in a fortnight (for 4 parameters) and once in a year (23 parameters) (for effluent quality) | For ground water level monitoring | 4 times in a year (i.e. April/May, August, November & January) | For noise level | Once in a day-time and once in a night-time in fortnight from each station. |
| For air quality                   | Two days in a month at each station (once in a fortnight).  |  |                 |  |                                |   |                                   |  |                 |   |
| For water and effluent quality    | Once in a month for each station (for drinking water quality), once in a fortnight (for 4 parameters) and once in a year (23 parameters) (for effluent quality) |  |                 |  |                                |   |                                   |  |                 |   |
| For ground water level monitoring | 4 times in a year (i.e. April/May, August, November & January)  |  |                 |  |                                |   |                                   |  |                 |   |
| For noise level                   | Once in a day-time and once in a night-time in fortnight from each station.   |  |                 |  |                                |   |                                   |  |                 |   |

|   |   |
|---|---|
| <b>J. PROGRESSIVE AND FINAL MINE CLOSURE PLAN<br/>(A separate chapter is also to be incorporated)</b> |   |
| a)  | Estimated total capital expenditure for mine closure activities |
| b)  | Major closure Activities with proposed Capital expenditure      |

|  |  |
|--|--|
| Preparation of survey and disposal reports   | <p>Approx. <b>Rs. 83759.874Lakhs</b><br/>(Cost base June 2020)<br/>compounded @5% annually<br/>will be required to be<br/>deposited in Escrow Account<br/>as per the guidelines for Mine<br/>Closure circulated by Ministry<br/>of Coal.</p> <p>Details of closure cost<br/>incorporated in the Mine<br/>Closure Report.</p> |
| Subsidence Area study  |  |
| Disposal of P&M items  |  |
| Subsided Area (Technical & biologically reclaimed)   |  |
| Dismantling of Industrial Structure<br>(Like substation / water treatment plant / ETP / STP, etc.) |  |
| Leveling & gradient  |  |
| Fencing of subsided area   |  |
| Cleaning of coal stock and infrastructure area   |  |
| Disposal / Dismantling of Residential colony   |  |
| Plantation and landscaping on subsided/backfilled area   |  |
| Plantation over cleaned land of infrastructure   |  |
| Environmental monitoring   |  |
| Permanent lighting arrangement in and around mine periphery  |  |
| <b>Total</b>   |  |

|  |  |
|--|--|
| <b>K. OTHERS</b>   |  |
| a) Base date of Mining Plan.   | <b>APRIL, 2020</b><br><b>2020-21 as Year-1 for mining plan .</b><br><b>June 2020 as cost base for Mine</b><br><b>closure cost calculations</b> |
| b) Calendar year from which the production will start  | The mine is already a running mine.  |
| c) Results of any investigation carried out for scientific mining, conservation of minerals and protection of environment; future proposals. | Not Applicable   |
| d) Signature of RQP<br>Date<br>Place   | <br><br>Bhubaneswar  |

## Chapter - 1

### INTRODUCTION

#### 1.0 BACKGROUND

#### 1.1 TALCHER COALFIELD

Talcher coalfield, located in Brahmani valley to the north of Mahanadi river, constitutes the south eastern member of lower Gondwana basin within Mahanadi valley group of coalfields.

The coalfield spreads over 80km on the strike (east-west) and 26km on dip rise (north-south) covering an area of about 1860 sq.km (coal bearing) of which about 201 sq.km has been explored in detail in the southern part of the coalfield. In the northern part, an area of about 53 sq.km. has also been explored in detail. Major portion of coalfield is situated in the district of Angul of Odisha, whereas part areas of the coalfield spread over to Dhenkanal, Deogarh and Sambalpur districts.

#### 1.2 BACKGROUND IN CHRONOLOGICAL ORDER ABOUT MINING COMPANY

- a) Coalfield discovered in 1837.
- b) G.S.I surveyed & mapped in 1855.
- c) First mining started by state PWD department in Hingula block in 1875 & was subsequently discontinued due to poor quality coal.
- d) Handidhua colliery was started by M/s. Villiers Ltd in 1921.
- e) Deulbera colliery was started by B.N railways in 1926.
- f) Talcher colliery was started by MSM railways in 1927.
- g) NCDC was formed & Deulbera & Talcher colliery came under it in 1956.
- h) NCDC opened South Balanda OC in 1960.
- i) NCDC opened Nandira U/G in 1962.
- j) NCDC opened Jagannath OCP in 1971.

- k) After nationalization in 1973, CMAL was formed in 1973.
- l) The coalfield came under the administrative control of CCL in 1975.
- m) Came under SECL which was formed in 1986.
- n) Came under MCL which was formed in 1992.

### 1.3 DEMAND AND SUPPLY SCENARIO OF MCL

Long-term demand projection of coal is quite complex issue owing to rapid changes in the relative availability & fresh coal linkages or cancellation of linkages under New Coal Distribution Policy (NCDP) - 2007.

Total demand of coal on MCL (both Talcher and Ib-valley coalfield) was assessed to be 285 Mt based on the FSA and LOA issued. Since the status of the New End use plants of the consumers are not known, demand built up cannot be assessed.

Considering the location of various consumers and transport logistics, it is further assessed that 171 Mt will be linked from Talcher coalfield and balance 114 from Ib-valley coalfield. However, this demand may vary depending upon commissioning of end use plants and converting LOA into FSA.

Coal demand and target production as projected is given below:

**Table – 1.1**  
**Coal demand projection of MCL**

(In Mt.)

| Sl No | Year              | 2020-21 | 2021-22 | 2022-23 | 2023-24 |
|-------|-------------------|---------|---------|---------|---------|
| 1     | Demand            | 199.79  | 222.99  | 222.99  | 218.50  |
| 2     | Production Target | 178.00  | 189.50  | 197.50  | 204.50  |
| 3     | Balance           | -21.79  | -33.49  | -25.49  | -14.00  |

## 1.4 UTILITY OR MARKET FOR THE COAL FROM MINE/PROJECT

The capacity of the mine will be increased up to 15 MTPA. The linkages will be as mentioned below.

|      |                               |                   |
|------|-------------------------------|-------------------|
| i)   | Washery APGENCO               | = 7MTPA           |
| ii)  | Basket Linkage(Siding IX)     | = <u>4.8 MTPA</u> |
|      | Total                         | = 11.8MTPA        |
| iii) | Local Consumers- by road sale | = <u>3.2 MTPA</u> |
|      | Total                         | = 15 MTPA         |

## 1.5 AVAILABLE LINKAGE OR FIRM FUEL SUPPLY AGREEMENT (FSA)

The capacity of the mine will be increased up to 15 MTPA However till that time the existing customers of the project will continue.

Fuel supply agreement (FSA) exists between MCL and APGENCO washery for supply of around 4.52 Mty of coal as provided by Hingula area office.

## 1.6 JUSTIFICATION OF OPENING THE PROJECT

The commitments & availability figures as shown in the above table, have been obtained from MCL. The gap in demand and availability of coal justifies implementation of this project.

## 2.0 PREVIOUS REPORTS

Project report of Kalinga OCP (Balram OCP) was prepared by CMPDI in December-1986 and cleared by the company board on 30/01/1987 and UCE of July,1991 was cleared by PIB and was Sanctioned by Govt.



Detailed Environmental Management plan for Kalinga OCP (Balram OCP) was prepared and submitted to MoEF. Subsequently 85.01 Ha of forest land was cleared by Govt. vide letter No.8-143/89-FC, Dt.28.09.1990.Environmental clearance for 8Mty Project was cleared by MoEF Vide O.M, J-11015/4/87-IA, Dt.24.10.90 (Refer Annexure-2).

Project Report of Kalinga OCP (8Mty), which has been renamed as Balram OCP, was sanctioned in March,1992 by Govt. of India, vide letter no. 43011/21/87-CPA dated 18.3.1992, for a target capacity of 8 Mty at a capital of Rs.345.96 crores (after delinking the coal beneficiation plant). All the activities as per the sanctioned project were proposed to be carried out by departmental means. The above mine was carved out of Kalinga East Block, located in the south-central part of the Talcher coalfield, under command area of Mahanadi Coalfields Limited.

Kalinga OCP (8Mty), sanctioned in March, 1992 was completed as per schedule in March 2000. The completion cost of the project was worked out as Rs.344.63 crores. The proposal for delinking of coal preparation plant (CPP) from Kalinga Integrated Mine-cum-Beneficiation project of MCL and Revised Cost Estimate of Kalinga OCP (Mine part) at a capital investment of Rs.344.63 crores was sanctioned by Govt. of India vide letter no.43011/22/99-CPAM, dated 8<sup>th</sup> June, 2001.

During 2006-07 in view of R&R problems, the mine could not be advanced in the northern direction. As a result, about 116 Ha of the approved project area lying in the north could not be mined. Accordingly it was decided to advance the mine in the west direction in the Kalinga west block. Based on this P.R of Balram OCP Extension (8MTY) was formulated on additional land area of 270.43 Ha lying on the west of existing OCP and sanctioned by 92<sup>nd</sup> MCL board meeting held on 22<sup>nd</sup> December 2007.

Mining plan for Balram OCP Extension (8Mty) was prepared in March 2009 and approved (Letter No.43012/(1)/2008/CPAM, Dt.28/08/2009).

Mine closure plan of Balram Expansion OCP (15Mty Normative, 20Mty Peak) was prepared and approved by MCL Board on its 172<sup>nd</sup> meeting held on 16/12/2015.

Due to enhanced production and change in lease area, as per revised guidelines, combined Mining plan and Mine closure plan for Balram Expn. OCP (15Mty normative, 20 Mty peak) was prepared in March 2016 and subsequently approved by Advisor (Projects), MoC, Vide Ref.No.34012/(04)/2011-CPAM,GOI,MoC,N.Delhi Dt.09/03/2016.(Refer Annexure-4)

Project report of Balram Expansion OCP (15 Mty) was prepared and ESC of CIL Board recommended to CIL, Board to consider the Project Report of Balram Expansion OCP for a rated capacity of 15.0 MTY with additional capital investment of Rs. 3504.21 Crores for implementation of the project under Partial Outsourcing Option.

**(Refer Annexure-9 for approval of change in name of Kalinga OCP to Balram OCP)**

### 3.0 EXPLORATION STATUS

In the area under consideration 89019.45m were drilled by CMPDI & MECL in a total of 540 number of boreholes. The agency-wise and block wise breakup of drilling is given below in the table:

**Table - 1.2**

| Agency             | No. of BH drilled |              | Meterage        | Year of drilling |
|--------------------|-------------------|--------------|-----------------|------------------|
|                    | Kalinga East      | Kalinga West |                 |                  |
| CMPDI              | 318               | 120          | 70137.30        | 1979-2005        |
| MECL               | 17                | 85           | 18882.15        | 1982-1992        |
| <b>Total</b>       | <b>335</b>        | <b>205</b>   |                 |                  |
| <b>Grand Total</b> | <b>540</b>        |              | <b>89019.45</b> |                  |

A total of 540 boreholes drilled an area of 30.5 sq. Km gives a borehole density of 17.7.



In the Kalinga East block ten (10) coal seams of Barakar Formation occurs as 20 distinct splits/combination, viz. in ascending order, II A, II B, II C, II D+E, III A, III B, III C, III D, III E, IV A, IV B, V A, V B, VI A, VI B, VII, VIII, IX, X and XI. Out of these, 5 coal seams, viz. seams II A, III B, VI A, X and XI have been identified as either not so potential or having localized development and hence, are not dealt in details in the geological report. Hence seams & Splits considered in ascending order are II B, II C, II D+E, III A, III C, III D, III E, IV A, IV B, V A, V B, VI B, VII, VIII and IX. In the Kalinga West block fourteen (14) no. of seams were considered potential and assessed in details in the geological report. Seams XI T, XI B, X B, X A, L 2, L 1, III C, III B, II B and II A are developed locally or are being generally less than 1 m thickness and hence not considered for further detail assessment. Seams & Splits considered in ascending order are IIC, IID, IIE, IIIA, IIID, IIIE, IVA+B, VA, VB, VIB, VIIA, VIIB, VIII and IX.

#### 4.0 PRESENT MINING ACTIVITIES

At present part of the OBR is being excavated by departmental means by existing 10 cum/5cum/6.5cum shovels with 100T/85T/ 60T dumpers and coal being extracted contractually by surface miner and pay loader combination. Coal produced from this OCP is being evacuated through Jagannath siding.

The last three years performance of the OCP is as follows:

| Year                                     | 2017-18 | 2018-19 | 2019-20 |
|--|---------|---------|---------|
| Existing manpower of the project is 1326 |         |         |         |
| Coal (Mt)                                | 2.379   | 3.632   | 5.234   |
| OB (Mm <sup>3</sup> )                    | 6.967   | 8.371   | 9.973   |

#### 5.0 DIFFICULTIES AND CONSTRAINTS IN MINING

The main constraint of the project is Rehabilitation and Resettlement of the villages falling within the mine boundary. The R&R problem of the already acquired land within the original PR area as well as within the extension area is yet to be resolved. As many as 2783 nos. of balance PAFs need to be resettled. Other constraint is presence of Gopalprasad reserve forest. No major river or roads need to be diverted from the area under proposal.

## Chapter – 2

### DETAILS OF EARLIER APPROVAL OF MINING PLAN

#### 2.1 STATUS

Mining plan for Balram OCP Extension (8Mty) was prepared in March 2009 and approved (Letter No.43012/(1)/2008/CPAM, Dt.28/08/2009).

Due to enhanced production and change in lease area, Mining plan and Mine closure plan for Balram Expn. OCP (15 Mty normative, 20 Mty peak) was prepared in March 2016 and subsequently approved by Advisor (Projects), MoC, Vide Ref.No.34012/(04)/2011-CPAM,GOI,MoC,N.Delhi Dt.09/03/2016 (Ref: Annexure-4).

This Mining plan is revision-1 to Mining plan and Mine Closure Plan for Balram Expn. OCP (15Mty normative, 20 Mty peak). MCL proposed to prepare Revised MP&MCP for a rated Capacity of 15Mty due to change in lease area, land type and to incorporate Hingula washery, reject storage site in mining plan as desired by EAC. Hingula washery was proposed at southern side in excavation zone of Balram OCP (8Mty). The revised MP&MCP is being prepared as per the Land data and Landuse/Revenue plan provided by MCL.

Parameters of approved MP&MCP vis-à-vis Revised MP&MCP are given below:

| Particulars |                              | Old MP&MCP<br>(Approved)      | REVISED MP&MCP         |
|-------------|------------------------------|-------------------------------|------------------------|
| (i)         | Total Lease Area (Ha) -----  | 2558.02                       | 2779.00                |
| (ii)        | Mining Lease area (Ha) ----- | 2507.42                       | 2574.00                |
| (iii)       | Forest Area (Ha) -----       | 250.61                        | 278.855                |
| (iv)        | Excavation Area (Ha) -----   | 1866.52                       | 1863.70                |
| (v)         | Production level (Mty) ----- | 15.0(Normative)<br>20.0(Peak) | 15.0 (Rated )          |
| (vi)        | Life (Years) –               | 54<br>(01.4.2010)             | 49<br>(01.4.2020)      |
| (vii)       | Reserves (Mineable) -----    | 756.37<br>(01.4.2010)         | 712.134<br>(01.4.2020) |

## Chapter - 3

### LOCATION, COMMUNICATION & TOPOGRAPHY

#### 3.1 LOCATION

The Kalinga East and Kalinga West Blocks lie on the south central part of Talcher Coalfield. The area of the combined block is about 30.5 Sq. Kms. It is found in Survey of India Toposheet Map 73 H/1 on RF 1:50,000.

Co-ordinates:

Kalinga East-

|           |   |           |                |
|-----------|---|-----------|----------------|
| Latitude  | - | 20°53'33" | :20°59'05" (N) |
| Longitude | - | 85°03'56" | :85°06'57" (E) |

Kalinga West-

|           |   |           |                |
|-----------|---|-----------|----------------|
| Latitude  | - | 20°56'02" | :20°59'05" (N) |
| Longitude | - | 85°02'52" | :85°03'56" (E) |

Adjoining Blocks of combined Kalinga Block:

|       |   |                                 |
|-------|---|---------------------------------|
| West  | - | Hingula                         |
| South | - | Natraj                          |
| North | - | Konark                          |
| East  | - | Padma, Bharatpur (North, South) |

(Refer GEN-II for Block location plan)

#### 3.2 ACCESSIBILITY & COMMUNICATION

The blocks are well connected by metal road and all weather roads passing through the block and is approachable all through the years. Angul and Talcher are the district headquarter and nearest towns. The nearest rail head of East Coast

Railways is at Angul as well as at Talcher. The state capital Bhubaneswar and also the nearest airport are at a distance of about 160 & 165 km from the blocks.

The distances of the important towns, Rly. Stations and airport are as follows:

| Sl. No. | Places                          | Distance in Km |              |
|---------|---------------------------------|----------------|--------------|
|         |                                 | Kalinga East   | Kalinga West |
| 1       | Talcher town                    | 19             | 22           |
| 2       | Nearest Railway station (Angul) | 16             | 24           |
| 3       | Angul town                      | 16             | 24           |
| 4       | State capital Bhubaneswar       | 160            | 160          |
| 5       | Airport                         | 165            | 165          |

### 3.3 CLIMATE

The climate of the area is tropical & humid. Monsoon breaks towards the end of June & continue till end of October. The temperature during summer shoots up to 47°C accompanied with high humidity. During winter, the temperature remains generally between 6.7°C to 38.1°C.

### 3.4 TOPOGRAPHY AND DRAINAGE

**KALINGA EAST BLOCK**-The terrain is largely flat covered with soil. The conglomerate peak stands out as ridges towards southern part bordering Nataraj block. There are some bushy jungles present in the southern region. Otherwise the land is being used for cultivation purpose. The north-western part of the block exhibit rugged and undulating topography.

The altitudes within the block vary between 97 m and 137 m. Minimum elevation above mean sea level within the block is 97 m (near borehole CMTB-057

along Bangaru jhor in the north eastern part) and highest elevation is around 137 m near borehole CMTK-100 in the south western part of the block.

The main drainage of the coalfield is controlled by the perennial Brahmani river flowing north-south along the eastern boundary of the coalfield and east of Talcher town. Kalinga East block is located 15 Km. (crow-fly distance) to the west of this river. There is one seasonal nallah viz. Bangaru Jhor that originates within Kalinga East block and flows from south-western part to north-eastern part of the block. Ultimately this drains into Brahmani river near north of Talcher town. There are some very small seasonal nallah in the block which develop along the local gradient of the area. There are many small and very small seasonal nallah present within the block. The area also has numbers of man-made ponds and wells utilized by local villagers for irrigation as well as for drinking purposes.

**KALINGA WEST BLOCK-**The terrain is largely flat covered with soil. The conglomerate peak stands out as ridges towards southern part bordering Natraj block. There are some bushy jungle present in the region, otherwise the land is flat and being used for cultivation purpose. The north western part of the block exhibit rugged and undulating topography & about 1 sq. km area of Gopalprasad reserve forest falls in the region.

The altitudes within the block vary between 99.42 m and 142.5 m. Minimum elevation above mean sea level within the block is 99.42 m (CMKR-17) and highest elevation is around 142.5 m near borehole KW-19.

The drainage of revised Kalinga West block is controlled by perennial Singhda jhor which ultimately drains out to Brahmani River towards northern part. Brahmani River flows in the eastern extremities of the coalfield. There are many small and very small seasonal nala present within the block. The area also has nos. of man-made ponds and wells utilized by local villagers for irrigation as well as for drinking purposes. (Refer GEN-V for Drainage map).



## Chapter - 4

# EXPLORATION, GEOLOGY, SEAM SEQUENCE, COAL QUALITY AND RESERVE

## 4.1 INTRODUCTION

### 4.1.1 DIFFERENT GRs PREPARED AT DIFFERENT PERIOD FOR THE BLOCK UNDER REFERENCE

Total of two Geological reports have been made on Kalinga block so far. The reports are as follows:

- i. Geological Report on Kalinga East Block, Talcher Coalfields, Angul, Orissa, March 2009, by CMPDIL
- ii. Geological Report on Kalinga West Block, Talcher Coalfields, Angul, Orissa, March 2009, by CMPDIL

The geology and reserves of the deposit is on the basis of these reports.

### 4.1.2 BLOCK BOUNDARY

The Kalinga East and Kalinga West Blocks lie on the south central part of Talcher Coalfield. The area of the combined block is about 30.5 sq. Kms. It is found in Survey of India Toposheet Map 73 H/1 on RF 1:50,000.

Co-ordinates:

Kalinga East-

Latitude - 20°53'33" :20°59'05" (N)

Longitude - 85°03'56" :85°06'57" (E)

Kalinga West-

Latitude - 20°56'02" :20°59'05" (N)

Longitude - 85°02'52" :85°03'56" (E)

Adjoining Blocks of combined Kalinga Block:

- West - Hingula
- South - Natraj
- North - Konark
- East - Padma, Bharatpur (North, South)

## 4.2 EXPLORATION STATUS

In the area under consideration 89019.45 m were drilled by CMPDI & MECL in a total of 540 number of boreholes. The agency-wise and block wise breakup of drilling is given below in the table:

| Agency             | No. of BH drilled |              | Meterage        | Year of drilling |
|--------------------|-------------------|--------------|-----------------|------------------|
|                    | Kalinga East      | Kalinga West |                 |                  |
| CMPDI              | 318               | 120          | 70137.30        | 1979-2005        |
| MECL               | 17                | 85           | 18882.15        | 1982-1992        |
| <b>Total</b>       | <b>335</b>        | <b>205</b>   |                 |                  |
| <b>Grand Total</b> | <b>540</b>        |              | <b>89019.45</b> |                  |

### 4.2.1 DENSITY OF BOREHOLES

A total of 540 boreholes have been drilled in the Kalinga East & Kalinga West Block combined having an area of 30.5 sq. Km giving a **borehole density of 17.7 BHs/sq. km.**

### 4.2.2 PROXIMATE ANALYSIS OF COAL SEAMS KALINGA EAST

Overall proximate analyses of coal seams for representative boreholes were determined in different laboratories for BCS & I<sub>100</sub> samples on equilibrated basis (40% RH and 40°C). The overall proximate analysis for balance boreholes for which band by band analysis were available have been calculated using M<sub>100</sub> value and standard formula.

8 nos. workable coal seams of Kalinga East block, viz., VI B, V B, V A, IV A, III D, III C, II AS and II B, are generally 1m to 3m in thickness, except for rest 7 nos. of thick coal horizons, viz., seams IX, VIII, VII, IV B, III E, II D+E and II C. Seam IX is the thickest coal horizons with general thickness ranges from 18m to 23m, followed by seam II D+E (15m to 17m), seam VIII (7m to 11m), II C (6m to 10m), seam IV B (3m to 7m), seam III E (4m to 6m) and seam VII (3m to 5m). All these coal seams of Kalinga East block exhibit high moisture (generally 5% to 8%), high ash (generally 35% to 45%) with general UHV ranges from 1300 to 3000 kcal/kg with corresponding grade of G to F on I100 samples on seam overall equilibrated basis. Gross CV of all coal seams generally ranges from 2500 kcal/kg to 4500 kcal/kg.

#### **4.2.3 ULTIMATE ANALYSIS KALINGA EAST**

Elementary analyses along with VM, CV, CO<sub>2</sub> and phosphorous were carried out for very few representative boreholes. All the coal horizons in this block shows DMMF carbon at around 78% and DMMF hydrogen at around 5%, Unit volatile matter as high as 40% to 45% and unit CV at around 7000 kcal/kg to 7500 kcal/kg indicating less matured non-coking bituminous to sub-bituminous nature of coal.

#### **4.2.4 WASHABILITY STUDY**

Borehole coal cores of CMTK-001, 002, 008, 013, 020, 025, 034 and 051, KW-005, 018, 028, 030, 062 & 063 were subjected to washability study after due seam correlation. The coal seam-wise test result is provided below:



# **Borehole-wise, seam-wise washability Study Results in Kalinga East and Kalinga West blocks, Talcher Coalfield**

Note: Suffix "+" denotes roof / floor not tallying

| BOREHOLE NO. | SEAM NAME      | DEPTH  |           | ASH % ON RAW COAL (1100 SAMPLE) | CLEANS |       | REJECTS |       |
|--------------|----------------|--------|-----------|---------------------------------|--------|-------|---------|-------|
|              |                | FROM   | THICKNESS |                                 | WT. %  | ASH % | WT. %   | ASH % |
| CMTK-001     | II C+D+E +     | 30.40  | 25.02     | 42.4                            | 69.2   | 33.5  | 30.8    | 62.4  |
| CMTK-002     | II C+D+E +     | 41.70  | 24.58     | 44.3                            | 64.9   | 32.7  | 35.1    | 65.7  |
| CMTK-002     | II A+B +       | 75.50  | 2.50      | 42.3                            | 76.7   | 32.8  | 23.3    | 73.6  |
| CMTK-008     | II D+E         | 71.39  | 15.78     | 43.1                            | 64.5   | 33.4  | 35.5    | 60.7  |
| CMTK-008     | II C           | 99.67  | 3.19      | 38.1                            | 76.1   | 32.2  | 23.9    | 56.9  |
| KW-005       | II D+E +       | 131.45 | 14.71     | 42.3                            | 66.0   | 31.7  | 34.0    | 62.8  |
| KW-005       | II C +         | 150.85 | 4.50      | 43.5                            | 62.7   | 31.2  | 37.3    | 64.2  |
| KW-005       | II A+B +       | 165.43 | 1.71      | 51.6                            | 51.1   | 37.0  | 48.9    | 66.8  |
| CMTK-025     | II C+D+E +     | 97.36  | 27.04     | 40.8                            | 75.7   | 32.2  | 24.3    | 67.5  |
| CMTK-025     | II A+B +       | 128.15 | 3.01      | 44.4                            | 62.1   | 34.2  | 37.9    | 61.1  |
| CMTK-020     | II A+B +       | 162.08 | 1.67      | 48.3                            | 53.9   | 33.9  | 46.1    | 65.1  |
| CMTK-013     | II C+D+E +     | 185.50 | 25.05     | 37.8                            | 75.7   | 31.9  | 24.3    | 56.2  |
| CMTK-034     | II A+B+C+D+E + | 118.75 | 35.35     | 45.0                            | 66.9   | 36.0  | 33.1    | 63.2  |
| KW-018       | II D+E +       | 63.40  | 14.70     | 39.3                            | 78.0   | 33.8  | 22.0    | 58.8  |
| KW-018       | II C           | 92.07  | 3.16      | 37.9                            | 83.7   | 33.8  | 16.3    | 63.1  |
| KW-030       | II D+E +       | 154.95 | 15.18     | 39.8                            | 72.3   | 33.1  | 27.7    | 57.3  |
| KW-030       | II C           | 176.90 | 4.89      | 35.3                            |        |       |         |       |
| KW-062       | II D+E +       | 146.83 | 15.93     | 38.9                            | 78.1   | 33.4  | 21.9    | 58.5  |
| CMTK-008     | III E          | 22.52  | 4.53      | 38.0                            | 70.5   | 29.6  | 29.5    | 58.1  |
| KW-028       | III E          | 23.55  | 4.45      | 37.1                            | 85.4   | 34.5  | 14.6    | 52.3  |
| KW-028       | III D          | 31.59  | 1.03      | 36.0                            | 84.7   | 33.1  | 15.3    | 52.1  |
| KW-028       | III A +        | 51.95  | 3.79      | 43.8                            | 50.2   | 31.8  | 49.8    | 55.5  |
| KW-005       | III E          | 82.60  | 5.28      | 28.7                            |        |       |         |       |
| KW-005       | III D          | 94.75  | 1.90      | 32.7                            | 86.0   | 28.2  | 14.0    | 60.3  |
| KW-005       | III A +        | 110.30 | 2.25      | 42.9                            | 56.9   | 30.0  | 43.1    | 59.9  |
| CMTK-025     | III E          | 41.05  | 4.40      | 34.8                            | 85.4   | 28.5  | 14.6    | 71.1  |
| CMTK-025     | III C          | 54.97  | 2.99      | 36.0                            |        |       |         |       |
| CMTK-020     | III E          | 72.30  | 5.49      | 39.0                            | 68.0   | 28.5  | 32.0    | 61.3  |
| CMTK-020     | III C          | 92.80  | 1.50      | 34.5                            |        |       |         |       |
| CMTK-013     | III E          | 134.60 | 4.40      | 35.2                            | 70.1   | 27.0  | 29.9    | 54.5  |
| CMTK-013     | III A          | 161.68 | 1.74      | 36.3                            | 76.7   | 30.2  | 23.3    | 56.4  |
| CMTK-034     | III E          | 64.98  | 5.27      | 34.8                            | 81.0   | 28.9  | 19.0    | 60.1  |
| CMTK-051     | III E          | 171.71 | 6.49      | 33.7                            | 86.1   | 28.6  | 13.9    | 65.2  |
| CMTK-051     | III D          | 184.63 | 1.95      | 36.1                            | 89.1   | 30.8  | 10.9    | 79.3  |
| CMTK-051     | III A          | 207.03 | 2.42      | 40.2                            | 74.6   | 32.3  | 25.4    | 63.4  |
| KW-018       | III E          | 15.35  | 4.95      | 33.6                            | 86.2   | 28.6  | 13.8    | 64.8  |
| KW-018       | III A +        | 42.32  | 3.31      | 30.9                            |        |       |         |       |

| BOREHOLE NO. | SEAM NAME  | DEPTH  |           | ASH % ON RAW COAL (1100 SAMPLE) | CLEANS |       | REJECTS |       |
|--------------|------------|--------|-----------|---------------------------------|--------|-------|---------|-------|
|              |            | FROM   | THICKNESS |                                 | WT. %  | ASH % | WT. %   | ASH % |
| KW-030       | III A +    | 136.20 | 4.78      | 42.9                            |        |       |         |       |
| KW-062       | III D      | 121.10 | 4.30      | 37.4                            | 94.0   | 34.5  | 6.0     | 82.6  |
| KW-062       | III A      | 128.90 | 3.89      | 43.8                            | 68.3   | 36.6  | 31.7    | 59.3  |
| KW-063       | III E +    | 162.85 | 9.35      | 38.6                            | 72.7   | 28.7  | 27.3    | 64.9  |
| KW-063       | III D      | 174.65 | 2.09      | 30.9                            | 88.6   | 27.6  | 11.4    | 56.4  |
| KW-063       | III A +    | 187.14 | 4.11      | 46.8                            | 41.1   | 29.7  | 58.9    | 83.7  |
| CMTK-025     | IV A +     | 30.95  | 3.92      | 43.3                            | 62.3   | 32.0  | 37.7    | 62.0  |
| CMTK-013     | IV A+B +   | 116.01 | 9.80      | 48.7                            | 49.0   | 41.3  | 51.0    | 55.8  |
| CMTK-034     | IV A+B +   | 45.16  | 7.96      | 52.1                            | 39.5   | 38.1  | 60.5    | 61.2  |
| KW-030       | IV A+B +   | 89.55  | 7.35      | 50.9                            | 37.1   | 38.9  | 62.9    | 61.5  |
| KW-062       | IV A+B +   | 88.75  | 8.45      | 48.5                            | 53.4   | 40.7  | 46.6    | 57.4  |
| KW-063       | IV A+B +   | 141.86 | 6.07      | 48.2                            | 55.1   | 41.3  | 44.9    | 56.7  |
| CMTK-020     | IV+V +     | 42.05  | 19.06     | 52.3                            | 44.8   | 32.5  | 55.2    | 68.3  |
| CMTK-013     | IV+V +     | 105.53 | 20.28     | 52.1                            | 39.4   | 34.4  | 60.6    | 63.6  |
| KW-005       | V A +      | 55.90  | 3.00      | 50.7                            | 45.1   | 29.1  | 54.9    | 68.5  |
| KW-005       | V B        | 50.55  | 1.50      | 33.3                            | 92.3   | 31.5  | 7.7     | 55.0  |
| CMTK-013     | V +        | 105.53 | 6.33      | 56.4                            | 34.5   | 24.7  | 65.5    | 73.1  |
| CMTK-034     | V A+B +    | 31.30  | 7.20      | 53.4                            | 42.5   | 31.4  | 57.5    | 69.6  |
| CMTK-020     | V B +      | 18.57  | 3.03      | 54.7                            | 37.3   | 29.3  | 62.7    | 69.5  |
| CMTK-013     | V A+B +    | 80.05  | 4.50      | 53.1                            | 40.7   | 26.7  | 59.3    | 71.2  |
| KW-030       | V B +      | 71.71  | 4.43      | 58.9                            | 39.1   | 29.5  | 60.9    | 77.7  |
| KW-063       | V B +      | 121.55 | 4.25      | 55.8                            | 36.2   | 26.7  | 63.8    | 72.3  |
| KW-030       | VII A +    | 42.34  | 1.49      | 44.4                            | 62.9   | 33.7  | 37.1    | 62.6  |
| KW-030       | VII B +    | 30.90  | 5.93      | 42.1                            | 77.5   | 33.9  | 22.5    | 70.4  |
| CMTK-013     | VII+VIII + | 32.92  | 16.38     | 46.8                            | 54.7   | 29.8  | 45.3    | 67.3  |
| CMTK-051     | VII+VIII + | 63.23  | 18.86     | 48.2                            | 49.8   | 28.6  | 50.2    | 67.7  |
| KW-030       | VIII       | 18.96  | 10.39     | 50.4                            | 46.0   | 29.0  | 54.0    | 68.6  |
| KW-062       | VIII +     | 10.47  | 11.88     | 46.6                            | 50.0   | 26.2  | 50.0    | 67.0  |
| CMTK-013     | IX INC     | 12.32  | 4.14      | 37.9                            | 73.8   | 29.2  | 26.2    | 62.5  |
| CMTK-051     | IX         | 27.07  | 25.44     | 46.0                            | 54.7   | 32.8  | 45.3    | 61.9  |
| KW-062       | IX_INC     | 3.00   | 2.46      | 40.0                            | 75.0   | 30.7  | 25.0    | 67.9  |
| KW-063       | IX +       | 34.99  | 22.44     | 45.6                            | 61.4   | 35.1  | 38.6    | 62.3  |

#### 4.2.5 PHYSICO-MECHANICAL STUDIES

No borehole from Kalinga East block was subjected to physico-mechanical studies. However one borehole from adjoining Kalinga West block has been

studied for physico-mechanical properties. Results are summarized below for references:

| Correlation of seams | Depth (m) |        |           | Rock type                              | Bulk density GMS/cc | Comp strength Dty/KG F/ SQCM | Comp strength wet KGF/ SQCM | Tensile strength KGF/ SQCM | Shear strength KGF/ SQCM | Young Modulus 10 <sup>4</sup> E KGF/ SQCM | PSI       |
|----------------------|-----------|--------|-----------|--|---------------------|------------------------------|-----------------------------|----------------------------|--------------------------|---|-----------|
|                      | From      | To     | Thickness |  |                     |                              |                             |                            |                          |   |           |
| Roof V B             | 17.15     | 21.75  | 4.60      | Grey shale/ Carb shale                 | -                   | -                            | -                           | -                          | -                        | -   | 1.26-2.12 |
| V B                  | 21.79     | 24.63  | 2.88      | Coal/Shaly coal/Carb. Sh.              | -                   | -                            | -                           | -                          | -                        | -   | 0.69-1.63 |
| Parting              | 24.63     | 26.00  | 1.37      | Coal/Shale/ Carb. Shale                | -                   | -                            | -                           | -                          | -                        | -   | 1.75-1.95 |
| V A                  | 26.00     | 29.95  | 3.95      | Coal/Shaly coal/Carb. Shale/Grey shale | 3.19                | 560.10                       | -                           | 99.9                       | -                        | 6.35                                      | 0.84-1.55 |
| Parting              | 29.95     | 35.38  | 5.43      | Coal/Shaly coal/Carb. Sh.              | -                   | -                            | -                           | -                          | -                        | -   | 1.36-2.00 |
| IV - A+B Comb.       | 35.38     | 38.81  | 3.43      | Coal/Shaly coal/Carb. Sh.              | -                   | -                            | -                           | -                          | -                        | -   | 1.34-1.95 |
| Parting              | 38.81     | 56.59  | 17.78     | Sandstone/ Grey Sh./Carb. Sh.          | 1.91-2.27           | 68.0-169.5                   | 54.5-61.8                   | 3.3-20.7                   | 9.5-27.0                 | 2.44                                      | 0.19-1.59 |
| III - E              | 56.59     | 62.15  | 5.86      | Coal/Shaly coal/Carb. Sh.              | -                   | -                            | -                           | -                          | -                        | -   | 0.77-1.73 |
| Parting              | 62.15     | 67.42  | 5.27      | Sandstone/ Grey Sh./Carb. Sh.          | 2.27                | -                            | -                           | 23.9                       | 14.9-21.2                | -   | 0.33-1.67 |
| III - D              | 67.42     | 68.84  | 1.42      | Coal/Shaly coal/Carb. Sh.              | -                   | -                            | -                           | -                          | -                        | -   | 0.99-1.35 |
| Parting              | 68.84     | 80.10  | 11.26     | Sandstone/ Grey Sh./Carb. Sh.          | 1.95-2.17           | 103.30                       | -                           | 5.3-17.0                   | 11.0-17.3                | -   | 0.14-1.56 |
| III - C              | 80.10     | 80.35  | 0.25      | -                                      | -                   | -                            | -                           | -                          | -                        | -   | -         |
| Parting              | 80.35     | 87.69  | 7.34      | Sandstone/ Shale                       | 2.11-2.27           | 247.50                       | -                           | 14.0-32.5                  | 12.0-26.7                | -   | 0.11-1.85 |
| III - A              | 87.69     | 89.21  | 1.52      | Coal/Shaly coal                        | -                   | -                            | -                           | -                          | -                        | -   | 1.12-1.28 |
| Parting              | 89.21     | 110.35 | 21.14     | Sandstone/ Shale                       | 1.98-2.23           | 139.3-241.6                  | 72.0-123.5                  | 4.0-30.0                   | 12.6-32.8                | -   | 0.14-2.79 |
| II (E+D)             | 110.35    | 127.26 | 16.91     | Coal/Shaly coal                        | -                   | -                            | -                           | -                          | -                        | -   | 0.85-2.33 |
| Parting              | 127.26    | 134.90 | 7.64      | Sandstone/ Shale/Carb Sh.              | 2.12-2.22           | -                            | -                           | 7.6-17.0                   | -                        | -   | 0.54-2.33 |
| II - C               | 134.90    | 137.35 | 2.45      | Coal/Carb. Shale                       | -                   | -                            | -                           | -                          | -                        | -   | 1.10-1.91 |

| Correlation of seams | Depth (m) |        |           | Rock type                | Bulk density<br>GMS/cc | Comp strength<br>Dty/KG F/<br>SQCM | Comp strength<br>h wet<br>KGF/<br>SQCM | Tensile strength<br>h KGF/<br>SQCM | Shear strength<br>h KGF/<br>SQCM | Young Modulus<br>E 10<br>KGF/<br>SQCM | PSI       |
|----------------------|-----------|--------|-----------|--------------------------|------------------------|------------------------------------|--|------------------------------------|----------------------------------|---------------------------------------|-----------|
|                      | From      | To     | Thickness |                          |                        |                                    |  |                                    |                                  |                                       |           |
| Parting              | 137.35    | 150.20 | 12.85     | Sandstone/S./ Carb Sh.   | 2.06-2.25              | 114.9-321.0                        | 171                                    | 8.5-5.34                           | -                                | 1.10-2.55                             | 0.19-1.91 |
| II (A+B)             | 150.20    | 151.31 | 1.11      | Coal/Carb. Shale/S. Coal | -                      | -                                  | -                                      | -                                  | -                                | -                                     | 1.61-1.95 |

### 4.3 GEOLOGY OF KALINGA EAST & KALINGA WEST BLOCK

The blocks are located in the south central part of Talcher coalfield. The Talcher coalfield is the south eastern most member of the lower Gondwana basin within the Mahanadi valley graben. The coalfield occupies an area of over 1800 sq. km and is bound by latitude 20°53' and 21°15' North and longitude 84°25' and 85°21' East. The coalfield falls largely within Angul district of Odisha with small portions falling in adjoining districts of Dhenkanal and Sambalpur.

The coalfield consists of thickly bedded sedimentary deposits up to over 1500 m thick. The lithology of these strata are constituted by various rock types namely; sandstone, shale, coal seams, conglomerate boulder beds etc. The coalfield comprises of Talcher, Karharbari, Barakar, Barren Measures and Kamthi formations. Out of these above formations, the Barakar and Karharbari contain coal deposits. While coal seam of Karharbari formations is better in quality, the coal seams of Barakar largely records high ash coals.

The Stratigraphic succession in Talcher Coalfield is summarised in table below:



| Group                          | Age                                  | Formation                 | Lithology   |
|--------------------------------|--------------------------------------|---------------------------|---|
|                                | Recent                               | Recent deposits           | Soil, Sub-soil etc.   |
| SUPER<br><br>GONDWANA<br>GROUP | Lower Permian                        | Barakar Formation         | Medium to coarse grained greyish feldspathic sandstone, grey to dark grey shale and coal seams (XI to II), and boulder bed at base. |
|                                |                                      | Karharbari Formation      | Medium to coarse grained sandstone with undecomposed feldspars and coal seams (I group).  |
|                                | Upper Carboniferous to Lower Permian | Talchir Formation         | Diamictite, sandstone, needle shale, turbidite, rhythmites and varves.  |
| -----Unconformity-----         |                                      |                           |   |
|                                | Archaean (?) to Lower Proterozoic    | Pre-Cambrian Metamorphics | Granites, gneisses and associated supracrustals.  |

Talcher Formation and Archaean basement have neither encountered in any borehole nor exposed on surface within the block.

#### 4.3.1 GEOLOGICAL STRUCTURE:

The geological structure of the Kalinga East and Kalinga West blocks is in continuity with adjoining block i.e. Padma, Subhadra west and Bharatpur towards east and Gopalprasad East towards west. The general strike of the strata is E-W with broad swing. The dip is northerly being 3°-8°. The Kalinga East block is moderately disturbed and 34 numbers of faults have been interpreted ranging in throw from less than 5 m to over 100m whereas Kalinga West block is having 23 faults ranging from 5 to 60 m. The detail description of the faults is given below.

Description of faults, Kalinga East & Kalinga West Block, Talcher Coalfield:

### KALINGA EAST

| Fault No. | Extent of Fault (m) | Location in Block                | Trend     | Throw      |            |
|-----------|---------------------|----------------------------------|-----------|------------|------------|
|           |                     |                                  |           | Direction  | Amount (m) |
| F1-F1     | 1700 m              | South- Western Part of the block | ESE-WNW   | North      | 55 m       |
| F2-F2     | 550 m               | South Western Part               | E -W      | South      | 5 m        |
| F3-F3     | 350 m               | South Western Part               | E -W      | South      | 5 m        |
| F4-F4     | 1725 m              | South Western Part               | NW-SE     | South-West | 30-40 m    |
| F5-F5     | 1750 m              | South Central Part               | East-West | North      | 0-10 m     |
| F6-F6     | 1000 m              | South Western Part               | NEN-SWS   | West       | 0-15 m     |
| F7-F7     | 3400 m              | Southern Part                    | E-W       | South      | 15-50 m    |
| F8-F8     | 2750 m              | South central Part               | WNW-ESE   | South      | 5-25 m     |
| F9-F9     | 975 m               | South eastern Part               | East-West | South      | 5-10 m     |
| F10-F10   | 4650 m              | Central Part                     | NW-SE     | NE         | 30-45 m    |
| F11-F11   | 750 m               | Eastern Part                     | E-W       | South      | 10 m       |
| F12-F12   | 1700 m              | East Central Part                | E-W       | South      | 5-15 m     |
| F13-F13   | 800 m               | Central Part                     | East-West | North      | 0-15 m     |
| F14-F14   | 3000 m              | East Central Part                | WNW-ESE   | South      | 15-100 m   |
| F15-F15   | 2000 m              | West Central Part                | WNW-ESE   | South      | 10 m       |
| F16-F16   | 200 m               | Eastern Part                     | East-West | South      | 5 m        |

| Fault No. | Extent of Fault (m) | Location in Block         | Trend            | Throw                       |            |
|-----------|---------------------|---------------------------|------------------|-----------------------------|------------|
|           |                     |                           |                  | Direction                   | Amount (m) |
| F17-F17   | 350 m               | Eastern Part              | East-West        | South                       | 5 m        |
| F18-F18   | 600 m               | Eastern                   | WNW-ESE          | North                       | 0-15 m     |
| F19-F19   | 650 m               | East Central Part         | WSW-ENE          | North                       | 0-10 m     |
| F20-F20   | 200 m               | Eastern Part              | NW-SE            | North-East                  | 0-5 m      |
| F21-F21   | 625 m               | East Central Part         | East-West        | South                       | 0-5 m      |
| F22-F22   | 100 m               | East Central Part         | East-West        | North                       | 0-5 m      |
| F23-F23   | 4500 m              | Central                   | E-W              | South                       | 25-100 m   |
| F24-F24   | 500 m               | East Central Part         | E-W              | South                       | 0-5 m      |
| F25-F25   | 850 m               | North Part Southern       | WNW-ESE          | South                       | 0-5 m      |
| F26-F26   | 350 m               | North Part Western        | E-W              | North                       | 0-10 m     |
| F27-F27   | 2250 m              | Northern Part             | E-W              | North                       | 0-30 m     |
| F28-F28   | 750 m               | North Part Western        | E-W              | South                       | 0-5 m      |
| F29-F29   | 550 m               | North Part Eastern        | E-W              | South                       | 0-7 m      |
| F30-F30   | 400 m               | North Part Eastern        | NW-SE, E-W       | South-West, South           | 0-5 m      |
| F31-F31   | 200 m               | North Part Eastern Corner | NW-SE            | South-West                  | 3 m        |
| F32-F32   | 3500 m              | North Part Central        | NW-SE, EW, NE-SW | North-East-North North-West | 10-30 m    |
| F33-F33   | 850 m               | North Part Central        | NW-SE            | South-West                  | 10-20 m    |
| F34-F34   | 300 m               | Northern Part             | E-W              | North                       | 25 m       |

**KALINGA WEST**

| Fault No. | Extent of Fault | Location Block in                   | Trend                                   | Throw      |            |
|-----------|-----------------|-------------------------------------|---|------------|------------|
|           |                 |                                     |   | Direction  | Amount (m) |
| F1-F1     | 2180 m          | South: (Southern Part of the block) | East-West                               | North      | 65 m       |
| F2-F2     | 620 m           | South Eastern Part                  | SW - NE                                 | South East | 10 m       |
| F3-F3     | 495 m           | South Eastern Part                  | SW - NE                                 | North      | 7-10 m     |
| F4-F4     | 1620 m          | South                               | East-West                               | South      | 0-7 m      |
| F5-F5     | 2100 m          | South                               | East-West                               | South      | 7-10 m     |
| F6-F6     | 1670            | South                               | East-West                               | South      | 5-7 m      |
| F7-F7     | 2270 m          | South-West                          | East-West & NW-SE towards southern side | South-West | 7-20 m     |
| F8-F8     | 1600 m          | South central part                  | SW-NE                                   | South-East | 7-10 m     |
| F9-F9     | 520 m           | South central part                  | East-West                               | North      | 0-5 m      |
| F10-F10   | 2250 m          | Central Part                        | East-West                               | South      | 35-55 m    |
| F11-F11   | 440 m           | Central Part                        | SW-NE                                   | North West | 0-5 m      |
| F12-F12   | 1560 m          | North Central Part                  | NW-SE                                   | South-West | 0-5 m      |
| F13-F13   | 1730 m          | North Central Part                  | East-West                               | South      | 0-8 m      |
| F14-F14   | 1670 m          | North Central Part                  | SW-NE                                   | South-East | 15 m       |
| F15-F15   | 640 m           | North Central East Part             | NW-SE                                   | North-East | 20 m       |
| F16-F16   | 1470 m          | East Central Part                   | East-West                               | South      | 5 m        |
| F17-F17   | 2620 m          | North Central                       | East-West                               | South      | 5-65 m     |



| Fault No. | Extent of Fault | Location Block     | Trend     | Throw      |            |
|-----------|-----------------|--------------------|-----------|------------|------------|
|           |                 |                    |           | Direction  | Amount (m) |
| F18-F18   | 1300 & 1680 m   | North              | East-West | South      | 5-15 m     |
| F19-F19   | 2470 m          | Northern Part      | NW-SE     | North-East | 2-65 m     |
| F20-F20   | 1160 m          | North Eastern Part | NW-SE     | North-East | 2-15 m     |
| F21-F21   | 1500 m          | North              | East-West | South      | 5-20 m     |
| F22-F22   | 1700 m          | North              | East-West | South      | 5-15 m     |
| F23-F23   | 120 m           | North              | NW-SE     | South-West | 20-25 m    |

(Refer G-I for Geological plan)

#### 4.4 DESCRIPTION OF COAL SEAMS

##### 4.4.1 KALINGA EAST BLOCK

Altogether, 11 coal seams have been regionally correlated in this block, viz., seam I of Karharbari Formation and seams II to XI in Barakar Formation. Seam I occurs as three distinct splits, viz., seams I Top, I Middle and I Bottom, out of which seam I Top has got some localized development. However, information on seam I is limited in Kalinga East block as only 11 boreholes have been drilled in Karharbari Formation. Hence detail study on seam I is not made in this report. Remaining 10 coal seams of Barakar Formation occurs as 20 distinct splits/combination, viz. in ascending order, II A, II B, II C, II D+E, III A, III B, III C, III D, III E, IV A, IV B, V A, V B, VI A, VI B, VII, VIII, IX, X and XI. Out of these, 5 coal seams, viz. seams II A, III B, VI A, X and XI have been identified as either not so potential or having localized development and hence, are not dealt in details. However, whatever details are available for seam I and other non-potential Barakar coal seams have been provided in relevant annexure. Remaining 15 coal seams of Barakar Formation from seams II B to IX have been studied and assessed in details in this report.

While identifying coal, shaly coal, carbonaceous shale and other lithological units, the standard norms of chemical analysis and visual logging were followed.

Based on sub-surface borehole information, coal seam sequence with intervening parting within the block has been established and provided.

### Sequence of coal seams in Kalinga East Block, Talcher Coalfield

| Seam / Parting between seams | ROOF DEPTH |          | FLOOR DEPTH |          | THICKNESS |          | GENERAL THICKNESS |     | Nos. of BH |
|------------------------------|------------|----------|-------------|----------|-----------|----------|-------------------|-----|------------|
|                              | MIN (M)    | MAX (M)  | MIN (M)     | MAX (M)  | MIN (M)   | MAX (M)  | MIN               | MAX |            |
| SOIL                         | 0.00       | 0.00     | 0.00        | 16.70    | 0.00      | 16.70    | 2                 | 9   | 335        |
|                              | CMTK-001   | CMTK-001 | CMTK-131    | CMTK-149 | CMTK-131  | CMTK-149 |                   |     |            |
| WM                           | 0.00       | 16.70    | 6.00        | 36.75    | 0.00      | 28.85    | 2                 | 13  | 335        |
|                              | CMTK-131   | CMTK-149 | CMTK-264    | CMTK-049 | CMTK-041  | CMTK-049 |                   |     |            |
| Part Parting above XI 01     | 13.50      | 23.00    | 23.28       | 35.57    | 0.28      | 22.07    |                   |     | 2          |
|                              | CMTK-218   | CMTK-288 | CMTK-288    | CMTK-218 | CMTK-288  | CMTK-218 |                   |     |            |
| XI                           | 23.28      | 35.57    | 23.80       | 36.28    | 0.52      | 0.71     |                   |     | 2          |
|                              | CMTK-288   | CMTK-218 | CMTK-288    | CMTK-218 | CMTK-288  | CMTK-218 |                   |     |            |
| Parting between X & IX 02    | 22.25      | 36.28    | 41.63       | 60.29    | 19.38     | 24.01    |                   |     | 2          |
|                              | CMTK-248   | CMTK-218 | CMTK-248    | CMTK-218 | CMTK-248  | CMTK-218 |                   |     |            |
| X                            | 12.84      | 65.44    | 14.10       | 66.47    | 0.13      | 1.77     | 1                 | 1   | 16         |
|                              | CMTK-203   | KR-016   | CMTK-203    | KR-016   | CMTK-286  | CMTK-245 |                   |     |            |
| Parting between X & IX 03    | 14.10      | 66.47    | 18.89       | 75.09    | 1.23      | 9.24     | 2                 | 7   | 16         |
|                              | CMTK-203   | KR-016   | CMTK-203    | KR-016   | KR-007    | CMTK-286 |                   |     |            |
| IX                           | 14.00      | 75.09    | 37.85       | 98.30    | 14.30     | 23.85    | 19                | 23  | 37         |

| Seam / Parting between seams   | ROOF DEPTH |          | FLOOR DEPTH |          | THICKNESS |          | GENERAL THICKNESS |     | Nos. of BH |
|--------------------------------|------------|----------|-------------|----------|-----------|----------|-------------------|-----|------------|
|                                | MIN (M)    | MAX (M)  | MIN (M)     | MAX (M)  | MIN (M)   | MAX (M)  | MIN               | MAX |            |
|                                | CMTK-259   | KR-016   | CMTK-259    | KR-016   | CMTK-260  | CMTK-259 |                   |     |            |
| Parting between IX & VIII 04   | 9.72       | 98.30    | 26.50       | 121.03   | 5.06      | 29.75    | 15                | 23  | 84         |
|                                | CMTK-194   | KR-016   | CMTK-052    | KR-016   | CMTK-022  | CMTK-182 |                   |     |            |
| VIII                           | 10.40      | 121.03   | 19.09       | 131.37   | 2.17      | 11.17    | 7                 | 11  | 108        |
|                                | CMTK-220   | KR-016   | CMTK-220    | KR-016   | METS-020  | CMTK-308 |                   |     |            |
| Parting between VIII & VII 05  | 12.00      | 131.37   | 14.00       | 133.85   | 1.03      | 9.57     | 2                 | 4   | 123        |
|                                | CMTK-212   | KR-016   | CMTK-212    | KR-016   | CMTK-105  | CMTK-284 |                   |     |            |
| VII                            | 11.43      | 133.85   | 15.15       | 138.54   | 0.88      | 6.89     | 3                 | 5   | 124        |
|                                | CMTK-111   | KR-016   | CMTK-111    | KR-016   | CMTK-300  | CMTK-263 |                   |     |            |
| Parting between VII & VI B 06  | 9.00       | 112.04   | 36.70       | 149.00   | 24.58     | 42.45    | 29                | 36  | 120        |
|                                | CMTK-267   | KR-008   | CMTK-267    | KR-008   | CMTK-087  | CMTK-303 |                   |     |            |
| VI B                           | 14.59      | 149.00   | 16.18       | 151.49   | 0.22      | 3.63     | 1                 | 2   | 140        |
|                                | CMTK-110   | KR-008   | CMTK-062    | KR-008   | CMTK-063  | CMTK-295 |                   |     |            |
| Parting between VI B & VI A 07 | 13.64      | 145.51   | 19.21       | 150.95   | 0.62      | 16.77    | 2                 | 10  | 128        |
|                                | CMTK-113   | CMTK-176 | CMTK-062    | CMTK-288 | CMTK-063  | CMTK-197 |                   |     |            |
| VI A                           | 10.95      | 150.95   | 12.03       | 151.15   | 0.06      | 1.86     | 0.2               | 1   | 139        |
|                                | CMTK-056   | CMTK-288 | CMTK-056    | CMTK-288 | CMTK-057  | CMTK-258 |                   |     |            |
| Parting between VI A & V B 08  | 15.49      | 149.15   | 17.52       | 161.23   | 2.03      | 22.24    | 12                | 20  | 90         |
|                                | CMTK-096   | CMTK-176 | CMTK-096    | CMTK-176 | CMTK-096  | CMTK-053 |                   |     |            |
| V B                            | 12.63      | 178.94   | 13.32       | 179.85   | 0.03      | 4.05     | 0.2               | 2   | 119        |
|                                | CMTK-108   | KR-016   | CMTK-108    | KR-016   | CMTK-096  | CMTK-205 |                   |     |            |

| Seam / Parting between seams     | ROOF DEPTH |         | FLOOR DEPTH |         | THICKNESS |          | GENERAL THICKNESS |     | Nos. of BH |
|----------------------------------|------------|---------|-------------|---------|-----------|----------|-------------------|-----|------------|
|                                  | MIN (M)    | MAX (M) | MIN (M)     | MAX (M) | MIN (M)   | MAX (M)  | MIN               | MAX |            |
| Parting between V B & V A 09     | 13.32      | 179.85  | 15.88       | 182.65  | 0.36      | 8.66     | 1                 | 5   | 119        |
|                                  | CMTK-108   | KR-016  | CMTK-108    | KR-016  | CMTK-176  | CMTK-145 |                   |     |            |
| V A                              | 10.15      | 182.65  | 11.00       | 184.35  | 0.10      | 4.71     | 1                 | 3   | 186        |
|                                  | CMTK-058   | KR-016  | CMTK-058    | KR-016  | CMTK-224  | CMTK-084 |                   |     |            |
| Parting between V A & IV B 10    | 11.00      | 184.35  | 19.22       | 188.54  | 1.46      | 13.87    | 4                 | 8   | 185        |
|                                  | CMTK-058   | KR-016  | CMTK-058    | KR-016  | CMTK-080  | CMTK-115 |                   |     |            |
| IV B                             | 13.70      | 188.54  | 17.27       | 194.34  | 0.13      | 7.70     | 2                 | 6   | 204        |
|                                  | CMTB-026   | KR-016  | CMTB-026    | KR-016  | CMTK-025  | CMTK-250 |                   |     |            |
| Parting between IV B & IV A 11   | 10.07      | 194.34  | 11.90       | 196.50  | 0.20      | 8.06     | 1                 | 3   | 191        |
|                                  | CMTK-109   | KR-016  | CMTK-109    | KR-016  | CMTK-077  | CMTK-298 |                   |     |            |
| IV A                             | 10.70      | 196.50  | 14.00       | 198.50  | 0.13      | 4.84     | 1                 | 3   | 194        |
|                                  | CMTK-240   | KR-016  | CMTK-240    | KR-016  | CMTK-046  | CMTK-016 |                   |     |            |
| Parting between IV A & III E 12  | 12.43      | 198.50  | 19.90       | 212.21  | 4.39      | 17.55    | 9                 | 15  | 191        |
|                                  | CMTK-140   | KR-016  | CMTK-066    | KR-016  | CMTK-035  | CMTK-300 |                   |     |            |
| III E                            | 10.35      | 212.21  | 13.99       | 217.27  | 1.70      | 7.32     | 4                 | 6   | 217        |
|                                  | CMTK-028   | KR-016  | CMTK-028    | KR-016  | CMTK-138  | CMTK-049 |                   |     |            |
| Parting between III E & III D 13 | 13.99      | 217.27  | 18.95       | 223.18  | 1.26      | 9.94     | 3                 | 7   | 131        |
|                                  | CMTK-028   | KR-016  | CMTK-028    | KR-016  | CMTK-056  | CMTK-057 |                   |     |            |

| Seam / Parting between seams      | ROOF DEPTH |          | FLOOR DEPTH |          | THICKNESS |          | GENERAL THICKNESS |     | Nos. of BH |
|-----------------------------------|------------|----------|-------------|----------|-----------|----------|-------------------|-----|------------|
|                                   | MIN (M)    | MAX (M)  | MIN (M)     | MAX (M)  | MIN (M)   | MAX (M)  | MIN               | MAX |            |
| III D                             | 18.95      | 223.18   | 19.37       | 224.58   | 0.07      | 4.15     | 0.3               | 2   | 132        |
|                                   | CMTK-028   | KR-016   | CMTK-028    | KR-016   | CMTK-042  | CMTKN003 |                   |     |            |
| Parting between III D & III C 14  | 19.37      | 208.70   | 24.53       | 216.00   | 3.65      | 12.28    | 4                 | 8   | 88         |
|                                   | CMTK-028   | CMTK-285 | CMTK-028    | CMTK-285 | CMTK-050  | CMTK-019 |                   |     |            |
| III C                             | 10.58      | 216.00   | 13.04       | 216.40   | 0.04      | 5.35     | 0.4               | 2   | 189        |
|                                   | CMTK-021   | CMTK-285 | CMTK-021    | CMTK-285 | CMTK-284  | CMTK-016 |                   |     |            |
| Parting between III C & III C 15  | 13.04      | 216.40   | 18.75       | 223.20   | 2.34      | 14.01    | 5                 | 10  | 138        |
|                                   | CMTK-021   | CMTK-285 | CMTK-021    | CMTK-285 | CMTK-235  | METS-008 |                   |     |            |
| III B                             | 18.75      | 225.46   | 19.32       | 225.62   | 0.06      | 1.14     | 0.2               | 0.6 | 163        |
|                                   | CMTK-021   | CMTK-248 | CMTK-021    | CMTK-248 | CMTK-037  | CMTK-261 |                   |     |            |
| Parting between III B & III A 16  | 19.32      | 225.62   | 22.88       | 230.93   | 0.87      | 13.37    | 3                 | 10  | 159        |
|                                   | CMTK-021   | CMTK-248 | CMTK-128    | CMTK-176 | CMTK-248  | CMTK-035 |                   |     |            |
| III A                             | 14.53      | 246.03   | 15.45       | 247.39   | 0.03      | 3.91     | 0.6               | 2   | 236        |
|                                   | CMTK-269   | KR-016   | CMTK-269    | KR-016   | CMTK-125  | KR-018   |                   |     |            |
| Parting between III A & II D+E 17 | 15.00      | 247.39   | 36.15       | 268.47   | 11.31     | 29.01    | 18                | 23  | 228        |
|                                   | CMTK-150   | KR-016   | CMTK-150    | KR-016   | CMTK-199  | CMTB-032 |                   |     |            |
| II D+E                            | 12.55      | 268.47   | 27.73       | 285.55   | 11.56     | 18.65    | 15                | 17  | 241        |
|                                   | CMTK-009   | KR-016   | CMTK-009    | KR-016   | CMTK-278  | CMTK-202 |                   |     |            |
| Parting between II D+E & II C 18  | 9.87       | 285.55   | 13.39       | 288.78   | 0.20      | 16.40    | 1                 | 6   | 259        |
|                                   | CMTK-064   | KR-016   | CMTK-011    | KR-016   | CMTK-199  | CMTK-088 |                   |     |            |



| Seam / Parting between seams   | ROOF DEPTH |         | FLOOR DEPTH |         | THICKNESS |          | GENERAL THICKNESS |     | Nos. of BH |
|--------------------------------|------------|---------|-------------|---------|-----------|----------|-------------------|-----|------------|
|                                | MIN (M)    | MAX (M) | MIN (M)     | MAX (M) | MIN (M)   | MAX (M)  | MIN               | MAX |            |
| II C                           | 12.80      | 288.78  | 17.48       | 298.28  | 0.72      | 12.47    | 6                 | 10  | 259        |
|                                | CMTK-085   | KR-016  | CMTK-085    | KR-016  | CMTK-088  | CMTK-096 |                   |     |            |
| Parting between II C & II B 19 | 9.71       | 298.28  | 13.61       | 303.94  | 0.15      | 13.52    | 5                 | 10  | 240        |
|                                | CMTK-117   | KR-016  | CMTK-117    | KR-016  | CMTK-232  | CMTK-138 |                   |     |            |
| II B                           | 10.91      | 303.94  | 13.91       | 305.48  | 0.10      | 4.52     | 0.8               | 3   | 245        |
|                                | CMTK-070   | KR-016  | CMTK-070    | KR-016  | CMTK-149  | CMTK-092 |                   |     |            |
| Parting between II B & II A 20 | 16.54      | 305.48  | 18.26       | 306.85  | 0.19      | 12.39    | 0.6               | 5   | 140        |
|                                | CMTK-117   | KR-016  | CMTK-117    | KR-016  | CMTK-173  | CMTK-269 |                   |     |            |
| II A                           | 18.26      | 306.85  | 19.42       | 307.56  | 0.06      | 3.09     | 0.4               | 1.5 | 143        |
|                                | CMTK-117   | KR-016  | CMTK-117    | KR-016  | CMTK-030  | CMTK-062 |                   |     |            |

It can be seen from the above table that seams II A, III B, VI A, X and XI are either not so potential or having localized development and hence, are not dealt in details in this report. Seam II B has been identified as lower-most coal seam to be exploited by opencast method. Among the 15 coal horizons identified for exploitation, seams II C, II D+E, III E and IV B have considerable development over larger part of the block. Seams VII, VIII and IX exhibits high coal thickness in this block but are occurring on the northern part of the block only.

## SEAM-WISE GENERAL OBSERVATIONS

### SEAM XI

Seam XI is the youngest coal horizon available in Kalinga East block. It has got very limited occurrence towards northern-most part of the block. Due to its un-



economical thickness and very limited occurrence, this coal seam has not been considered as potential coal horizon.

### **SEAM X**

Seam X is next seam occurs below seam XI with in between parting of about 20m. Like seam XI, this seam has got limited occurrence with insignificance development towards northern-most part of the block and hence, has not been considered as potential coal horizon.

### **SEAM IX**

Seam IX is one of the major coal seams of this block and is occurring below seam X with general parting thickness of about 2m to 7m. However, due to insignificant development of the younger coal seams XI and X, this seam is considered as top-most coal horizon to be exploited. Accordingly, overburden above seam IX, without considering seams XI and X, is worked out to be from 8m to 75m. This seam is developed in the northern part of the block and major part of its area of occurrence is falling in in-crop zone. The thick in-crop of the seam is repeated across the area of its occurrence due to strike faults. The effective thickness of the seam is generally around 20m. The seam overall M% and Ash% on I100 basis varies from 4.9% to 7.4% and 39.3% to 52.3% respectively, Gross CV varies from 2920 kcal/kg to 3969 kcal/kg. General UHV varies from 1450 kcal/kg to 2000 kcal/kg and grade of the seam is generally G. Average M100 value of the seam is 13, unit VM% ranges from 42.7% to 47.7% and unit CV ranges from 7280 kcal/kg to 7838 kcal/kg, as such part of this seam may fall in B<sub>s</sub> group of long flame coal.

### **SEAM VIII**

Seam VIII is one of the major coal seams of this block and is occurring below seam IX with general parting thickness of about 15m to 23m. The parting between these two seams increases to around 29m towards north- west corner of the block. This seam is developed in the northern part of the block. The thick in-crop of the seam is repeated across its area of occurrence due to strike faults. The effective thickness of the seam is generally around 8m to 10m. The seam overall M% and Ash% on I100 basis varies from 4.8% to 8.0% and 22.2% to 54.2% respectively, Gross CV varies from 2683 kcal/kg to 5360 kcal/kg. General UHV varies from 1350 kcal/kg to 2450 kcal/kg and grade of the seam is generally G to F. Average M100 value of the seam is 13, unit VM% ranges from 42.2% to 47.0% and unit CV ranges from 7035 kcal/kg to 7842 kcal/kg, as such part of this seam may fall in B<sub>5</sub> group of long flame coal.

### **SEAM VII**

Seam VII is one of the major coal seams of this block and is occurring below seam VIII with general parting thickness of about 2m to 4m. The parting between these two seams increases to around 9m towards north-west corner of the block. This seam is moderately thick, but is reduced to less than 1m in thickness, as encountered in one borehole, viz., CMTK-300, towards north-eastern part of the block. The seam is developed in the northern part of the block. The in-crop is repeated across its area of occurrence due to strike faults. The effective thickness of the seam is generally around 3m to 5m. The seam overall M% and Ash% on I100 basis varies from 4.5% to 9.2% and 28.7% to 55.5% respectively, Gross CV varies from 2677 kcal/kg to 4792 kcal/kg. General UHV varies from 1400 kcal/kg to 2600 kcal/kg and grade of the seam is generally G to F. Average M100 value of the seam is 13, unit VM% ranges from 44.2% to 48.9% and unit CV ranges from 7127 kcal/kg to 7841 kcal/kg, as such part of this seam may fall in B<sub>5</sub> group of long flame coal.

### **SEAM VI B**

Seam VI B is occurring below seam VII with general parting thickness of about 29m to 36m. The parting between these two seams increases to around 42m towards north-west corner of the block. This seam is generally thin and is even reduced to less than 1m in thickness in patches over the block. The seam is developed in the central to northern part of the block. The in-crop is thin and is repeated across its area of occurrence due to strike faults. The effective thickness of the seam is generally around 1m to 2m. The seam overall M% and Ash% on I100 basis varies from 4.3% to 9.0% and 29.3% to 58.4% respectively, Gross CV varies from 2215 kcal/kg to 4736 kcal/kg. General UHV varies from 1350 kcal/kg to 2250 kcal/kg and grade of the seam is generally G. Average M100 value of the seam is 13, unit VM% ranges from 41.6% to 49.0% and unit CV ranges from 7025 kcal/kg to 7843 kcal/kg, as such part of this seam may fall in B<sub>s</sub> group of long flame coal.

### **SEAM VI A**

Seam VI A is occurring below seam VI B with general parting thickness of about 2m to 10m. The parting between these two seams is even less than 1m at places. Seam VI A is thin and does not attain the workable thickness over majority of its area of occurrence. As such, like seams XI and X, this seam has not also been considered as potential coal.

### **SEAM V B**

Seam V B is occurring below seam VI A with general parting thickness of about 12m to 20m. The parting between these two seams increases to around 22m towards north-central part of the block. Due to non-development of seam VI A over major part of the area, parting between seams V B and VI B is worked out to be 16m to 26m, which increases to around 31m towards north-east corner of the

block. This seam is generally thin and is reduced to less than 1m in thickness in many places over the block. This seam is developed as workable coal seam in the north-central and north-western part of the block. The in-crop is thin and is repeated across its area of occurrence due to strike faults. The effective thickness of the seam is generally around 1m to 2m. The seam overall M% and Ash% on I100 basis varies from 3.9% to 9.9% and 34.4% to 57.5% respectively, Gross CV varies from 2577 kcal/kg to 4292 kcal/kg. General UHV varies from 1350 kcal/kg to 2350 kcal/kg and grade of the seam is generally G. Average M100 value of the seam is 13, unit VM% ranges from 41.2% to 44.8.0% and unit CV ranges from 7213 kcal/kg to 7841 kcal/kg, as such part of this seam may fall in B<sub>s</sub> group of long flame coal.

#### **SEAM V A**

Seam V A is occurring below seam V B with general parting thickness of about 1m to 5m. The parting between these two seams is even less than 1m at places. The parting between these two seams increases to around 8m towards north-central part of the block. This seam is generally thin and is reduced to less than 1m in thickness in mostly in the eastern part of the block. This seam is developed as workable coal seam in the west-central to northern part of the block. The in crop is moderately thick in western part of the block, whereas it is generally thin in the eastern part of the block. The in-crop is repeated across its area of occurrence due to strike faults. The effective thickness of the seam is generally around 1m to 2.5m. The seam overall M% and Ash% on I100 basis varies from 4.6% to as high as 11.2% and as low as 20.1% to 54.7% respectively, Gross CV varies from 2491 kcal/kg to as high as 5601 kcal/kg. General UHV varies from 2100 kcal/kg to 4000 kcal/kg and grade of the seam is generally G to E. Average M100 value of the seam is 13, unit VM% ranges from 39.7% to 47.0.0% and unit CV ranges from 7111 kcal/kg to 7948 kcal/kg, as such part of this seam may fall in B<sub>s</sub> group of long flame coal.



## **SEAM IV B**

Seam IV B is one of the major coal seams of the block and is occurring below seam V A with general parting thickness of about 4m to 8m. The parting between these two seams increases to around 14m towards west-central part of the block. This seam is moderately thick, but is reduced to less than 1m in thickness in patches in the northern part of the block. This seam is developed in the northern part of the block. The in-crop is moderately thick over the block and is repeated across its area of occurrence due to strike faults. The effective thickness of the seam is generally around 3m to 6m. The seam overall M% and Ash% on I100 basis varies from 3.3% to 8.9% and 31.8% to 56.5% respectively, Gross CV varies from 2467 kcal/kg to 4267 kcal/kg. General UHV varies from 1350 kcal/kg to 1950 kcal/kg and grade of the seam is generally G. Average M100 value of the seam is 12, unit VM% ranges from 39.8% to 48.5.0% and unit CV ranges from 5875 kcal/kg to 8010 kcal/kg, as such part of this seam may fall in B<sub>5</sub> group of long flame coal.

## **SEAM IV A**

Seam IV A is occurring below seam IV B with general parting thickness of about 1m to 3m. The parting between these two seams is even less than 1m at places. The parting between these two seams increases to around 8m towards north-western part of the block. This seam is generally thin to moderately thick, but is reduced to less than 1m in thickness towards western part of the block, otherwise, this seam is well developed in the remaining part of its area of occurrence with in the block. The in-crop is moderately thick over the block with a thinning tendency towards part of the western side of the block and is repeated across its area of occurrence due to strike faults. The effective thickness of the seam is generally around 1m to 3m. The seam overall M% and Ash% on I100 basis varies from 4.6% to as high as 10.1% and 27.6% to 55.0% respectively,



Gross CV varies from 2536 kcal/kg to 4880 kcal/kg. General UHV varies from 1850 kcal/kg to 3200 kcal/kg and grade of the seam is generally G to F. Average M100 value of the seam is 12, unit VM% ranges from 39.6% to 48.5.0% and unit CV ranges from 7086 kcal/kg to 8009 kcal/kg, as such part of this seam may fall in B<sub>5</sub> group of long flame coal.

### **SEAM III E**

Seam III E is one of the major coal seams of the block and is occurring below seam IV A with general parting thickness of about 9m to 15m. The parting between these two seams increases to around 17m towards north-eastern part of the block. This seam is well developed in the block. The in-crop is moderately thick over the block and is repeated across its area of occurrence due to strike faults. The effective thickness of the seam is generally around 4m to 6m. The seam overall M% and Ash% on I100 basis varies from 3.6% to as high as 11.5% and 24.9% to 49.3% respectively, Gross CV varies from 3261 kcal/kg to 5046 kcal/kg. General UHV varies from 2700 kcal/kg to 3550 kcal/kg and grade is generally F to E. Average M100 value of the seam is 12, unit VM% ranges from 37.9% to 43.5.0% and unit CV ranges from 7233 kcal/kg to 7997 kcal/kg, as such part of this seam may fall in B<sub>5</sub> group of long flame coal.

### **SEAM III D**

Seam III D is occurring below seam III E with general parting thickness of about 3m to 7m. The parting between these two seams increases to around 10m towards central part of the block. This seam is generally thin and is reduced to less than 1m in thickness over major part of the block. This seam is developed to workable coal seam towards north-western part of the block. The in-crop is thin and is repeated across its area of occurrence due to strike faults. The effective thickness of the seam is generally around 1m to 2m. The seam overall M% and

Ash% on I100 basis varies from 4.3% to 8.2% and 24.6% to 56.7% respectively, Gross CV varies from 2521 kcal/kg to 5155 kcal/kg. General UHV varies from 2100 kcal/kg to 3700 kcal/kg and grade of this seam is generally G to E. Average M100 value of the seam is 12, unit VM% ranges from 40.3% to 45.0% and unit CV ranges from 7354 kcal/kg to 8004 kcal/kg, as such part of this seam may fall in B<sub>5</sub> group of long flame coal.

### **SEAM III C**

Seam III C is occurring below seam III D with general parting thickness of about 4m to 8m. The parting between these two seams increases to around 12m towards north-western part of the block. This seam is generally thin and is reduced to less than 1m in thickness over north-western and west-central parts of the block, but it shows better development of the seam thickness of 3m to 5m at patches towards south-eastern parts of the block. The in-crop is thin towards eastern part of the block to moderately thick towards western part of the block and is repeated across its area of occurrence due to strike faults. The effective thickness of the seam is generally around 1m to 3m. The seam overall M% and Ash% on I100 basis varies from 4.7% to 9.5% and 24.7% to 48.1% respectively, Gross CV varies from 3303 kcal/kg to 5096 kcal/kg. General UHV varies from 2300 kcal/kg to 3550 kcal/kg and grade of this seam is generally G to E. Average M100 value of the seam is 12, unit VM% ranges from 39.8% to 45.7% and unit CV ranges from 7290 kcal/kg to 8003 kcal/kg, as such part of this seam may fall in B<sub>5</sub> group of long flame coal.

### **SEAM III B**

Seam III B is occurring below seam III C with general parting thickness of about 5m to 10m. Seam III B is thin and does not attain the workable thickness

over majority of its area of occurrence. As such, like seams XI, X and VI A, this seam has not also been considered as potential coal horizon.

### **SEAM III A**

Seam III A is occurring below seam III B with general parting thickness of about 3m to 10m. The parting between these two seams increases to around 13m towards central part of the block, although it reduces to even less than 1m at places. Due to non-development of seam III B over major part of the area, parting between seams III A and III C is worked out to be 12m to 17m, which increases to around 22m towards extreme northern part of the block. This seam is generally thin and is reduced to less than 1m in thickness towards south-eastern part of the block. The in-crop is thin and is repeated across its area of occurrence due to strike faults. The effective thickness of the seam is generally around 1m to 2m. The seam overall M% and Ash% on I100 basis varies from as low as 2.8% to 9.2% and as low as 24.1% to 56.3% respectively, Gross CV varies from 2759 kcal/kg to 5138 kcal/kg. General UHV varies from 2500 kcal/kg to 3900 kcal/kg and grade is generally F to E. Average M100 value of the seam is 12, unit VM% ranges from 39.7% to 45.5% and unit CV ranges from 7193 kcal/kg to 8330 kcal/kg, as such part of this seam may fall in B<sub>s</sub> group of long flame coal.

### **SEAM II D+E**

Seam II D+E is the major contributor of the coal resources of this block and is occurring below seam III A with general parting thickness of about 18m to 23m. The parting between these two seams increases to around 29m towards south-eastern corner of the block. This seam is well developed all over its area of occurrence within the block. The in-crop is very thick and is repeated along southern part of the block due to faulting. The effective thickness of the seam is generally around 15m to 17m. The seam overall M% and Ash% on I100 basis

varies from 3.6% to 9.9% and 27.1% to 48.4% respectively, Gross CV varies from 3150 kcal/kg to 4986 kcal/kg. General UHV varies from 2450 kcal/kg to 3250 kcal/kg and grade of this seam is generally F. Average M100 value of the seam is 11, unit VM% ranges from 40.4% to 44.7% and unit CV ranges from 7367 kcal/kg to 8089 kcal/kg, as such part of this seam may fall in B<sub>s</sub> group of long flame coal.

### **SEAM II C**

Seam II C is the second-most major contributor of the coal resources of this block after seam II D+E and is occurring below seam II D+E with general parting thickness of about 1m to 6m. The parting between these two seams is less than 1m at places, but it increases to around 16m towards southern part of the block. This seam is well developed all over its area of occurrence with in the block. The in-crop is very thick and is repeated along southern part of the block due to faulting. The effective thickness of the seam is generally around 6m to 10m. The seam overall M% and Ash% on I100 basis varies from 3.4% to 8.8% and 29.3% to 53.3% respectively, Gross CV varies from 2914 kcal/kg to 4823 kcal/kg. General UHV varies from 2150 kcal/kg to 3050 kcal/kg and grade of this seam is generally G to F. Average M100 value of the seam is 11, unit VM% ranges from 40.1% to 44.9% and unit CV ranges from 7442 kcal/kg to 8087 kcal/kg, as such part of this seam may fall in B<sub>s</sub> group of long flame coal.

### **SEAM II B**

Seam II B is occurring below seam II C with general parting thickness of about 5m to 10m. The parting between these two seams increases to around 13m towards central part of the block, although it reduces to even less than 1m towards south-eastern corner of the block. This seam is generally thin and is reduced to less than 1m in thickness towards north-western part of the block, but it shows better development of the seam thickness around 2m to 3m towards eastern part



of the block. The in-crop is moderately thick and is repeated along southern part of the block due to faulting. The effective thickness of the seam is generally around 1m to 2m. The seam overall M% and Ash% on I100 basis varies from as low as 2.9% to 7.1% and 29.5% to as high as 61.1% respectively, Gross CV varies from 2296 kcal/kg to 4804 kcal/kg. General UHV varies from 1350 kcal/kg to 2700 kcal/kg and grade of this seam is generally G to F. Average M100 value of the seam is 11, unit VM% ranges from 34.4% to 46.5% and unit CV ranges from 7185 kcal/kg to 8123 kcal/kg, as such part of this seam may fall in B5 group of long flame coal.

### **SEAM II A**

Seam II A is occurring below seam II B with general parting thickness of about 0.5m to 5m. Seam II A is thin and does not attain the workable thickness over majority of its area of occurrence. As such, like seams XI, X, VI A and III B, this seam has also not been considered as potential coal horizon.

#### **4.4.2 KALINGA WEST BLOCK**

Regionally co-relatable coal seams I to XI exist within the block with different splits/sections. Altogether, 27 number of coal seams including splits and combinations of splits were co-relatable within the block, of which 14 no. of seams were considered potential and assessed in details. Seams XI T, XI B, X B, X A, L 2, L 1, III C, III B, II B and II A are developed locally or are being generally less than 1 m thickness and hence not considered for further detail assessment. Further, seam I in three splits viz. I Top, I Mid. and I Bottom have not been explored in detail and hence not considered for assessment. However, whatever details are available for seam I and other non-potential seams have been provided in relevant annexure. The better quality seams are available in Karharbari i.e. in seam-I only.



**Coal seam sequence, Kalinga West Block, Talcher Coalfield**

| Sl.No. | Coal Seam/<br>Parting | Depth of Occurrence of Coal Seam (m) |                   | Thickness (m)    |                       | General Thickness (m) |       | No. of Boreholes considered |
|--------|-----------------------|--------------------------------------|-------------------|------------------|-----------------------|-----------------------|-------|-----------------------------|
|        |                       | From                                 | To                | From             | To                    | From                  | To    |                             |
| 1      | Soil                  | 0.00                                 | 18.60             | 0.00<br>CMKW-01  | 18.60<br>CMKW-01      | 4.00                  | 8.00  | 209                         |
| 2      | XI T                  | 20.03<br>CMKR-022                    | 21.02             | 0.99<br>CMKW-10  | 3.20 (INC)<br>CMKR-20 |                       |       | 2                           |
| 3      | P XI T8 XI B          | 12.71<br>CMKR-20                     | 21.02<br>CMKR-20  | 3.39<br>CMKR-20  | 16.84<br>CMKR-20      | 3.00                  | 15.00 | 2                           |
| 4      | XI B                  | 18.34<br>CMKR-18                     | 37.86<br>CMKR-22  | 3.06<br>CMKR-22  | 3.08<br>CMKR-18       |                       |       | 5                           |
| 5      | P XI B-XB             | 7.42<br>CMKR-62                      | 40.92<br>CMKR-22  | 1.96<br>CMKR-18  | 7.32<br>CMKR-22       | 2.00                  | 4.00  | 5                           |
| 6      | XB                    | 15.41<br>CMKR-65                     | 27.02<br>CMKR-20  | 1.12<br>CMKR-65  | 5.75<br>CMKR-20       | 1.00                  | 1.50  | 9                           |
| 7      | P XB-XA               | 5.00<br>CMKR-10                      | 44.57<br>CMKR-22  | 4.43<br>CMKR-58  | 23.15<br>CMKR-28      | 8.00                  | 15.00 | 9                           |
| 8      | XA                    | 17.34<br>CMKR-58                     | 56.50<br>CMKR-20  | 0.04<br>CMKR-54  | 2.51<br>CMKR-60       | 0.50                  | 0.80  | 20                          |
| 9      | PXA-IX                | 9.20<br>KW-73                        | 57.34<br>CMKR-22  | 6.32 KW-70       | 34.40<br>CMKR-37      | 15.00                 | 20.00 | 20                          |
| 10     | IX                    | 16.33<br>KW-25                       | 66.30<br>CMKR-22  | 16.60<br>CMKR-58 | 24.92<br>KW-25        | 20.00                 | 22.00 | 53                          |
| 11     | PIX & VIII            | 5.30<br>KW-59                        | 90.79<br>CMKR-22  | 3.45<br>CMKR-22  | 20.42<br>KW-42        | 8.00                  | 10.00 | 53                          |
| 12     | VIII                  | 8.11<br>KW-51                        | 94.24<br>CMKR-22  | 6.80<br>CMKR-74  | 12.76<br>CMKR-22      | 7.00                  | 9.00  | 78                          |
| 13     | P VIII&VIIB           | 6.00<br>CMKR-16                      | 107.00<br>CMKR-22 | 2.82<br>CMTK-146 | 9.00<br>KW-58         | 4.00                  | 6.00  | 78                          |
| 14     | VII B                 | 10.20<br>CMKR-16                     | 114.99<br>CMKR-22 | 0.22<br>CMKR-09  | 4.63<br>CMKR-58       | 1.00                  | 2.00  | 78                          |
| 15     | P VII B & VII A       | 8.35<br>KW-16                        | 116.15<br>CMKR-22 | 0.25<br>CMKW-33  | 22.82<br>CMKR-24      | 6.00                  | 14.00 | 78                          |
| 16     | VII A                 | 14.25<br>CMKW-16                     | 131.26<br>CMKR-20 | 0.05<br>KW-33    | 2.46<br>CMKW-24       | 1.00                  | 1.50  | 92                          |
| 17     | P VII A & L2          | 14.20<br>KW-14                       | 159.54<br>CMKR-22 | 5.47<br>KW-53    | 39.09<br>KW-73        | 15.00                 | 20.00 | 92                          |

| Sl.No. | Coal Seam/<br>Parting | Depth of<br>Occurrence of Coal<br>Seam (m) |                   | Thickness (m)           |                   | General Thickness (m) |       | No. of<br>Boreholes<br>considered |
|--------|-----------------------|--|-------------------|-------------------------|-------------------|-----------------------|-------|-----------------------------------|
|        |                       | From                                       | To                | From                    | To                | From                  | To    |                                   |
| 18     | L2                    | 20.20<br>CMKW-14                           | 149.30<br>CMKR-20 | 0.07<br>KW &<br>CMKR-59 | 1.78<br>CMKR-28   | 0.40                  | 0.95  | 97                                |
| 19     | P L2 & L1             | 13.70<br>CMKW-64                           | 138.52<br>CMKR-22 | 2.27<br>CMKW-35         | 29.49<br>CMKR-59  | 8.00                  | 10.00 | 82                                |
| 20     | L1                    | 15.90<br>CMKW-47                           | 153.43<br>CMKR-22 | 0.03<br>KW-35           | 2.03<br>CMKR-047  | 0.10                  | 0.60  | 82                                |
| 21     | P L1 & VI B           | 16.55<br>CMKW-47                           | 154.43<br>CMKR-22 | 0.31<br>KW-27           | 12.92<br>CMKR-14  | 1.00                  | 2.00  | 82                                |
| 22     | P VII A & VI<br>B     | 14.20<br>KW-47                             | 131.69<br>CMKR-20 | 23.33<br>KW-62          | 51.76<br>CMKR-59  | 28.00                 | 34.00 | 92                                |
| 23     | VI B                  | 19.40<br>KW-60                             | 161.15<br>CMKR-20 | 0.12<br>CMKW-62         | 5.40<br>CMKR-46   | 1.50                  | 2.50  | 123                               |
| 24     | P VI B & V B          | 16.23<br>KW-60                             | 164.23<br>CMKR-22 | 0.69<br>KW-44           | 12.44<br>CMTK-152 | 4.00                  | 7.00  | 123                               |
| 25     | VB                    | 12.45<br>CMKW-15                           | 167.86<br>CMKR-22 | 0.11<br>KW-40           | 5.25<br>CMKW-70   | 2.00                  | 3.00  | 148                               |
| 26     | P VB & VA             | 13.70<br>CMKW-52                           | 171.55<br>CMKR-22 | 0.10<br>CMKR-10         | 6.84<br>KW-36     | 2.00                  | 4.00  | 148                               |
| 27     | VA                    | 11.44<br>CMKW-65                           | 173.20<br>CMKR-20 | 0.20<br>CMKR-75         | 5.00<br>CMKW-17   | 1.50                  | 2.50  | 153                               |
| 28     | P V A & IV<br>A+B     | 11.42<br>CMKW-65                           | 176.20<br>CMKR-22 | 1.56<br>CMKR-7          | 9.79<br>CMKR-74   | 4.00                  | 7.00  | 153                               |
| 29     | IV A+B                | 11.53<br>KW-29                             | 181.22<br>CMKR-22 | 0.62<br>KW-37           | 7.92<br>CMKR-21   | 2.00                  | 5.00  | 168                               |
| 30     | P IV A+B &<br>III E   | 8.62<br>CMKW-58                            | 187.16<br>CMKR-22 | 5.98<br>CMKR-22         | 23.22<br>KW-75    | 13.00                 | 18.00 | 168                               |
| 31     | III E                 | 13.55<br>KW-31                             | 194.58<br>CMKR-20 | 2.20<br>KW-24           | 7.73<br>KW-65     | 4.00                  | 6.00  | 187                               |
| 32     | P III E & III D       | 15.00<br>CMKW-42                           | 199.92<br>CMKR-20 | 2.53<br>CMKW-45         | 12.33<br>CMKR-75  | 4.00                  | 7.00  | 187                               |

| Sl.No. | Coal Seam/<br>Parting | Depth of<br>Occurrence of Coal<br>Seam (m) |                   | Thickness (m)            |                  | General Thickness (m) |       | No. of<br>Boreholes<br>considered |
|--------|-----------------------|--|-------------------|--------------------------|------------------|-----------------------|-------|-----------------------------------|
|        |                       | From                                       | To                | From                     | To               | From                  | To    |                                   |
| 33     | III D                 | 21.45<br>CMKW-42                           | 211.33<br>CMKR-22 | 0.32<br>KW-02 &<br>KW-17 | 5.60<br>CMKR-65  | 0.50                  | 2.00  | 187                               |
| 34     | P III D & III C       | 17.00<br>KW-39                             | 214.80<br>CMKR-22 | 0.35<br>CMTH-25          | 15.22<br>CMKR-11 | 4.00                  | 6.00  | 122                               |
| 35     | III C                 | 15.15<br>KW-16                             | 215.96<br>CMKR-22 | 0.06<br>KW-45            | 1.21<br>CMKR-20  | 0.30                  | 0.80  | 122                               |
| 36     | P III C & III B       | 31.52<br>KW-17                             | 200.95<br>KW-22   | 2.85<br>KW-73 &<br>KW-74 | 14.21<br>CMKW-73 | 7.00                  | 12.00 | 122                               |
| 37     | P III D & III A       | 18.50<br>KW-77                             | 214.80<br>CMKR-22 | 1.80<br>CMKR-65          | 25.16<br>KW-33   | 8.00                  | 17.00 | 187                               |
| 38     | P III C & III B       | 16.10<br>KW-16                             | 215.00<br>CMKR-20 | 1.03<br>CMKR-17          | 14.18<br>KW-15   | 4.00                  | 7.00  | 149                               |
| 39     | P III C & III A       | 28.06<br>KW-03                             | 217.06<br>CMKR-22 | 0.97<br>CMKR-18          | 19.38<br>KW-33   | 5.00                  | 14.00 | 122                               |
| 40     | III B                 | 52.39<br>CMKW-38                           | 216.04<br>CMKR-20 | 0.05<br>KW-63            | 1.34<br>CMKR-20  | 0.40                  | 0.85  | 149                               |
| 41     | P III B & III A       | 24.10<br>KW-82                             | 217.38<br>CMKR-20 | 0.47<br>KW-49            | 7.97<br>KW-29    | 1.00                  | 5.00  | 149                               |
| 42     | III A                 | 17.20<br>KW-35                             | 218.79<br>CMKR-20 | 0.45<br>KW-29            | 6.23<br>CMKR-18  | 1.00                  | 2.00  | 191                               |
| 43     | P III A & II E        | 18.85<br>KW-35                             | 223.95<br>CMKR-22 | 9.31<br>KW-82            | 24.15<br>KW-02   | 14.00                 | 20.00 | 191                               |
| 44     | II E                  | 23.60<br>KW-79                             | 234.50<br>CMKR-22 | 2.57<br>KW-16            | 15.60<br>CMKW-09 | 10.00                 | 12.00 | 192                               |
| 45     | P II E & II D         | 24.20<br>KW-91                             | 244.03<br>CMKR-20 | 0.13<br>KW-66            | 15.60<br>KW-67   | 0.50                  | 5.00  | 191                               |
| 46     | II D                  | 31.44<br>KW-91                             | 245.10<br>CMKR-20 | 0.79<br>CMKW-09          | 10.08<br>CMTH-32 | 2.00                  | 4.00  | 191                               |
| 47     | P II D & II C         | 34.05<br>KW-91                             | 252.38<br>CMKR-20 | 2.25<br>CMKW-31          | 32.13<br>CMTH-39 | 6.00                  | 14.00 | 177                               |
| 48     | II C                  | 47.52<br>KW-85                             | 270.07<br>CMKR-20 | 0.50<br>CMKW-61          | 8.50<br>CMKW-13  | 2.00                  | 4.00  | 177                               |
| 49     | P II C & II B         | 33.60<br>KW-19                             | 247.65<br>KW-20   | 0.47<br>CMTH-25          | 18.00<br>CMKW-22 | 6.00                  | 10.00 | 140                               |

| Sl.No. | Coal Seam/<br>Parting | Depth of Occurrence of Coal Seam (m) |                 | Thickness (m)   |                 | General Thickness (m) |        | No. of Boreholes considered |
|--------|-----------------------|--------------------------------------|-----------------|-----------------|-----------------|-----------------------|--------|-----------------------------|
|        |                       | From                                 | To              | From            | To              | From                  | To     |                             |
| 50     | II B                  | 65.65<br>KW-91                       | 257.65<br>KW-65 | 0.07<br>KW-94   | 2.32<br>CMKW-70 | 0.20                  | 0.95   | 140                         |
| 51     | P II B & II A         | 66.51<br>KW-91                       | 258.03<br>KW-65 | 0.15<br>CMKW-45 | 6.54<br>KW-14   | 1.00                  | 3.00   | 140                         |
| 52     | II A                  | 58.15<br>KW-85                       | 275.17<br>KW-10 | 0.12<br>KW-70   | 2.00<br>KW-34   | 0.20                  | 0.95   | 154                         |
| 53     | P II A & I<br>TOP     | 106.33<br>KW-89                      | 275.45<br>KW-10 | 90.70<br>KW-10  | 133.79<br>KW-89 | 120.00                | 130.00 | 4                           |
| 54     | I TOP                 | 240.12<br>KW-89                      | 366.15<br>KW-10 | 0.53<br>KW-10   | 1.26<br>KW-89   | 0.50                  | 1.00   | 4                           |
| 55     | P I TOP & I<br>MID    | 191.95<br>KW-80                      | 366.68<br>KW-10 | 5.62<br>KW-10   | 18.76<br>KW-89  | 15.00                 | 16.00  | 4                           |
| 56     | I MID                 | 260.14<br>KW-89                      | 372.30<br>KW-10 | 0.62<br>KW-10   | 1.91<br>KW-89   | 0.50                  | 1.50   | 4                           |
| 57     | P I MID & I<br>BOT    | 211.99<br>KW-80                      | 372.92<br>KW-10 | 6.41<br>KW-80   | 20.07<br>KW-10  | 9.00                  | 15.00  | 3                           |
| 58     | I BOT                 | 271.28<br>KW-89                      | 392.99<br>KW-10 | 0.33<br>KW-89   | 0.49<br>KW-10   | 0.49                  | 0.49   | 3                           |

## SEAMWISE GENERAL OBSERVATIONS

### SEAM - XI T

Seam-XI T is the youngest coal seam known to occur in Revised Kalinga West Block. Seam-XI T has been encountered in two boreholes CMKR-20 with 3.20 m (in crop) thickness and CMKR-22 with 0.99 m thickness. The seam has not been considered for detail study because of its limited area of occurrence.

**SEAM – XI B**

Seam – XI B occurs below seam XI T with a general parting varying between 3 m and 15 m. Thickness of the coal seam is over 3 m. The seam occurs in a very small part in the north-western part hence has not been considered for detail assessment. However, relevant data have been incorporated in the concerned annexure and tables.

**SEAM – X B**

The seam occurs below seam–XI B with a general parting between 2 m & 4 m. The general thickness of the seam varies between 1 m & 1.5 m. This seam has also not been considered for detail assessment due to small area of occurrence. Details are incorporated in relevant annexure and tables.

**SEAM – XA**

The seam occurs below X B seam with a general parting between 8 m and 15 m. The seam is very thin i.e. less than 1m thick. Hence, it has not been included for detail assessment.

**SEAM - IX**

The seam occurs below seam XA with a general parting between 15 m & 20m. This is the thickest coal seam having general thickness between 20 m & 25 m. The seam is occurring in the northern part of the block. The seam is interbanded and contains 1 m and above bands up to 8 numbers constituting up to 44% of the total thickness. The M% & ash% on I<sub>100</sub> basis vary from 4.4 to 7.1 & 41.4 to 45.8 respectively. The GCV (K.Cal/kg) varies from 2990 to 4410, UHV (K.Cal/kg) varies from 1584 to 2248 and the grade varies between G & F. Carbon



% and hydrogen % on dmmf basis are 77.9 & 5.0 respectively. IDT° C, HT° C & FT° C vary between 1040 & 1290, 1400 & 1450 and 1400 & 1450 respectively. M<sub>100</sub>, unit VM % & unit CV K.Cal/kg varies between 15, 41.6 & 46.4 and 7078 & 7904 respectively which indicate that the seam may partly possess B5 group of long flame characteristics.

### **SEAM – VIII**

The seam underlies seam – IX with a general parting between 8 m & 10 m. The thickness of the seam varies between 7m & 9 m. Moisture and ash percentage on I<sub>100</sub> basis varies between 4.5 & 7.6 and 37.1 & 52.7 respectively. GCV K.Cal/kg ranges between 2370 & 3790; UHV Kcal/kg ranges between 910 & 2773. The general grade is G. Carbon & Hydrogen percentage on dmmf basis vary from 77.1 to 78.8 & 5.2 to 5.4 respectively, IDT°C, HT°C, FT°C varies from 1040 to 1150, >1420 to 71450 & >1450 respectively. M<sub>100</sub>, unit VM% and unit CV K.cal/kg varies from 14, 42.8 to 48.4 and 7256 to 7820 which indicate part of the coal of this seam may possess B5 group of long flame characteristics.

### **SEAM – VII B**

The seam underlies seam – VIII with a general parting between 4 m & 6 m. The general thickness of the seam ranges between 1 m & 2 m. M% & Ash% K.Cal/kg varies between 2333 & 3835; UHV K.cal/kg varies between 1 & 5160. The grade is ungraded to C and generally F-G. Carbon % & hydrogen % on dmmf basis vary from 76.5 to 79.3 and 5.2 to 5.3 respectively. IDT°C, HT°C, FT°C varies from 1120 to > 1450, >1450 and >1450 respectively. M<sub>100</sub>, UVM% and unit CV K.cal/kg vary from 14, 42.1 to 51.00 and 6900 to 7806 which indicate that part of the coal seam may possess B5 group of long flame characteristics.

### **SEAM – VII A**

The seam underlies seam-VII B with a general parting varying from 6 m to 10m. The general thickness of the coal seam ranges between 1m & 1.5m. The M% & Ash% on I<sub>100</sub> basis vary from 1 to 10.2 & 22.6 to 90.9 respectively. The GCV K.cal/kg ranges between 2625 & 4097. UHV K.cal/kg & grade range from 1 to 4374 & D to ungraded. However, the general grade is G.

### **SEAM – VI A**

The seam underlies seam-VII A with a parting varying from 28 m to 34 m. There are two unworkable coal seams viz. L1 & L2 within the parting. The general thickness of the coal seam ranges between 1.5 m & 2.5 m. The M% & Ash% on I<sub>100</sub> basis vary from 4.5 to 11.2 & 18.0 to 66.4 respectively. The GCV K.cal/kg ranges between 1680 & 4838. UHV K.cal/kg & grade vary from 1 to 4870 & D to ungraded. The general grade is F. Carbon % and Hydrogen % on dmmf basis vary from 76.1 to 78.5 & 5.0 to 5.3 respectively. IDT° C, HT° C and FT° C vary from 1120 to 1290, >1400 to > 1450 and >1400 to >1450 respectively. M<sub>100</sub>, UVM% and unit CV. K.Cal/kg vary from 14, 41.6 to 49.0 and 7108 to 7848 respectively which indicate part of the coal seam may possess B5 group of long flame characteristics.

### **SEAM – V B**

The seam occurs below seam-VI B with a general parting varying from 4 m to 7 m. The general thickness of the coal seam varies between 2 m & 3 m. M% & Ash% on I<sub>100</sub> basis vary from 4.5 to 11.5 & 15.0 to 56.2. The GCV K.cal/kg varies between 2440 & 5543. The UHV K.cal/kg and grade vary from 1296 to 5312 & C to ungraded respectively. The general grade is F-G. The Carbon % and Hydrogen % on dmmf basis vary from 77.5 to 79.2 & 5.0 to 5.2 respectively. IDT° C, HT° C and

FT° C vary from 1210, >1400 and > 1450 respectively. M<sub>100</sub>, UVM% and unit CV K.Cal/kg vary from 15, 41.0 to 54.7 and 6900 to 7820. The part of the coal seam may possess B5 group of long flame characteristics.

### **SEAM – V A**

Seam-V A underlies seam V B with a general parting between 2 and 4 m. The general thickness of the coal seam varies between 1.5 m and 2.5 m. The M% & Ash% on I<sub>100</sub> basis vary from 4.4 to 10.6 and 21.2 to 60.7 respectively. The GCV K.cal/kg varies between 2625 & 4059. The UHV K.cal/kg and grade vary from 1 to 4512 and ungraded to D respectively. The general grade is F-G. Carbon % and hydrogen % on dmmf basis vary from 77.8 to 78.2 & 5.1 to 5.2 respectively. IDT° C, HT° C and FT° C are 1230, >1400 and > 1400 respectively. M<sub>100</sub>, UVM% and UCV K.cal/kg vary from 16, 39.4 to 50.5 and 7114 to 7889. The part of the coal seam may possess B5 group of long flame characteristics.

### **SEAM – IV (A+B)**

Seam-IV (A+B) underlies seam V A with a general parting between 4 m and 7 m. The thickness of the coal seam varies between 2m & 5m. M% & Ash% on I<sub>100</sub> basis vary from 3.9 to 8.9 and 22.7 to 57.3 respectively. The GCV K.cal/kg varies between 2260 & 3708. The UHV K.cal/kg and grade vary from 289 to 4539 and D to ungraded respectively. However, the general grade is F-G. Carbon % and hydrogen % on dmmf basis vary from 79.3 to 81.1 & 4.9 to 5.4 respectively. M<sub>100</sub>, UVM% and UCV K.cal/kg vary from 14, 37.9 to 49.2 and 7049 to 7906. These data indicate that part of the coal seam may possess B5 group of long flame characteristics.

### **SEAM – III E**

The seam occurs below seam IV (A+B) with a general parting varying from 13 m to 18 m. The general thickness of the seam varies between 4 m and 6 m. M% & Ash% on I<sub>100</sub> basis vary from 4.7 m to 9.3 and 26.0 to 47.4 respectively. The GCV K.cal/kg varies between 3112 & 4889. UHV K.cal/kg & grade vary from 1600 to 4167 & E-G respectively. The grade is generally E-F. Carbon % and hydrogen % on dmmf basis vary from 79.9 to 80.7 and 5.1 to 5.4 respectively. IDT° C, HT° C and FT° C vary from 1100, >1400 to >1450 and >1450 respectively. M<sub>100</sub>, UVM% and UCV K.cal/kg vary from 13, 37.9 to 46.7 and 7405 to 7957. These data indicate that this seam may possess B5 group of long flame characteristics.

### **SEAM – III D**

The seam underlies seam III E with a general parting varying from 4m to 7m. The seam is generally thin & the general thickness varies between 0.5m to 2 m but workable over considerable area. M% & Ash% on I<sub>100</sub> basis vary from 4.0 to 11.4 & 17.5 to 48.5. GCV K.cal/kg varies between 3010 & 4783. UHV K.cal/kg and grade vary from 1186 to 5119 & ungraded to C respectively. The grade is generally E - F. Carbon % and hydrogen % on dmmf basis vary from 78.9 to 79.4 and 5.0 to 5.2 respectively. IDT° C, HT° C and FT° C vary from 1060 to 1270, >1400 to >1450 and >1400 to > 450 respectively. M<sub>100</sub>, UVM% and UCV K.cal/kg vary from 14, 39.8 to 46.1 and 7286 to 8050. The above data indicate that part of the coal seam may possess B5 group of long flame characteristics.

### **SEAM – III A**

The seam occurs below seam III D with a general parting varying from 8 m & 17 m. The general thickness of the seam varies between 1 m to 2 m. M% & Ash% on I<sub>100</sub> basis vary from 3.8 to 15.0 & 20.3 to 53.2. GCV K.cal/kg & UHV



K.cal/kg varies from 2685 to 4810 & 523 to 4788 respectively. The general grade of coal is F - G. Carbon % and hydrogen % on dmmf basis vary from 78.2 to 80.9 & 4.6 to 5.4 respectively. IDT° C, HT° C and FT° C vary from 1130 to 1150, >1400 to > 1450 and >1400 to > 1450 respectively. M<sub>100</sub>, UVM% and UCV K.cal/kg vary from 14, 39.3 to 52.3 and 7182 to 7988. The above data indicate that part of the coal seam may possess B5 group of long flame characteristics.

### **SEAM – II E**

The seam underlies seam III A with a general parting varying between 14m & 20 m. The general thickness of the seam varies between 10 m & 12 m. M% & Ash% on I<sub>100</sub> basis vary from 4.8 to 9.1 & 32.1 to 49.8. GCV K.cal/kg & UHV K.cal/kg varies from 2850 to 4258 & 1255 to 3311 respectively. General grade is F - G. Carbon % and hydrogen % on dmmf basis vary from 79.1 to 81.2 & 4.8 to 5.4 respectively. M<sub>100</sub>, UVM% and UCV K.cal/kg vary from 13, 40.4 to 45.2 & 7422 to 7931. The above data indicate that the coal of seam-II may possess B5 group of long flame characteristics.

### **SEAM – II D**

The seam occurs below seam II E with a general parting varying between 0.5 m & 5.0 m. The general thickness of the seam varies between 2 m & 4 m. M% & Ash% on I<sub>100</sub> basis vary from 4.0 to 11.4 & 17.5 to 48.5 respectively. GCV K.cal/kg & UHV K.cal/kg varies from 3010 to 4783 & 1186 to 5119 respectively. The general grade of coal is E -F. Carbon % and hydrogen % on dmmf basis vary from 77.8 to 80.0 & 4.4 to 5.3 respectively. M<sub>100</sub>, UVM% and UCV K.cal/kg vary from 13, 41.2 & 7650 to 7781 respectively. The above data indicate that the coal of seam-II D may possess B5 group of long flame characteristics.



**SEAM – II C**

The seam is underlying seam II D with a general parting varying between 6 m & 14 m. The general thickness of the seam varies between 2 m & 4 m. M% & Ash% on I<sub>100</sub> basis vary from 3.5 to 9.2 and 22.6 to 62.4 respectively. GCV K.cal/kg & UHV K.cal/kg varies from 3050 to 5160 & 1 to 4594 respectively. The general grade ranges between F - G. Carbon % and hydrogen % on dmmf basis are 81.5 & 5.3 respectively. IDT° C, HT° C and FT° C vary from 1050 to 1190, >1450 and >1450 respectively. M<sub>100</sub>, UVM% and UCV K.cal/kg vary from 13, 41.2 to 48.2 and 7505 to 8098. These data indicate that the coal of seam-II C may possess B5 group of long flame characteristics.

**4.5 GEOLOGICAL RESERVES****4.5.1 BRIEF METHODOLOGY FOR RESERVE ESTIMATION**

Standard procedures have been adopted for calculating the reserves of the block under report. Isochore (thickness on I<sub>100</sub> i.e. excluding dirt band thickness of 1 m & above from the total thickness) contours are drawn along with other contours viz. iso-grad & iso-seam dirt bands (aggregate thickness of 1 m and above thickness) and are dovetailed on sectors and barriers.

Different minor polygon thus formed was measured for area calculation by AutoCAD software. The area is multiplied by the average thickness to obtain volume. The volume is then multiplied by the specific gravity of desired grade to achieve the gross reserve.

#### 4.5.2 NET GEOLOGICAL RESERVES (SEAM-WISE, GRADE-WISE) KALINGA EAST

| Seam      | Grade-wise Net Proved Reserves in million tonnes |       |        |         |         |             |
|-----------|--|-------|--------|---------|---------|-------------|
|           | C  | D     | E      | F       | G       | Total (mt.) |
| IX        | 0.000  | 0.055 | 0.493  | 3.613   | 69.816  | 73.977      |
| VIII      | 0.000  | 0.255 | 2.269  | 6.651   | 51.722  | 60.897      |
| VII       | 0.000  | 0.000 | 0.065  | 7.800   | 21.957  | 29.822      |
| VI B      | 0.000  | 0.000 | 0.063  | 1.037   | 10.618  | 11.718      |
| V B       | 0.000  | 0.000 | 0.013  | 0.945   | 4.333   | 5.291       |
| V A       | 0.005  | 0.585 | 4.118  | 11.961  | 4.751   | 21.420      |
| IV B      | 0.000  | 0.000 | 0.000  | 0.073   | 53.624  | 53.697      |
| IV A      | 0.000  | 0.000 | 0.470  | 20.443  | 7.990   | 28.903      |
| III E     | 0.000  | 0.000 | 25.041 | 54.646  | 1.114   | 80.801      |
| III D     | 0.000  | 0.081 | 1.934  | 4.917   | 1.390   | 8.322       |
| III C     | 0.000  | 0.003 | 2.377  | 3.425   | 4.385   | 10.190      |
| III A     | 0.000  | 0.063 | 5.423  | 11.627  | 1.820   | 18.933      |
| II D+E    | 0.000  | 1.187 | 17.195 | 263.221 | 50.044  | 331.647     |
| II C      | 0.000  | 0.000 | 0.734  | 118.248 | 24.098  | 143.080     |
| II B      | 0.000  | 0.000 | 0.126  | 8.597   | 17.224  | 25.947      |
| ALL SEAMS | 0.005  | 2.229 | 60.321 | 517.204 | 324.886 | 904.645     |

#### KALINGA WEST

| Seam   | Grade-wise Net Proved Reserves in million tonnes |       |        |        |        |             |
|--------|--|-------|--------|--------|--------|-------------|
|        | C  | D     | E      | F      | G      | Total (mt.) |
| IX     | 0.000  | 0.000 | 0.235  | 5.292  | 49.503 | 55.030      |
| VIII   | 0.000  | 0.000 | 0.009  | 5.530  | 36.298 | 41.837      |
| VII B  | 0.000  | 0.000 | 0.083  | 1.861  | 4.050  | 5.994       |
| VII A  | 0.000  | 0.000 | 0.148  | 1.767  | 3.223  | 5.138       |
| VI B   | 0.000  | 0.007 | 1.226  | 3.209  | 7.366  | 11.808      |
| V B    | 0.000  | 0.003 | 2.366  | 8.567  | 14.354 | 25.422      |
| V A    | 0.000  | 0.005 | 0.188  | 8.314  | 12.968 | 21.475      |
| IV A+B | 0.000  | 0.002 | 0.005  | 0.104  | 40.061 | 40.172      |
| III E  | 0.000  | 0.000 | 31.216 | 35.635 | 0.260  | 67.111      |
| III D  | 0.003  | 0.114 | 8.070  | 14.006 | 0.197  | 22.390      |

|                  |              |              |               |                |                |                |
|------------------|--------------|--------------|---------------|----------------|----------------|----------------|
| IIIA             | 0.000        | 0.000        | 5.749         | 11.435         | 14.914         | 32.098         |
| II E             | 0.000        | 0.000        | 0.000         | 114.764        | 45.807         | 160.571        |
| II D             | 0.000        | 0.000        | 0.440         | 32.260         | 8.290          | 40.976         |
| II C             | 0.000        | 0.048        | 14.679        | 37.642         | 7.893          | 60.262         |
| <b>ALL SEAMS</b> | <b>0.003</b> | <b>0.179</b> | <b>64.414</b> | <b>280.386</b> | <b>245.184</b> | <b>590.284</b> |

#### 4.5.3 SPECIAL OBSERVATION ON COAL SEAMS KALINGA EAST BLOCK

Out of total 15 no. of coal seams considered for reserve assessment, seam II D+E and II C are the most potential coal seams within the block, which together contributes over 53% of the coal reserve. Other than these seams, seam III E also contributes considerably and thereafter seam IV B and seams VIII & IX also contribute to total reserves of the block. The quality of the seam is largely F to G excepting for seam I which is expected to be of better quality, but the coal seam has not been explored in detail.

#### KALINGA WEST BLOCK

Out of total 14 no. of coal seams considered for reserve assessment, seam-II in different splits and combinations is the most potential seam within the block, which together contributes over 44% of the coal reserve. Other than seam-II, seam - III also contributes considerably and thereafter seam - IVB and seam - VIII & IX to certain extent. The quality of the seam is largely F-G excepting for seam - I that is expected to be of better quality but not have been explored in detail.

All the seams are highly interbanded and bituminous type with possibility of long flame coal in certain sections.

## Chapter - 5

### MINING TECHNOLOGY

#### 5.1 GENERAL

Kalinga OCP (8Mty), sanctioned in March 1992 was completed as per schedule in March 2000. Due to R&R problem in the north of the approved project, MCL sanctioned an extension report in 2007 towards the west of erstwhile Balram OCP.

In the meeting taken by D (T/P&D), MCL with CMPDIL, vide minutes of the meeting ref. no: MCL/SBP/CGM (CP&P)/2008/861 dated: 18.12.08, it was decided that a combined Expn Report will be prepared by CMPDIL during 2009-10 comprising of left out portion of Kalinga east/west and part of Konark block.

Later it was decided by MCL to attach a virgin portion of Kalinga East Geological block with the Bharatpur OCP and to formulate the Balram Expansion OCP with the left out portion of Kalinga east/west and part of Konark block. Accordingly P.R of Balram Expn. OCP (15Mty) was prepared and approved by MCL Board in February,2020.

Mining plan and Mine closure plan for Balram Expn. OCP (15Mty normative, 20 Mty peak) was prepared in March 2016 and subsequently approved by Advisor (Projects), MoC, Vide Ref.No.34012/(04)/2011-CPAM,GOI,MoC,N.Delhi Dt.09/03/2016.This Mining plan is revision-1 to Mining plan and Mine Closure Plan for Balram Expn. OCP (15Mty normative, 20 Mty peak)

#### 5.2 DEPOSIT CHARACTERISTICS

The gradient of the quarry floor varies from flat 1 in 21 to as steep as 1 in 7. The gradient of the floor varies between different pair of faults. The

average gradient upto fault F15 & F17 (in east block F15 is F10 and F17 is F23) is 1 in 14 to 1 in 18. Between F15 & F17 (in the east block F10 & F23) the gradient is as high as 1 in 7. Beyond F17 the gradient varies from 1 in 7 to 1 in 21.

The property under consideration for expansion report encounters a good number of faults. Most of the faults are upthrow in nature. However, a down throw fault F15-F15 (F10-F10 in east block) of about 45m is encountered in the dip side of the proposed quarry.

Faults encountered within the **quarry** area are as follows:

| Fault name as per West block | Fault name as per East block | Trend                             | Throw      |            |
|------------------------------|------------------------------|-----------------------------------|------------|------------|
|                              |                              |                                   | Direction  | Amount (m) |
| F7-F7                        | F4-F4                        | E-W & NW-SE towards southern side | South-west | 7-40 m     |
| F8-F8                        |                              | SW-NE                             | SE         | 7-10m      |
| F9-F9                        |                              | E-W                               | N          | 0-5m       |
|                              | F6-F6                        | NEN-SWS                           | W          | 0-15m      |
| F10-F10                      | F7-F7                        | E-W                               | S          | 35-55 m    |
|                              | F8-F8                        | WNW-ESE                           | S          | 5-25m      |
| F11-F11                      |                              | SW-NE                             | NW         | 0-5m       |
| F12-F12                      |                              | NW-SE                             | SW         | 0-5m       |
| F13-F13                      |                              | E-W                               | S          | 0-8 m      |
| F14-F14                      |                              | SW-NE                             | SE         | 15m        |
| F15-F15                      | F10-F10                      | NW-SE                             | NE         | 20-45 m    |
| F16-F16                      |                              | E-W                               | S          | 5 m        |
| F17-F17                      | F23-F23                      | E-W                               | S          | 5-100m     |
| F18-F18                      | F28-F28                      | E-W                               | S          | 5-15 m     |
| F19-F19                      |                              | NW-SE                             | NE         | 2-65 m     |
| F20-F20                      | F26-F26                      | NW-SE TO E-W                      | NE to N    | 0-15 m     |
| F21-F21                      |                              | E-W                               | S          | 5-20 m     |
| F22-F22                      |                              | E-W                               | S          | 5-15 m     |
| F23-F23                      |                              | NW-SE                             | SW         | 20-25 m    |
|                              | F32-F32                      | NW-SE                             | NE         | 10-25 m    |



Details of dirt bands are tabulated as follows:

Dirt bands in the Kalinga east block

|        | Seam Thickness |          | Bands( $\geq 1$ m in thickness) |          |           |          |          |          |
|--------|----------------|----------|---------------------------------|----------|-----------|----------|----------|----------|
|        | Min.           | Max.     | No.                             |          | Thick (m) |          | %        |          |
|        | (m)            | (m)      | Min.                            | Max.     | Min.      | Max.     | Min.     | Max.     |
| IX     | 14.30          | 23.85    | 0                               | 3        | 0.00      | 8.63     | 0        | 54       |
|        | CMTK-260       | CMTK-259 | CMTK-051                        | CMTK-298 | CMTK-051  | CMTK-288 | CMTK-051 | CMTK-288 |
| VIII   | 2.17           | 11.17    | 0                               | 3        | 0.00      | 2.22     | 0        | 32       |
|        | METS-020       | CMTK-308 | CMTK-007                        | SW-034   | CMTK-007  | CMTK-187 | CMTK-007 | CMTK-198 |
| VII    | 0.88           | 6.89     | 0                               | 1        | 0.00      | 1.08     | 0        | 19       |
|        | CMTK-300       | CMTK-263 | CMTK-007                        | CMTK-202 | CMTK-007  | CMTK-202 | CMTK-007 | CMTK-202 |
| IV B   | 1.08           | 7.70     | 0                               | 1        | 0.00      | 2.71     | 0        | 56       |
|        | CMTK-164       | CMTK-250 | CMTK-003                        | CMTK-209 | CMTK-003  | CMTK-209 | CMTK-003 | CMTK-209 |
| III E  | 1.70           | 7.31     | 0                               | 1        | 0.00      | 1.30     | 0        | 18       |
|        | CMTK-138       | CMTK-264 | CMTK-003                        | CMTK-264 | CMTK-003  | CMTK-264 | CMTK-003 | CMTK-264 |
| III A  | 0.12           | 3.91     | 0                               | 1        | 0.00      | 1.18     | 0        | 31       |
|        | CMTK-237       | KR-018   | CMTK-007                        | CMTK-266 | CMTK-007  | CMTK-266 | CMTK-007 | CMTK-266 |
| II D+E | 8.50           | 18.65    | 0                               | 1        | 0.00      | 2.98     | 0        | 25       |
|        | CMTK-290       | CMTK-202 | CMTK-002                        | CMTK-145 | CMTK-002  | CMTK-136 | CMTK-002 | CMTK-136 |
| II C   | 1.71           | 12.15    | 0                               | 1        | 0.00      | 1.71     | 0        | 33       |
|        | CMTK-040       | CMTK-077 | CMTK-003                        | CMTK-141 | CMTK-003  | CMTK-141 | CMTK-003 | CMTK-144 |

In seam band situation in Kalinga west are as follows:

| Seam Name | Total Seam Thickness |          | Thickness of dirt bands>1m thick |          |           |          |              |            |     | Nos. of Bh |
|-----------|----------------------|----------|----------------------------------|----------|-----------|----------|--------------|------------|-----|------------|
|           |                      |          | Excluded                         |          |           |          |              |            |     |            |
|           | Min.                 | Max.     | No.                              |          | Thick (m) |          | Percentage   |            |     |            |
|           | (m)                  | (m)      | Min.                             | Max.     | Min.      | Max.     | Min.         | Max.       |     |            |
| IX        | 1.35                 | 24.92    | 0                                | 8        | 0.00      | 10.40    | 0            | 44         | 45  |            |
|           | CMKR-014             | KW-025   | CMKW-040                         | CMKR-001 | CMKW-040  | CMKR-001 | KW-9.30      | CMKR-1     |     |            |
| VIII      | 4.62                 | 12.76    | 0                                | 11       | 0.00      | 7.20     | 0            | 78         | 51  |            |
|           | CMKR-068             | CMKR-022 | CMKW-039                         | CMKR-071 | CMKW-039  | CMKR-071 | CMKR-2.10    | CMKR-71    |     |            |
| VIIB      | 1.04                 | 4.63     | 0                                | 3        | 0.00      | 1.96     | 0            | 87         | 46  |            |
|           | KW-051               | CMKR-070 | CMKW-023                         | CMKW-034 | CMKW-023  | CMKW-034 | CMKR-1.2,11  | CMKR-18    |     |            |
| VIIA      | 1.00                 | 2.46     | 0                                | 2        | 0.00      | 1.40     | 0            | 0          | 29  |            |
|           | KW-059               | CMKW-034 | CMKW-023                         | CMKR-014 | CMKW-023  | CMKR-014 | CMKW-8,16,70 | KW-7,10,25 |     |            |
| VIB       | 1.03                 | 5.40     | 0                                | 10       | 0.00      | 3.47     | 0            | 74         | 50  |            |
|           | CMKW-068             | CMKR-046 | CMKW-025                         | CMKR-022 | CMKW-025  | CMKR-022 | CMKR-1.2,11  | CMKR-22    |     |            |
| VB        | 1.07                 | 5.72     | 0                                | 6        | 0.00      | 2.87     | 0            | 0          | 104 |            |
|           | KW-032               | CMKR-018 | CMKW-003                         | CMKW-047 | CMKW-003  | CMKW-047 | CMKW-3.4     | CMKR-10,11 |     |            |
| VA        | 1.04                 | 5.00     | 0                                | 3        | 0.00      | 2.92     | 0            | 0          | 121 |            |
|           | KW-032               | CMKW-017 | CMKW-001                         | CMKW-052 | CMKW-001  | CMKW-052 | CMKW-30      | CMKR-10,11 |     |            |
| IVAB      | 1.12                 | 7.92     | 0                                | 6        | 0.00      | 4.75     | 0            | 38         | 130 |            |
|           | CMKW-052             | CMKR-021 | CMKW-001                         | CMKW-012 | CMKW-001  | CMKW-012 | CMKW-37      | CMKW-44    |     |            |
| IIIE      | 2.20                 | 7.73     | 0                                | 1        | 0.00      | 3.50     | 0            | 17         | 149 |            |
|           | KW-024               | KW-065   | CMKW-001                         | CMKW-040 | CMKW-001  | CMKW-040 | CMKW-1.2,3   | KW-50      |     |            |
| IIID      | 1.00                 | 5.60     | 0                                | 1        | 0.00      | 1.10     | 0            | 0          | 126 |            |
|           | CMKW-063             | CMKR-065 | CMKW-001                         | CMKW-047 | CMKW-001  | CMKW-047 | CMKW-1.2     | CMKW-3.4   |     |            |
| IIIA      | 1.04                 | 6.23     | 0                                | 1        | 0.00      | 1.05     | 0.00         | 18         | 146 |            |
|           | CMKW-026             | CMKR-018 | CMKW-001                         | KW-059   | CMKW-001  | KW-059   | CMKW-1.2     | KW-59      |     |            |

| Seam Name | Total Seam Thickness |          | Thickness of dirt bands>1m thick |          |          |          |            |          | Nos. of Bh |
|-----------|----------------------|----------|----------------------------------|----------|----------|----------|------------|----------|------------|
|           |                      |          | Excluded                         |          |          |          |            |          |            |
|           |                      |          |                                  |          |          |          |            |          |            |
| IIE       | 1.89                 | 15.60    | 0                                | 2        | 0.00     | 2.00     | 0          | 17       | 155        |
|           | KW-091               | CMKW-009 | CMKW-001                         | CMKW-024 | CMKW-001 | CMKW-024 | CMKW-1,2,3 | KW-48,60 |            |
|           |                      |          |                                  |          |          |          |            |          |            |
| IID       | 1.12                 | 10.08    | 0                                | 2        | 0.00     | 2.00     | 0          | 38       | 152        |
|           | KW-001               | CMTH-032 | CMKW-001                         | KW-011   | CMKW-001 | KW-011   | CMKW-1,2,3 | KW-24    |            |
|           |                      |          |                                  |          |          |          |            |          |            |
| IIC       | 1.00                 | 8.50     | 0                                | 1        | 0.00     | 1.73     | 0          | 36       | 137        |
|           | CMKW-054             | CMKW-013 | CMKW-001                         | CMKW-014 | CMKW-001 | KW-042   | CMKW-1,2,3 | KW-79    |            |

Thickness, quality characteristics of the seams and thickness of corresponding Tob/parting is as follows:

| SL. No. | Particulars             | Unit | Min | Max | Average/Usual |
|---------|-------------------------|------|-----|-----|---------------|
| 1.0     | <b>Strata thickness</b> |      |     |     |               |
|         | WM                      | m    | 0   | 20  | 15.00         |
|         | Seam IX                 | m    | 20  | 22  | 20.00         |
|         | Parting                 | m    | 8   | 10  | 9.00          |
|         | Seam VIII               | m    | 7   | 9   | 8.00          |
|         | Parting with VIIB       | m    | 4   | 6   | 5.00          |
|         | Parting with VII        | m    | 2   | 4   | 3.00          |
|         | Seam VIIB               | m    | 1   | 2   | 1.50          |
|         | Parting                 | m    | 6   | 14  | 10.00         |
|         | Seam VIIA               | m    | 1   | 1.5 | 1.00          |
|         | Parting with VIB        | m    | 28  | 34  | 30.00         |
|         | Seam VII                | m    |     |     |               |
|         | Parting                 | m    | 29  | 36  | 30.00         |
|         | Seam VIB                | m    | 1.5 | 2.5 | 2.00          |
|         | Parting                 | m    | 4   | 7   | 5.00          |
|         | Seam VB                 | m    | 2   | 3   | 2.00          |
|         | Parting                 | m    | 2   | 4   | 3.00          |
|         | Seam VA                 | m    | 1.5 | 2.5 | 2.00          |
|         | Parting with IVB        | m    | 9   | 12  | 10.00         |
|         | Parting with IVA+B      | m    | 4   | 7   | 5.00          |
|         | Seam IVA+B              | m    | 2   | 5   | 4.00          |
|         | Parting with IIIIE      | m    | 13  | 18  | 14.00         |
|         | Seam IVB                | m    | 2   | 6   | 4.00          |
|         | Parting with IVA        | m    | 1   | 3   | 2.00          |
|         | Seam IVA                | m    | 1   | 3   | 2.00          |
|         | Parting                 | m    | 9   | 15  | 12.00         |
|         | Seam IIIIE              | m    | 4   | 6   | 5.00          |
|         | Parting                 | m    | 4   | 7   | 5.00          |

| SL. No. | Particulars        | Unit  | Min  | Max  | Average/Usual |
|---------|--------------------|-------|------|------|---------------|
|         | Seam IIID          | m     | 0.5  | 2    | 1.00          |
|         | Parting            | m     | 4    | 6    | 6.00          |
|         | Seam IIIC          | m     | 0.3  | 0.8  | --            |
|         | Parting            | m     | 4    | 7    | 6.00          |
|         | Seam IIIB          | m     | 0.4  | 0.85 | --            |
|         | Parting            | m     | 1    | 5    | 3.00          |
|         | Seam IIIA          | m     | 1    | 2    | 1.00          |
|         | Parting with IID+E | m     | 18   | 23   | 20.00         |
|         | Parting with IIE   | m     | 14   | 20   | 17            |
|         | Seam IIE           | m     | 10   | 12   | 10            |
|         | Parting            | m     | 0.5  | 5.00 | 3.00          |
|         | Seam IID           | m     | 2    | 4    | 3.00          |
|         | Parting with IIC   | m     | 6    | 14   | 8.00          |
|         | Seam IID+E         | m     | 15   | 17   | 16.00         |
|         | Parting with IIC   | m     | 1    | 6    | 4.00          |
|         | Seam IIC           | m     | 2    | 4    | 3.00          |
| 2.0     | Seam Gradient      | deg.  | 2.75 | 8    | 4-5           |
| 3.0     | Specific Gravity   |       |      |      |               |
|         | -OB                | t/cum | 2.4  |      | --            |
|         | -Coal              | t/cum | 1.65 | 1.75 | 1.71          |
|         | Seam IX            |       |      |      | 1.74          |
|         | Seam VIII          |       |      |      | 1.74          |
|         | Seam VIIIB         |       |      |      | 1.73          |
|         | Seam VII           |       |      |      | 1.73          |
|         | Seam VIIA          |       |      |      | 1.72          |
|         | Seam VIB           |       |      |      | 1.73          |
|         | Seam VB            |       |      |      | 1.72          |
|         | Seam VA            |       |      |      | 1.70          |
|         | Seam IVB           |       |      |      | 1.75          |
|         | Seam IVA+B         |       |      |      | 1.75          |
|         | Seam IVA           |       |      |      | 1.70          |
|         | Seam IIIE          |       |      |      | 1.65          |
|         | Seam IIID          |       |      |      | 1.66          |
|         | Seam IIIC          |       |      |      | 1.69          |
|         | Seam IIIA          |       |      |      | 1.69          |
|         | Seam IIE           |       |      |      | 1.70          |
|         | Seam IID+E         |       |      |      | 1.69          |
|         | Seam IID           |       |      |      | 1.69          |
|         | Seam IIC           |       |      |      | 1.68          |
| 4.0     | Coal Quality       |       |      |      |               |
|         | Seam IX            |       | E    | G    | G             |
|         | Seam VIII          |       | E    | G    | G             |
|         | Seam VIIIB         |       | E    | G    | G             |
|         | Seam VII           |       | F    | G    | G             |
|         | Seam VIIA          |       | E    | G    | G             |
|         | Seam VIB           |       | D    | G    | G             |

| SL. No. | Particulars | Unit                     | Min | Max | Average/Usual |
|---------|-------------|--------------------------|-----|-----|---------------|
|         | Seam VB     |                          | D   | G   | G             |
|         | Seam VA     |                          | D   | G   | G             |
|         | Seam IVB    |                          | F   | G   | G             |
|         | Seam IVA+B  |                          | D   | G   | G             |
|         | Seam IVA    |                          | F   | G   | G             |
|         | Seam IIIE   |                          | E   | G   | F             |
|         | Seam IIID   |                          | C   | G   | F             |
|         | Seam IIIC   |                          | D   | G   | F-G           |
|         | Seam IIIA   |                          | E   | G   | F             |
|         | Seam IIE    |                          | F   | G   | F             |
|         | Seam IID+E  |                          | D   | G   | F             |
|         | Seam IID    |                          | E   | G   | F             |
|         | Seam IIC    |                          | D   | G   | F             |
| 5.0     | Category    |                          |     |     |               |
|         | OB          | Cat-III 50% & Cat-IV 50% |     |     |               |
|         | Coal        | Cat- III 100%            |     |     |               |

Selection of mining method, mining equipment and layout for this project are based on the geo-mining characteristics, site conditions, target capacity and optimisation of mining operations.

### 5.3 MINING METHOD

Seams of this project have gradients ranging from 2.75 to 8 degrees. The gradient, multiple seams of variable thickness ranging from 1m to 20m, occurrence at shallow depth etc. makes the project viable for opencast mining.

### 5.4 CHOICE OF TECHNOLOGY & PIT FORMULATION STRATEGY

Flat to Steeper gradient of the deposit make the mining suitable for the shovel-dumper combination. Other technologies like Dragline, Bucket Wheel Excavator are not suitable under the given geo-mining conditions. Surface Miner by outsourcing agencies has been tried and found applicable in most of the Talcher deposits. Although at places the gradient of the seams become steeper it is proposed to extract coal of the thick seams by deploying surface miner.



## **PIT FORMULATION STRATEGY**

The present expansion report has been prepared, keeping in view the status of land acquisition and R&R problem associated with the project. Accordingly the adopted strategies are as follows:

1. The existing advance of the mine in the west direction is to be maintained but gradually the working face is to be orientated in the strike direction from the existing dip direction. The left out portions in between western block boundary and western lease boundary has to be included in future as this area is required for future coal evacuation.
2. After 5 years, once the face is oriented in the strike direction, the entire strike of about 4 km of the proposed quarry would be taken at a time. It is expected that within this period of 5 years the R&R problem associated with the northern part of the original Kalinga OCP will be resolved. Location of the Reclaim feeders proposed for coal evacuation at this stage requires adjustment of existing internal dump.
3. Through a portion of the west geological block the coal transportation route of Hingula OCP has been proposed. This proposed route forms part of the boundary in the west and south of the proposed quarry. The left out reserves in the south beyond the proposed transportation route is to be taken along with south quarry of Hingula OCP in its stage II operation.

## **5.5 DELINEATION OF MINE BOUNDARIES**

Mine boundaries are finalised as per approved P.R of Balram OC Expansion (15Mty) and as per plan provided by MCL.

1. In the west, other than the proposed transportation rout of Hingula OCP the common boundary of the geological blocks of Gopalprasad East and Kalinga West forms the west boundary of the proposed quarry. A barrier of 100m has been left from Singadha Jore at the North-west corner of the block. A distance of 300 m from the famous Hingula temple has also been maintained while tracing the west boundary as decided by MCL.
2. In the east the boundary has been fixed after leaving some of the property of Kalinga East geological block for Bharatpur OCP as decided by MCL. Western boundary of Bharatpur Expansion OCP (26Mty) is considered as eastern boundary of Balram OC Expansion as desired by MCL.
3. The quarry boundary in the north is the boundary of the geological blocks of Kalinga east & west blocks and Konark block.
4. The existing quarry surface and the proposed coal transportation rout from Hingula OCP form the quarry boundary in the south.  
Safety barrier of 7.5mt left from the boundary of Expansion area to fix the excavation area of expansion quarry.

The brief of the boundary is as follows:

- North: Konark block
- South: The existing quarry and the coal transportation rout from Hingula OCP.
- East: The west boundary of the proposed Bharatpur expansion OCP (26Mty)
- West: Proposed coal transportation rout from Hingula OCP, Hingula temple, Singadha Jore and boundary of Hingula OCP after leaving required barriers and maintaining safety distances.

## 5.6 MINEABLE RESERVES

For majority of the quarry, seam IIC has been considered as the base seam. In the south west corner of the proposed quarry seam IIE has been considered as base as the other seams below have thinned out with increase in parting leading to higher cutoff ratio. A small portion in the south, seam IID forms the base of the quarry for similar reasons.

### GEOLOGICAL LOSS

Net geological reserves has been arrived at after providing 10% loss on Gross Reserve to account for geological uncertainties.

### MINEABLE RESERVES

Seams having thickness less than 1m have not been considered for mineable reserves estimation. The mineable reserves as on 01.04.18 are as follows:

| Name of Seam | Avg. Thickness(ex-band) | Geo Res       | Mineable Res  |
|--------------|-------------------------|---------------|---------------|
|              | m.                      | MT.           | MT.           |
| IX           | 15.70                   | 76.38         | 73.80         |
| VIII         | 8.50                    | 69.19         | 66.85         |
| VIIB         | 1.60                    | 5.61          | 5.42          |
| VII          | 3.85                    | 13.16         | 12.72         |
| VIIA         | 1.30                    | 3.60          | 3.48          |
| VIB          | 1.90                    | 14.71         | 14.21         |
| VB           | 2.10                    | 22.44         | 21.68         |
| VA           | 2.40                    | 29.62         | 28.62         |
| IVB          | 4.50                    | 26.57         | 25.67         |
| IVA+B        | 4.20                    | 35.49         | 34.29         |
| IVA          | 1.60                    | 3.92          | 3.79          |
| IIIE         | 5.10                    | 77.06         | 74.46         |
| IIID         | 1.80                    | 18.93         | 18.29         |
| IIIC         | 1.20                    | 1.58          | 1.53          |
| IIIA         | 2.00                    | 31.25         | 30.20         |
| IIE          | 11.40                   | 103.55        | 100.05        |
| IID+E        | 15.40                   | 110.89        | 107.14        |
| IID          | 2.30                    | 18.49         | 17.87         |
| IIC          | 5.10                    | 83.77         | 80.93         |
| <b>Total</b> |                         | <b>746.21</b> | <b>721.00</b> |

Seam-wise, sector-wise mineable reserves are as follows:

| SEAM         | SECTOR       |               |              |               |               | TOTAL         |
|--------------|--------------|---------------|--------------|---------------|---------------|---------------|
|              | 1            | 2             | 3            | 4             | Balance       |               |
| IX           | 0.00         | 0.06          | 5.25         | 15.56         | 52.93         | 73.80         |
| VIII         | 0.00         | 3.26          | 8.71         | 16.46         | 38.42         | 66.85         |
| VIIIB        | 0.00         | 0.02          | 1.14         | 1.55          | 2.71          | 5.42          |
| VII          | 0.00         | 1.08          | 1.75         | 2.72          | 7.17          | 12.72         |
| VIIA         | 0.00         | 0.07          | 1.20         | 1.37          | 0.84          | 3.48          |
| VIB          | 0.09         | 0.43          | 1.88         | 3.34          | 8.47          | 14.21         |
| VB           | 1.13         | 2.20          | 4.03         | 4.83          | 9.49          | 21.68         |
| VA           | 1.42         | 5.37          | 4.23         | 5.65          | 11.95         | 28.62         |
| IVB          | 0.18         | 5.87          | 2.7          | 5.26          | 11.66         | 25.67         |
| IVA+B        | 2.81         | 5.15          | 6.18         | 6.75          | 13.40         | 34.29         |
| IVA          | 0.07         | 1.33          | 0.44         | 1.13          | 0.82          | 3.79          |
| IIIE         | 7.66         | 14.35         | 10.21        | 12.41         | 29.83         | 74.46         |
| IIID         | 0.57         | 1.68          | 2.7          | 2.9           | 10.44         | 18.29         |
| IIIC         | 0.52         | 0.89          | 0.06         | 0.04          | 0.02          | 1.53          |
| IIIA         | 4.07         | 4.78          | 3.62         | 4.38          | 13.35         | 30.20         |
| IIIE         | 16.89        | 17.07         | 15.78        | 15.53         | 34.78         | 100.05        |
| IID+E        | 19.99        | 27.93         | 8.51         | 8.83          | 41.88         | 107.14        |
| IID          | 2.89         | 2.81          | 2.46         | 2.82          | 6.89          | 17.87         |
| IIC          | 13.27        | 15.22         | 9.26         | 10.15         | 33.03         | 80.93         |
| <b>TOTAL</b> | <b>71.56</b> | <b>109.57</b> | <b>90.11</b> | <b>121.68</b> | <b>328.08</b> | <b>721.00</b> |

The Mineable reserves shown above and corresponding OB of 1514.60 Mcum are as per approved P.R of Balram OC Expn. (15Mty) as on 01.04.2018.

The last two years performance of the OCP is as follows:

| Year     | 2018-19 | 2019-20 |
|----------|---------|---------|
| Coal(Mt) | 3.632   | 5.234   |
| OB(Mm3)  | 8.371   | 9.973   |

Hence, total Extractable coal as on 01.04.2020 is 712.134 Mt and corresponding OB is 1496.257 Mcum within the boundaries mentioned above.

The left out portions in between western block boundary and western lease boundary has to be included in future as this area is required for future coal evacuation and extraction. Project proponent mentioned that DGPS survey has not been done for this area hence the area was not included in

present land schedule. It was also mentioned by project proponents that the area left out between approved 8Mty southern excavation boundary and existing southern boundary considered for this project is non-viable for extraction.

## 5.7 QUALITY ANALYSIS

In-seam dirt bands having thickness less than 1m are included in the coal seam, whereas, the same having 1m and above in thickness (ISB) are excluded from the effective thickness of coal seam for all the purposes. These in-seam dirt bands are generally carb. shale, grey shale and sandy shale. The coal seams of these blocks are generally inter-banded, resulting in its poor quality. The in-seam dirt bands having thickness 1m and above are not generally present in majority of the coal seams, except in seams IX, VIII, IID+E and IIC where one or two such bands are present in few numbers of the borehole samples of respective coal seams.

Seam wise coal reserve and quality of seams envisaged to be worked out in Balram Expansion OCP are given in table below:

Seam-wise coal reserve & quality:

| Seams | Coal (Mt.) | Grade |
|-------|------------|-------|
| IX    | 73.80      | G13   |
| VIII  | 66.85      | G12   |
| VIIIB | 5.42       | G12   |
| VII   | 12.72      | G13   |
| VIIA  | 3.48       | G12   |
| VIB   | 14.21      | G13   |
| VB    | 21.68      | G13   |
| VA    | 28.62      | G12   |
| IVB   | 25.67      | G13   |
| IVA+B | 34.29      | G12   |
| IVA   | 3.79       | G13   |
| IIIE  | 74.46      | G11   |



|       |               |     |
|-------|---------------|-----|
| IIID  | 18.29         | G11 |
| IIIC  | 1.53          | G10 |
| IIIA  | 30.20         | G12 |
| IIIE  | 100.05        | G13 |
| IID+E | 107.14        | G12 |
| IID   | 17.87         | G13 |
| IIIC  | 80.93         | G12 |
|       | <b>721.00</b> |     |

**Mineable coal reserves as on 01.04.2018 are 721.00Mt.**

**Mineable coal reserves as on 01.04.2020 are 712.134 Mt.**

From the above table, the weighted average GCV of coal seams works out to be 3765 Kcal/Kg. The overall average grade of the coal is G12.

- \* Reserves & Quality considered as per approved P.R of Balram OC. Expansion (15Mty).

## 5.8 TARGET OUTPUT & LIFE OF THE MINE

Within the proposed quarry boundaries, a total mineable reserves of 712.134 Mt. has been estimated. With this mineable reserves, the life of the proposed Balram Expansion OCP has been estimated as 49 years, for a rated capacity of 15.00 Mt of coal per year. The nominal incremental capacity of the project would be 7 Mty.

The breakup of total period is as follows:

- Production built up period. – 3 years.
- Production period – 45 yrs.
- Tapering period – 1 yr.
- Total period – 49 yrs.

## 5.9 BASIC MINE PARAMETERS

Mine parameters for the delineated pit are as follows:

|     | Parameters                              | Unit  | Value    |
|-----|---|-------|----------|
| 1.  | Net Geological Reserves                 | Mt.   | 746.21   |
| 2.  | Mineable Reserves<br>(as on 01.04.2020) | Mt.   | 712.134  |
| 3.  | OB quantity<br>(as on 01.04.2020)       | Mcum  | 1496.257 |
| 4.  | Av. Stripping Ratio                     | Cum/t | 2.10     |
| 5.  | Capacity                                | Mty   | 15.0     |
| 6.  | Life (as on 01.04.2020)                 | Years | 49       |
| 7.  | Floor gradient                          | deg   | 2.75-8   |
| 8.  | Quarry depth:                           |       |          |
|     | Max:                                    | M     | 270      |
|     | Min:                                    | m     | 45       |
| 9.  | Width along Mine Floor:                 |       |          |
|     | Max                                     | m     | 4050     |
|     | Min                                     | m     | 3275     |
| 10. | Width along Mine Surf:                  |       |          |
|     | Max                                     | m     | 4480     |
|     | Min                                     | m     | 3900     |

### PRESENT MINING ACTIVITIES

#### DEPARTMENTAL

At present the OBR is being excavated by departmental means by existing 10cum/5cum/6.5cum shovels with 100T/85T/60T dumpers and coal been extracted by departmental surface miners.

#### OUTSOURCING

The coal being mechanically loaded from face and been transported to different destinations. Part of OBR contract is being executed by civilian contract.

## 5.10 SEQUENCE OF MINING

The progress of the Balram OCP got restricted in the north on account of R&R issues. Subsequently the working faces in the north have been discontinued and the mine had been proposed to be extended in the west in the extension proposal after getting all statutory approvals. Further it is necessary to extend the mine in west direction to get the advantage of extended strike length to enhance the production to 15 Mty. Therefore, the existing advancing of the mine in the west direction is to be maintained but gradually the working face is to be orientated in the strike direction from the existing dip direction. In 5<sup>th</sup> year, once the face is oriented in the strike direction, the entire strike of about 4 km of the proposed quarry would be taken at a time.

It is proposed to remove OB by shovel dumper & excavate coal by surface miner.

A 120m wide central corridor has been proposed for access to the lower seam coals of the quarry. Reclaim feeders and conveyors have been proposed for receiving and conveying surface miner coal from seams IIC, IID, IIE, IID+E, IIIE, IV (A, B and A+B), VIII and IX.

Coal from seams IIC, IID, IIE and IID+E are proposed to be conveyed by proposed central conveyor at the floor of the quarry after being loaded by reclaim feeder. Coal from seams IIIE, IV (A, B and A+B), VIII and IX are proposed to be carried to the surface by coal body rear dumpers and thereafter through reclaim feeder and conveyor. The receiving reclaim feeders are proposed to be shifted every 5 years. (Refer MIN-I for final stage excavation plan).

## 5.11 DUMPING STRATEGY

Total volume of OBR is 1496.257Mm<sup>3</sup> as on 01.04.2020, With the present rate of coal production and as proposed in the calendar programme the total OBR will be accommodated internally. There will not be any requirement of

external dump. During the initial years OB can be adjusted above the dumps of the Kalinga & Balram extension OCP. With the advancement and orientation of the face the waste generated will be backfilled from 6<sup>th</sup>-7<sup>th</sup> year onwards. The waste material will be accommodated internally in the west and east sides of the central corridor. It is proposed to maintain internal dump toe at least 100m from the face for better safety. The floor of the internal dump is proposed to be ripped by dozer fitted with ripper before dumping. As on 31.03.2020 external Ob dump is 155.20 Mcum and internal Ob dump is 11.28Mcum.

| YEAR  | Total OB (Mcum) | Internal Dump (Mcum) | External dump (Mcum) |
|-------|-----------------|----------------------|----------------------|
| 1     | 18              | 18                   | 0                    |
| 2     | 24              | 24                   | 0                    |
| 3     | 29              | 29                   | 0                    |
| 4     | 33              | 33                   | 0                    |
| 5     | 33              | 33                   | 0                    |
| 6     | 33              | 33                   | 0                    |
| 7     | 33              | 33                   | 0                    |
| 8     | 33              | 33                   | 0                    |
| 9     | 33              | 33                   | 0                    |
| 10    | 33              | 33                   | 0                    |
| 11    | 33              | 33                   | 0                    |
| 12    | 33              | 33                   | 0                    |
| 13    | 33              | 33                   | 0                    |
| 14    | 33              | 33                   | 0                    |
| 15    | 33              | 33                   | 0                    |
| 16    | 33              | 33                   | 0                    |
| 17    | 33              | 33                   | 0                    |
| 18    | 33              | 33                   | 0                    |
| 19    | 33              | 33                   | 0                    |
| 20    | 33              | 33                   | 0                    |
| 21    | 33              | 33                   | 0                    |
| 22    | 33              | 33                   | 0                    |
| 23    | 33              | 33                   | 0                    |
| 24    | 33              | 33                   | 0                    |
| 25    | 33              | 33                   | 0                    |
| 26-48 | 692.45          | 692.45               | 0                    |
| 49    | 6.807           | 6.807                | 0                    |
| Total | 1496.257        | 1496.257             | 0                    |

## 5.12 DUMPING ARRANGEMENTS

Internal dump height upto RL of 205 has been proposed on the east side of the quarry. On the west decks only upto RL 175 will be required. Decks each of 30m height leaving 40m wide berms on each deck have been proposed in internal dumps. Overall slope of the dump will be 21-23 degrees from the horizontal.

The internal dumping will be carried out from the benches in the batter. Dumpers movement will be so planned as to avoid the unnecessary movement of dumpers in different horizons. All the statutory norms regarding dumps and its stability shall be followed including regular slope stability studies.

(Refer MIN-VI for final stage Dump plan)

## 5.13 MINING SYSTEM AND SYSTEM PARAMETERS

The seam inclination in most of the quarry is relatively less and suitable for incline slicing. At places in later years the seams are steeper favouring horizontal slicing. Following mining system parameters have been considered in the project:

| S. No. | Particulars             | Unit   | Value  |
|--------|-------------------------|--------|--|
| 1      | Bench height            | m      | 5-17   |
| 2      | Working bench width     | m      | 50-70  |
| 3      | Non-working bench width | m      | 30-35  |
| 4      | Bench slope             | Deg    | 70 for shovel dumpers and 60 for surface miner |
| 5      | Blast hole dia          | mm     | 250  |
| 6      | Powder factor           | Kg/cum | 0.3-0.4  |



## 5.14 EQUIPMENT SELECTION

The existing HEMM at Balram OCP will be continued to be deployed departmentally for coal extraction and OB removal. The balance coal extraction and OB removal will be outsourced.

Electric rope shovels of 20 cum bucket size with 190T RD have been proposed for removal of top OB and partings of thickness more than 15m. In addition, OB will also be removed by electric rope shovels of 10-12 cum bucket size in combination with 100T rear dumper and hydraulic shovel of 6.5 cum bucket size in combination with 60T rear dumper. Electric drill of 250mm and 160mm have been proposed for drilling of OB benches. It is proposed that mining trucks with proper dallas size are procured to suit the volume weight of the handling material for better productivity.

Surface miners of 3000-3800mm drum size in combination with high lift 6.4-7cum FEL and 60T RD with coal body have been provided for extraction of coal seams.

In partial outsourcing variant the existing HEMM at Balram OCP will be continued to be deployed departmentally for extraction of coal and removal of OB. The capacity of existing equipment has been calculated as 9.00 Mtes for coal extraction and 12.14 Mtes for OB removal. The balance coal and OB will be outsourced. Similar type and size of equipment as proposed in departmental option have been considered for deployment by the external agencies. The scope of work to be carried out by the external agency in outsourcing option includes

- Ground Preparation
- Drilling and blasting under departmental supervision (explosives will be made available departmentally)
- Excavation, loading and transportation of coal to CHP/stockpile

- Excavation, loading and transportation of overburden (including top soil, alluvial soil, hard overburden etc.) to the dumping site marked by the authorities from time to time in accordance with the dump plan of the project
- Dumping, dozing and levelling, grading of overburden at dumping site
- Maintenance for HEMM to be deployed by the outsourcing agencies
- Water Spraying on Haul roads, Mine faces and overburden dumps to control dust generation.

In partial outsourcing option quarry illumination, pumping, CHP etc. will be carried out departmentally.

## **5.15 MINING SCHEDULE AND EQUIPMENT PHASING**

### **5.15.1 DESIGN CRITERIA**

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

|                              |     |
|------------------------------|-----|
| a. No of annual working days | 330 |
| b. No of daily shifts        | 3   |
| c. Duration of shift, hours  | 8   |

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

#### Excavation Category

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

#### In-situ Volume Weight

For Coal 1.73 t/cum

For OB 2.40 t/cum

#### Hardness of OB & Coal

OB Medium Hard to Hard

Coal Medium Hard

Average lead of dumpers has been taken as 2.5-3km for OB and 2-2.5km for Coal.

#### 5.15.2 PRODUCTIVITY OF EXCAVATOR

| Sl No. | Equipment                          | Rock Type | Annual Productivity (Mcum) |
|--------|------------------------------------|-----------|----------------------------|
| 1      | 20cum ERS+ 190T Dumpers            | OB        | 4.63                       |
| 2      | 10-12cum ERS+ 100T Dumpers         | OB        | 2.27                       |
| 3      | 6.5 cum hydraulic shovel + 60 T RD | OB        | 1.78                       |
| 4      | 3800 mm Surface Miner              | Coal      | 2.00                       |
| 5      | 6.5 FEL + 60 T RD (Coal Body)      | Coal      | 0.963                      |

#### 5.15.3 PRODUCTIVITY OF DUMPER

| Rock Type | Equipment                                | Lead in Km. |       |       |
|-----------|--|-------------|-------|-------|
|           |  | 2.5         | 3     | 3.5   |
| OB        | 190T Dumper with 20 cum ERS              | 0.781       | 0.709 | 0.653 |
| OB        | 100T Dumper with 10 cum ERS              | 0.333       | 0.302 | 0.278 |
| OB        | 60T dumper with 6.5 cum hydraulic shovel | 0.227       | 0.206 | 0.189 |

| Rock Type | Equipment                       | Lead in Km. |       |       |
|-----------|---------------------------------|-------------|-------|-------|
|           |                                 | 2           | 2.5   | 3     |
| Coal      | 60T Dumper with 6.4-6.7 cum FEL | 0.301       | 0.276 | 0.250 |

## 5.16 MINING SCHEDULE

This is an existing project. Initially the mine is proposed to be advanced in the already acquired land in the west. The existing infrastructure will be used till the proposed ones are constructed.

The summarised mining schedules for 49 years (from 01.04.2020) for coal extraction and OB removal have been provided in the table as follows:

| YEAR  | COAL (Mt) | Cum Coal (Mt) | OB (Mcum) | Cum OB (Mcum)   | SR (cum/t) | Cum SR (cum/t) |
|-------|-----------|---------------|-----------|-----------------|------------|----------------|
| 1     | 8         | 8             | 18        | 18              | 2.25       | 2.25           |
| 2     | 10        | 18            | 24        | 42              | 2.4        | 2.33           |
| 3     | 13.63     | 31.63         | 29        | 71              | 2.13       | 2.24           |
| 4     | 15        | 46.63         | 33        | 104             | 2.2        | 2.23           |
| 5     | 15        | 61.63         | 33        | 137             | 2.2        | 2.22           |
| 6     | 15        | 76.63         | 33        | 170             | 2.2        | 2.22           |
| 7     | 15        | 91.63         | 33        | 203             | 2.2        | 2.22           |
| 8     | 15        | 106.63        | 33        | 236             | 2.2        | 2.21           |
| 9     | 15        | 121.63        | 33        | 269             | 2.2        | 2.21           |
| 10    | 15        | 136.63        | 33        | 302             | 2.2        | 2.21           |
| 11    | 15        | 151.63        | 33        | 335             | 2.2        | 2.21           |
| 12    | 15        | 166.63        | 33        | 368             | 2.2        | 2.21           |
| 13    | 15        | 181.63        | 33        | 401             | 2.2        | 2.21           |
| 14    | 15        | 196.63        | 33        | 434             | 2.2        | 2.21           |
| 15    | 15        | 211.63        | 33        | 467             | 2.2        | 2.21           |
| 16    | 15        | 226.63        | 33        | 500             | 2.2        | 2.21           |
| 17    | 15        | 241.63        | 33        | 533             | 2.2        | 2.21           |
| 18    | 15        | 256.63        | 33        | 566             | 2.2        | 2.21           |
| 19    | 15        | 271.63        | 33        | 599             | 2.2        | 2.21           |
| 20    | 15        | 286.63        | 33        | 632             | 2.2        | 2.2            |
| 21    | 15        | 301.63        | 33        | 665             | 2.2        | 2.2            |
| 22    | 15        | 316.63        | 33        | 698             | 2.2        | 2.2            |
| 23    | 15        | 331.63        | 33        | 731             | 2.2        | 2.2            |
| 24    | 15        | 346.63        | 33        | 764             | 2.2        | 2.2            |
| 25    | 15        | 361.63        | 33        | 797             | 2.2        | 2.2            |
| 26-48 | 345       | 706.63        | 692.45    | 1489.45         | 2.01       | 2.11           |
| 49    | 5.5       | <b>712.13</b> | 6.807     | <b>1496.257</b> | 1.24       | 2.1            |

Total 110.974 Mt of coal and 167.26 Mcum of Ob including topsoil has been removed till 31.03.2020.

The total Quantities of Coal & OB (inception to till end of the mine life)

Coal - 823.104 Mt

OB - 1663.52 Mcum

## 5.17 EQUIPMENT SCHEDULE

The requirement of mining equipment e.g., shovels, dumpers, surface-miner, drills and dozers etc. have been estimated as per annual productivity based on adopted design criteria and workload determined by the calendar plan considering the physical location of equipment within the operating mine. For calculating the number of dumpers, the OB and Coal transportation year-wise leads have been taken into account.

The proposed phasing of existing and additional HEMM for departmental variant as per approved P.R of Balram OC. Expansion (15Mty) is as follows:



| MCLM (Machinery/Equipment)  |                         |              |          |                     |            |                 |      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-----------------------------|-------------------------|--------------|----------|---------------------|------------|-----------------|------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Sl. No.                     | Equipment               | Size         | Existing | Existing (Upgraded) | Additional | Total Provision | Year |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|                             |                         |              |          |                     |            |                 | 1    | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |    |
|                             |                         |              |          |                     |            |                 | No   | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No |
| A Major Equipment(Overhaul) |                         |              |          |                     |            |                 |      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 1                           | Electric Rope Shovel    | 20 cum       |          |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |
| 2                           | Electric Rope Shovel    | 20 cum       | 1        |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |
| 3                           | Electric Rope Shovel    | 8.5 cum      | 1        | 1                   | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |
| 4                           | Electric Rope Shovel    | 8.5 cum      | 1        |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |
| 5                           | Electric Rope Shovel    | 7.5 cum      | 1        |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |
| 6                           | Wheel Loader            | 300 T        |          |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |
| 7                           | Wheel Loader            | 300 T        | 1        | 1                   | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |
| 8                           | Wheel Loader            | 300 T        |          |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |
| 9                           | Wheel Loader            | 300 T        |          | 1                   | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |
| 10                          | Wheel Loader (DPR)      | 250 mm       | 1        |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |
| 11                          | Wheel Loader (DPR)      | 250 mm       | 1        |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |
| 12                          | Wheel Loader            | 400 HP       | 1        |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |
| B Major Equipment(New)      |                         |              |          |                     |            |                 |      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 1                           | Surface Mixer           | 6000-8000 mm | 1        |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |
| 2                           | HL                      | 6.4 T cum    | 1        |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |
| 3                           | Wheel Loader(Cat Model) | 300 T        |          | 1                   | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |
| 4                           | Wheel Loader            | 300 T        |          | 1                   | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |
| 5                           | Loader                  | 320 HP       | 1        |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |
| 6                           | Wheel Loader            | 400 HP       | 1        | 1                   | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |
| 7                           | Wheel Loader            | 400-500 HP   | 1        |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |
| 8                           | Loader with Ripper      | 350 HP       | 1        |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |
| C Common Equipment          |                         |              |          |                     |            |                 |      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 1                           | Wheel Hydraulic Backhoe | 2.8 cum      | 1        |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |
| 2                           | Motor Grader            | 200-220 Hp   | 1        |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |
| 3                           | OT Loader               | 5.7 cum      |          | 1                   | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |
| 4                           | Water Sprinkler         | 70 KL        | 1        |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |
| 5                           | Water Sprinkler         | 28 KL        | 1        |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |
| 6                           | Water Sprinkler         | 28 KL        | 1        |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |
| 7                           | Electric Shovel         | 80           | 1        |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |
| 8                           | Truck LRV               | 10           | 1        |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |
| 9                           | Motor Truck             | 6-8 T        | 1        |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |
| 10                          | Truck Loader            | 7.5 T        | 1        |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |
| 11                          | Truck                   | 40-50 T      | 1        |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |
| 12                          | Truck                   | 30 T         | 1        |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |
| 13                          | Truck                   | 30 T         | 1        |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |
| 14                          | Service Crane           | 8 T          | 1        |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |
| 15                          | Voluntary compactor     | 25 T         |          |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |
| 16                          | Winch Trailer           | 10 T         | 1        |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |
| 17                          | Maintenance Van         | 10 T         | 1        |                     | 1          | 1               | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |
| D Reclamation               |                         |              |          |                     |            |                 |      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 1                           | Water Sprinkler         | 28 KL        |          |                     | 1          | 1               |      |    |    |    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |
| 2                           | OT Loader               | 2.5 cum      |          |                     | 1          | 1               |      |    |    |    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |
| 3                           | Trucking Truck          | 8 T          |          |                     | 1          | 1               |      |    |    |    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |
| 4                           | Excavator Loader        | 400 HP       |          |                     | 1          | 1               |      |    |    |    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |    |    |    |

41 Days (2022) completed for 100% of 1

\* Overhaul upgraded to New of 100 T & 12 cum of OT replaced by 1 T of OT

## 5.18 DRILLING AND BLASTING OPERATIONS

The site preparation will be carried out by the sufficient number of dozers provided in the project. The blast hole drilling will be done in patterns decided in advance depending on the strata hardness and the requirement of DGMS.

Blast hole drills of 250mm and 160mm dia will be used for OB depending upon the thickness of parting.

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 will be used for Blasting.

In outsourcing option, the external agency will prepare the site with their own equipment by deploying sufficient number of dozers and carry out blast hole drilling using suitable blast hole drilling machine, as per the pattern and other parameters decided by the project authorities depending on the strata conditions and stipulations of DGMS for both coal and overburden. However, the blasting operations will be carried out departmentally.

## Chapter – 6

### MANPOWER, SAFETY AND SUPERVISION

#### 6.1 REQUIREMENT OF MANPOWER

Manpower requirements are assessed on the basis of 7 days week and 330 days of annual working. Total manpower requirement for the 15Mtpa project has been estimated as 1157 for the departmental variant. The existing strength of the mine is 1326. Estimated manpower requirement for partial outsourcing variant is 719 including the operation manpower for operating the existing HEMM. Wherever necessary some of the existing manpower may be suitably upgraded or exchanged with manpower of neighboring OCPs to match the proposed requirement.

Comparative total manpower for both the departmental & partial outsourcing variant is as follows:

#### VARIANT – I : DEPARTMENTAL OPTION

Table 6.1

| Sl. No.              | Particulars                | No of persons (up to target year ) | Max no of Persons(Beyond target yr) |
|----------------------|----------------------------|------------------------------------|-------------------------------------|
| 1                    | Operations                 | 534                                | 544                                 |
| 2                    | Maintenance                | 248                                | 248                                 |
| 3                    | Coal Dispatch arrangements | 98                                 | 98                                  |
| 4                    | Supervision                | 100                                | 100                                 |
| 5                    | Others                     | 160                                | 160                                 |
| 6                    | Reclamation& Environment   | 07                                 | 07                                  |
| <b>Total</b>         |                            | <b>1147</b>                        | <b>1157</b>                         |
| <b>O.M.S (Peak))</b> |                            | <b>49.11</b>                       |                                     |

**VARIANT – II : OUTSOURCING OPTION**

**Table 6.2**

| Sl. No. | Particulars                | No of persons (up to target year) | Max no of Persons(Beyond target yr) |
|---------|----------------------------|-----------------------------------|-------------------------------------|
| 1       | Operations                 | 268                               | 268                                 |
| 2       | Maintenance                | 129                               | 129                                 |
| 3       | Coal Dispatch arrangements | 98                                | 98                                  |
| 4       | Supervision                | 90                                | 90                                  |
| 5       | Others                     | 134                               | 134                                 |
| 6       | Reclamation& Environment   |                                   |                                     |
|         | <b>Total</b>               | <b>719</b>                        | <b>719</b>                          |
|         | <b>O.M.S</b>               |                                   | <b>79.02</b>                        |

All the operations shall be under the supervision of Statutory Departmental Manpower as per the Mines Act 1957. In outsourcing option, the existing HEMM will be kept on operation and would be operated and looked after by existing manpower provided for the purpose.

## **6.2 TRAINING**

Most of the opencast projects of MCL are being operated departmentally. Therefore, for departmental option, trained manpower may be available in MCL. Further it is suggested that new recruits are to be trained as per the standing Guidelines stipulated in the V.T Rule of DGMS and the existing Training Schedules of CIL prior to actual placement in the job/ mine. In outsourcing option the manpower engaged by the outsourcing agency will be given training as per VT rules. For periodical training and development need, the existing group VTC of Area is to be utilised. If required, facilities at these training centres may be augmented.

## **6.3 SAFETY AND SUPERVISION**

Safety of men and machine deployed in the mining area should be properly taken care of irrespective of whether the mining activities are performed by departmental or by outsourcing option.

Outside agency deploying HEMM or any other equipment in the mine for excavation of coal & OB shall plan their activities in confirmation with the prevailing statutory provisions as per Mines Act 1952 and CMR 1957 and its latest amendments applicable for safety in opencast mines. However, all statutory rules, regulations, applicable laws etc. and statutory requirement related to Govt. licenses, workers compensation, Insurance, etc., including minimum wage act for workers employed by the outside agency shall have to be adhered to. Rules, if any, imposed by local/State/central authorities should also be complied by leaser of HEMM/equipment and then shall have to supply various protective equipments viz. helmet, shoes etc. to workman at their cost.

All the regulations & schedules of coal mines Regulations 1957 relating to opencast mining have to be adhered to and implemented in order to maintain day to day safety precautions as per statute.

#### **SAFETY ASPECTS FOR OUTSOURCING/HIRING OF HEMM/EQUIPMENT**

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

##### **A) For persons**

- i) No persons shall be deployed unless he is trained at VTC
- ii) Records in Form-B, Form-D shall be maintained.
- iii) Records of Vocational training Certificate and driving license of operators shall be kept by HEMM outsourcing agency and shall be made readily available for inspection by management.
- iv) No person shall be employed unless person holds VTC certificate and Management is informed. A record of it shall be maintained.
- v) Qualified competent persons shall maintain adequate supervision.



- vi) Outside agency shall follow safety guidelines and safety instruction from Project Authorities.

**B) For Machineries as recommended by DGMS Cir. (tech.) 1 of 1999.**

- i) All the machineries to be deployed in mines should be checked before deployment by competent authority.
- ii) Regular checking of m/c deployed by outside agency shall be done. No unfit machine shall be deployed before the defect is rectified.
- iii) A proper record of repair and maintenance along with inspection done by management and defect pointed out shall be maintained and signed by authorized person.
- iv) The trucks deployed outside agency shall be provided with Audio visual alarms, proper light for use at night and period when natural light is not sufficient. Also audio-visual alarms for reversing on trucks shall be provided.

**OTHER PRECAUTIONS FOR MACHINE**

- i) RTO certificate photo copies of all vehicles shall be submitted to management
- ii) Daily welding, monitoring, inspection shall be done by the agency's mechanic as directed by management.
- iii) Machine manufacturers should be asked to give risk analysis details in respect machines deployed by outside agencies.
- iv) Suitable type of the fire extinguishers shall be provided in every machine.
- v) General:
- vi) No person/vehicle shall be deployed at any place other than authorised place.
- vii) All worker should obey lawful instruction of mine management.
- viii) Risk management Plan shall be made and implemented.

- ix) All driver shall obey systematic traffics rules prepared by management
- x) Before deploying workers they must be trained and briefed about safety aspects in opencast mine. However, during course of execution of the work, if any accident occurs whether major or minor, the matter shall have to be immediately informed to mine management i.e. Colliery Manager/Agent/GM of the area so that Notices of accidents in 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.
- xi) Outside agency shall operate transport system in such a way so as to minimize pollution in the mine.

### **STABILITY OF BENCHES, QUARRY HIGHWALLS AND SPOIL DUMPS**

During quarry operations, it is necessary to adopt required mining parameters for the stability of benches, highwalls and spoil dumps. It is also mandatory to examine systematically the fencing of mine workings, landslides and cracks between benches. It is required to maintain well-graded and wide roads on benches keeping the width of working areas sufficient for spreading of blasted rock and movement of the mining and transport equipment. During actual mining operation, systematic observations of the conditions of benches highwall slopes and spoil dumps should be carried out and the dimensions be modified if necessary to suit the local conditions.

### **HAZARD AND RISK ASSESSMENT OF 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. Drainage of foundation.
7. Depth of ground water table.

The following precautions will be taken to reduce the risk of dump failure.

1. OB benches will be made of <30m ht in each tier.
2. The angle of repose of each dump tier should be around 37° and overall dump slope should be less than 26°.
3. Soil should be scrapped separately, so that it is not mixed in OB rock.
4. The slope of ground is kept mild so that it will not have any adverse effect.
5. The soil from the foundation ground should be scrapped before starting of OB dumping.
6. Garland drain to be made around OB dump area to avoid water flow during monsoon below the OB dump.
7. Ground water table is generally 3-5m below ground level hence may have no adverse impact.
8. Leveling, grading and drainage arrangement at the toe of OB dumps and at each dump tier should be done with much care and should be monitored regularly.
9. Technical & Biological reclamation will be done.
10. A scientific study regarding slope stability and monitoring team should be formed to assess the dump stability throughout the life of the mine.
11. A proper fencing with suitable material should be around dump toe to prevent failure or unauthorized access towards dump toe.
12. Precautions shall be taken to prevent spontaneous heating and fire in the carb shale when dumped along with overburden rock.
13. Sufficient clearance as per DGMS regulations or any other statutory law should be maintained between the toe of the dump and nearby road/village/ working face/infrastructure to avoid any accident or slope failure.

## HAUL ROAD MAINTENANCE

For proper haul road maintenance, following aspects have to be considered and implemented:

- i) Proper design and maintenance of the haul roads
- ii) Formulation, approval and enforcement of traffic rules regarding :
  - a) Speed limit
  - b) Parking and standing
  - c) Overtaking
- iii) One way traffic, otherwise width should not be less than 3 times the width of the largest vehicle.
- iv) Gradient should not be greater than 1 in 16.
- v) Berm should not less than 1 m in width.
- vi) Separate machines and personnel for maintenance of haul road.

During rainy season soil erosion will take place and it will deteriorate the haul road corridor and therefore.

- i) Proper drainage arrangement shall be made along the haul road.
- ii) Cross slopes (1 in 50 to 1 in 25) shall be provided on the haul road so that water flows into the drain.
- iii) Water barrier, cross drains, relief drains etc. should be constructed and maintained properly.
- iv) Culverts shall be designed, installed and maintained to withstand the vertical soil pressure, weight of the vehicles plying over the road etc.

## **PRECAUTIONS AGAINST DANGER OF INUNDATION FROM SURFACE WATER**

- 1) A careful assessment is to be made against the danger from surface water before on the onset of rainy seasons. The necessary precautions should be clearly laid down and implemented. A garland drain needs to be provided to drain away the surface rainwater from coming into the mine.
- 2) Inspections for any accumulation of rainwater, obstruction in normal drainage and weakening in embankment.
- 3) Standing order, for withdrawal of working persons in case of apprehended danger.
- 4) During heavy rain inspection of vulnerable points is essential. In case of any danger persons are to be withdrawn to safer places.
- 5) Nallah or water inlets may be diverted or isolated by embankments/if so required.

## **PREVENTIONS OF FLOODING OF EQUIPMENT DEPLOYED AT BOTTOM HORIZONS**

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

- 1) Drivage of initial trenches and coal cutting benches should be done during the dry period of the year.
- 2) Ramps should be made for quick shifting of equipment from bottom horizons, liable to be flooded during monsoon period, to the top horizons.



## **PREVENTION OF ELECTRIC SHOCKS**

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

- 1) For protection from electric shocks to persons, from electrical equipment with high voltage, Earth Leakage Relay should be provided which will automatically disconnect electrical circuits.
- 2) Closed mobile substations and switchgears should be mechanically interlocked which exclude the possibility of opening the door when oil switch and air circuit breaks are in operation.
- 3) All metal parts of electrical equipment should be properly earthed to avoid failure of insulation.
- 4) All H.T. lines and cables located within the blasting zones should be disconnected during blasting operations.

## **DUST SUPPRESSION & DILUTION OF EXHAUST FUMES**

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

- 1) Spraying with water on all working faces & haul roads, by special spraying machines or water-sprinkler.
- 2) While drilling holes, it is necessary to use dust extraction devices.
- 3) Installation of local dust suppression and air conditioning devices in cabins of excavators and drilling rigs may be considered.
- 4) Levelling of spoil dump surface.
- 5) Separate dust suppression arrangement should be provided for CHP.

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

- 6) To spread out the sources of dust formation and omission of harmful gases throughout the working area of the quarry.
- 7) Drilling & blasting operations should be timed for periods of maximum wind activity during the day.
- 8) Dumpers may be provided with purifiers for exhaust gases.

### **MEASURES TO BE TAKEN FOR FIRE FIGHTING AND FIRE PREVENTION**

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

- 1) Organizatoin of special cell for systematic observations to examine and prevent fire.
- 2) Removal of spillage of coal on benches and cleaning of coal horizons to prevent cases of coal heating.
- 3) Storage of lubricants and cotton waste in enclosed fireproof containers in working places.
- 4) Provisions of fire extinguishers

### **MEASURES TO BE TAKEN WHILE DRILLING BLASTING**

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

- 1) Drilling and Blasting in quarry should be done in accordance with the provisions of Mines Safety Act, rules and regulations.
- 2) Adequate safety measures have to be taken during blasting operation in the quarry so that men/machine are not affected.

## 6.4 CONSERVATION

Suitable measures should be taken to minimize coal loss during mining operations. Selective mining of in-seam dirt bands has been proposed. It is proposed not to dump any spoil material over coal bearing area, amenable for opencast mining, at present or even at a future date. The coal left out between boundaries and barriers has to be extracted in future.

**Chapter – 7****COAL HANDLING & DESPATCH ARRANGEMENTS****7.0 INTRODUCTION**

The present Coal Handling Plant envisages the coal collection from two sections of the mine. One from in pit for seam (Lower) evacuation and another for seam (upper) evacuation. It has been proposed that coal collected from upper seam, the mine shall be fed to the APGENCO washery at the surface, henceforth processing, handling, collection of coal from the washery, its storage and loading to the silo etc. shall be done by the APGENCO washery authorities. Part of the coal received through pipe conveyor from upper seam will be diverted to truck loading system for dispatch. Coal from lower seam will be collected and conveyed through in pit conveying system. It will be stored at surface in a bunker and finally loaded into railway wagons through silo and RLS system.

Balram OCP is being planned for a targeted production of 15 Mty. The life of the mine is 49 years. In the initial stage i.e.; up to 15 years of mine evacuation approximately 10 Mty coal shall be produced from the lower seam i.e.; seam III, balance shall be produced from the upper seams. After 15 years the targeted production shall be reversed i.e.; approximately 10 Mty shall be produced from the upper seams and balance shall be from the lower seam. For flexibility point of view the capacity for both the streams has been kept identical.

Out of 15 Mty production plan, 7 Mty shall be fed to APGENCO washery, whereas the balance shall be evacuated through silo loading of ROM coal, and road sale.

It has been proposed that entire coal (-100 mm) shall be produced through blast free i.e. through surface miner.

## 7.1 EXISTING STATUS

A Coal handling plant for Balram open cast project was constructed and commissioned. The CHP consisted of crushing complex (Feeder breakers – 4 nos.), associated conveyors and truck loading hoppers for dispatch through trucks.

These systems shall operate further till commissioning of proposed CHP for evacuation of 4 Mty coal to road sale or Hingula washery.

## 7.2 DESIGN PARAMETERS

The design parameters considered for the proposed Coal Handling Plant are as under:

### 7.2.1 BASIC DATA

#### 7.2.1.1 GENERAL

- |                        |  |
|------------------------|--|
| (a) Location           | : Talcher coalfield of Mahanadi Coalfields, Odisha |
| (b) Annual mine target | : 15.0 Mt of coal                                  |
| (c) Quality of coal    | : Grade – G12                                      |
| (d) Main consumer      | : APGENCO  |
| (e) Life of the mine   | : 49 yrs.  |

#### 7.2.1.2 COAL HANDLING PLANT

- |                               |                   |
|-------------------------------|-------------------|
| • Handling capacity           | : 15.00 Mty       |
| • No. of working days/year    | : 330 days        |
| • No. of working shifts/day   | : 3               |
| • Effective working hrs/shift | : 5               |
| • Bulk density of ROM coal    |                   |
| ❖ For capacity calculation    | : 0.8 tonne/cu.m  |
| ❖ For load calculation        | : 1.2 tonne/cu.m. |
| • Product size                | : (-)100 mm       |



### 7.2.1.3 COAL RECEIPT AND DISPATCH ARRANGEMENT

- a. ROM coal size : (-) 100 mm
- b. Coal Receipt : By reclaim feeder within the mine along the inpit trunk conveyor for evacuation of lower seam coal, and reclaim feeder along with Pipe conveyor along the boundary of Hingula and Balram OCP for upper seam coal.
- c. Coal Transport : By a series of inpit belt conveyors to surface for lower seam coal and loading into railway wagon through proposed Silo. Pipe conveyor from upper seam to proposed APGENCO washery and proposed conveyor to truck dispatch system.
- d. Proposed Dispatch: 7.0 Mty - through proposed CHP to APGENCO washery, 3 Mty by proposed truck loading system and balance 5 Mty to proposed Railway Wagon through proposed Silo in initial years and at later years 10 Mty can be loaded through proposed silo when production from lower seam reaches at peak.

### 7.2.1.4 SYSTEM CAPACITY OF CHP

The mine is being planned for producing 15 Mt of coal in a year. The coal handling system is planned for handing of entire coal produced from the mine. The coal has been planned to be produced by blast free technique ie; through surface miners. The ROM coal size shall be (-) 100mm. With the parameters narrated above i.e.; 330 working days in a year and three shifts in a day having 5 hours the system capacity envisaged at 3000 tph for entire coal handling plant.

However out of 15 Mty coal produced 7 Mty shall be fed to APGENCO washery, 3 Mty by proposed truck loading system and balance 5 Mty to Railway

Wagon through proposed Silo in initial years and at later years 10 Mty can be loaded through proposed silo when production from lower seam reaches at peak.

#### 7.2.1.5 SALIENT FEATURES OF CHP

The coal transport is being planned from in pit itself. Thus there is a remarkable reduction in dumper population in connection with the coal transport by dumpers up to surface.

Further the huge and complicated structures inside the mine like truck / dumpers, receipt hoppers have also been eliminated by introducing shiftable reclaim feeders within the mine/ coal receipt locations.

### 7.3 PLANT DESCRIPTION

#### 7.3.1 IN PIT COAL RECEIPT & TRANSPORT

- RECLAIM FEEDERS

Coal of (-) 100 mm size produced by surface miner in the mine shall be transported by tipping trucks/ dumpers and discharged at a suitable location as indicated in the plan for lower seam and upper seam, where the Reclaim feeders are installed. The quantity, capacity and location of reclaim feeders deployment has been given below. Also two no of dozers each has been envisaged for channelizing of coal to the reclaim feeders at each coal receiving center, which is likely to be arranged from the mines.

The technical parameters for design of reclaim feeders are as under

|  |   |
|--|---|
| Quantity                                 | : 8 (Eight)   |
| Location                                 | : 4 Nos. At Seam III and 4 Nos. for upper seams Seam II (2 working and 2 standby at both the seams) |
| Rated Capacity<br>Material to be handled | : 0-1500 TPH<br>Coal  |

|                  |                               |
|------------------|-------------------------------|
| Bulk Density     | : 0.8 to 1.2 t/m <sup>3</sup> |
| Material size    | : (-) 100mm                   |
| Maximum inherent | : 8% moisture content         |

- **IN PIT CONVEYING**

Coal shall be receipt by reclaim feeders within the mine and shall feed into the belt conveyors IC1 and IC2. Initially when mine excavation area is less the coal receipt system is feeding to the belt conveyor installed at mine as shown in the plan. Initially the conveyor IC1 shall be installed with lesser length of conveyor as total length envisaged for this conveyor. With the development of the mine the tail end shall be extended towards the dip to attain the total length of this conveyor as envisaged. With further development of the mine IC2 shall be installed. Now the coal receipt system shall be shifted to feed the conveyor with mine development. Then the coal shall be transported to surface through a transfer house in between. The layout of these conveyors may change during final design as per availability of space.

- **SURFACE COAL TRANSPORT**

In this project the surface coal transport has been envisaged in two parts

- i) Coal receipt from in pit for the lower seam and transport upto proposed transfer house at the surface and loading into Railway wagon through proposed Silo.
- ii) Coal receipt at surface for upper seam coal and transport up to transfer house located at surface for receiving of coal from in pit to proposed pipe conveyor which shall load into APGENCO washery and part of it to proposed truck loading system.

### **7.3.2 STORAGE & RECLAIM**

Storage and reclaim from washery shall be done by the APGENCO washery authorities. Part of the coal (5 Mty in initial years and at later years 10 Mty can when production from lower seam reaches at peak) shall be stored at surface in 20000 te bunker and loaded into railway wagons through silo and RLS.

### **7.3.3 WAGON LOADING SYSTEM**

Storage and reclaim from washery shall be done by the APGENCO washery authorities. Remaining coal (5 Mty in initial years and at later years 10 Mty can when production from lower seam reaches at peak) shall be stored at surface in 20000 te bunker and loaded into railway wagons through proposed silo and RLS for Balram Project near siding 9-10. Below hopper RLS, two numbers pre-weigh hoppers with one telescopic chutes in each are provided for loading facility.

OHE system below the silo is also being proposed.

The load out system shall be complete with power pack, level sensors and microprocessor based controls for the operation of the gates and chutes in a preset sequence for uniform and correct loading of wagons. The pre-weigh hopper filling capacity shall be selected in accordance with the type of railway wagons arriving under the loading station.

The system shall permit loading of each wagon with pre-weighed quantity of coal, thereby eliminating the necessity of any wagon weighing equipment.

### **7.3.4 WEIGHMENT**

For the purpose of weighment, belt weighers have been envisaged. In addition, for recording of weight of coal dispatched, pre-weigh system of weighment has also been envisaged with the wagon loading system.

### **7.3.5 DUST EXTRACTION**

The objective of the system is to extract coal dust from various dust generating points, clean the dust laden air by trapping coal particles and finally discharge clean air into the atmosphere so that dust concentration in the CHP

premises, even under the critical worst operating condition is less than stipulated limit.

### **7.3.6 DUST SUPPRESSION SYSTEM**

The objective of this system is to eliminate the air borne coal dust or suppresses the coal dust at its source. The system involves confinement of the dust within the dust producing area by a curtain of moisture and wetting the coal dust by direct contact between the particles and droplet of water. Adequate number of precision anti-cog nozzles will be installed at suitable locations for suppressing dust by spraying water. Suitable control for dust suppression shall be provided and the system shall be so interlocked that it operates only when the conveyor system is operating or the loading operation is on.

### **7.3.7 NOISE CONTROL**

It is well-accepted fact that noise pollution causes fatigue to operating personnel. Provision will be made to keep down the noise level to the extent it is feasible as per relevant IS/ International standard. All machine mounting will have in their foundation anti-vibration pads/sheets for reducing the vibration and thereby noise. All transfer chutes and hoppers shall have wear resistant rubber or ultra-high molecular weight plastic liners of various thicknesses as per design requirement and their suitability.

### **7.3.8 FIRE-FIGHTING SYSTEM**

Necessary firefighting system along with fire detection system has been envisaged for the plant. The fire detection unit shall be located at strategic location of the proposed plant. In addition, portable fire extinguishers to deal with electrical/oil/ordinary fires shall be provided at all strategic locations in the plant.



### **7.3.9 PLANT CLEANING SYSTEM**

To facilitate cleaning at strategic locations ample number of high pressure water servicing points have been envisaged. These service points will be provided with quick connecting hose couplings for easy fixing and dismantling of hoses. To handle discharge from plant effluent, washing of the plant area, sump pumps of suitable design and capacities have also been envisaged where required. Plant effluent shall be discharged through open drain/pipe after proper treatment.

### **7.3.10 PLANT MAINTENANCE SYSTEM**

For effective maintenance of all the equipment, there will be sufficient working space around the equipment/machinery. All the equipment and conveyor discharge drums/transfer points etc. shall have covered and well ventilated housing complete with access stair ways, hand rails, platforms, cross over ladders etc. as required. Necessary electric hoists and chain pulley blocks at suitable points of adequate capacity will also be provided on various floors.

## **7.4 ELECTRICAL**

The electrical system for reclaim feeders and in-pit conveyors and other conveyors the following electrical system has been envisaged:

- Power reception and distribution system.
- Centralised sequence control-cum-interlocking, automation, signaling and instrumentation system.
- Illumination of plant and adjacent area.
- Centralised welding circuit.
- Earthing

## **7.5 RAILWAY SIDING**

### **7.5.1 GENERAL INFORMATION**

Approx. 5 MTPA coal from Balram OCP will be dispatched by proposed RLS system in initial years and at later years 10 Mty can be loaded through proposed silo when production from lower seam reaches at peak. A new Railway siding has been proposed near siding 9-10. This proposed Railway Siding and loading point including other infrastructures near proposed siding are tentative and it can only be finalized in consultant with RITES/Railway agency. Accordingly the loading facility and alignment may change after finalizing the railway siding.

## Chapter-8

# INFRASTRUCTURE FACILITIES PROPOSAL AND THEIR LOCATION

### 8.1 INTRODUCTION

The existing HEMM of Balram OCP are being repaired and maintained at two locations near the mine entry. Dumper maintenance workshop located adjacent to the project officer's office caters to the repair and maintenance of dumpers and auxiliary equipments while a field workshop located near coal stock no. 2 caters to the needs of dozers and other face equipments. The facilities at both the workshops are quite inadequate for maintenance of the present fleet. Hence for both the departmental and partial outsourcing options, restructuring/expansion of both the workshops are proposed.

For maintenance and repair of equipment deployed in Balram OCP, the following facilities has been envisaged:

- a) Daily maintenance of HEMM is proposed to be carried out at a new field workshop to be located at a suitable location near coal stock-1.
- b) Scheduled maintenance, minor repair and medium repair is proposed to be carried out in project workshop to be located adjoining to the existing excavation workshop.
- b) Capital repair and major overhauling of equipment at Central workshop/ Regional workshop/ 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.

## **8.2 EQUIPMENT MAINTENANCE PLANNING**

Facility planning of project workshop and project store has been done based on a comprehensive maintenance and repair programme to achieve the high level of equipment availability, reliability and longer life.

Maintenance and repair load of project workshop has been assessed on the basis of annual operating time, inter repair period, life of the equipment/ assemblies/ sub-assemblies, weight and size of the equipment/ assemblies/ sub-assemblies, man-hours required per repair etc. Space requirement for maintenance and repair activities, parking facilities of HEMM and other equipment, washing of equipment and assemblies, requirement of open and covered storage space etc. have also been worked out.

For both the options, departmental and partial outsourcing, additional facilities for excavation workshop, E&M workshop and stores and are proposed adjacent to the existing workshops to cater to the maintenance and repair requirements.

## **8.3 SCOPE OF WORK**

For option-I (Departmental) the scope of work for Excavation and E&M workshop will be as under:

**8.3.1 FIELD WORKSHOP**

- a) Preventive maintenance, inspection and washing of dumper and dozer.
- b) Running repair and checking of tyre pressure of wheeled equipments.
- c) Parking of dumpers.

**8.3.2 EXCAVATION WORKSHOP**

- a) Dismantling, opening and refitting of tyres.
- b) Incidental minor repairs of assemblies and sub-assemblies of mining and mechanical equipment i.e., dumper, dozer, shovel, drill etc.
- c) Scheduled maintenance.
- d) Medium repair and replacement of assemblies and sub-assemblies.
- e) Mobile repair team with crew and facilities to cater the maintenance and minor repair needs of field equipment at site.

**8.3.3 E&M WORKSHOP**

For both option- I & II, i.e., Departmental and partial outsourcing option, 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 coal handling plant, pumps and electrical equipment.
- Minor and medium repair of switch gears, motors, self-starters and other electrical equipment.

**8.4 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:



#### **8.4.1 FIELD WORKSHOP**

- Parking of dumpers.
- Maintenance shop for dumpers and dozers.
- Lubrication system for dumpers and dozers.
- Pavements for dumper and dozer parking.
- Machine tools, general and special purpose tools, diagnostic tools, master tool kits etc.

#### **8.4.2 EXCAVATION WORKSHOP**

- Mechanised washing of dumpers and dozers.
- Schedule inspection and lubrication bays for dumpers.
- Scheduled maintenance, medium repair and minor repair facilities for dumpers.
- Minor repair and replacement of sub-assemblies and assemblies of shovels, drills and other field equipment at site by mobile repair team.
- Medium repair and overhauling of sub-assemblies and assemblies of field equipment.
- Electrical and auto repair section.
- Engine section.
- Radiator repair section.
- Welding and structural section.
- Tyre section.
- Face equipment repair shop.
- Open crane service ground.
- Pavements for dumper parking.
- Material handling facilities.
- Machine tools, general and special purpose tools, diagnostic tools, master tool kits etc.

### 8.4.3 E&M WORKSHOP

For Option-I & II, Departmental and Partial Outsourcing Option:

- E&M maintenance and repair unit for maintenance and minor repair of CHP components, pumps and electrical equipments.
- Mechanical repair shop and electrical repair shop.
- Material handling facilities.
- Machine tools, general and special purpose tools, diagnostic tools, master tool kits etc. for electrical and mechanical equipment.

## 8.5 WORKSHOP LAYOUT

The maintenance and repair bays and other facilities for dumpers and other HEMM have been designed based on the prevailing CMPDI norms and OEM's recommendations.

### 8.5.1 EXCAVATION WORKSHOP

Expansion of excavation workshop and field workshop has been proposed for maintenance and repair work of HEMM. Detailed description of major functional shops are given below:

**Table No. 8.1 Option-I (Departmental)**

| Major Shops                | No. of bays | Bay size (m x m) | Shop size (m x m) | Bracket height (m) | EOT Crane Capacity (t)            |
|----------------------------|-------------|------------------|-------------------|--------------------|-----------------------------------|
| <b>EXCAVATION WORKSHOP</b> |             |                  |                   |                    |                                   |
| Dumper Repair Shop         | 10          | 12 x 18          | 120 x 32          | 13 m               | 45/5 te.-1 no.<br>10/2 te - 1 no. |
| Face Equipment Repair Shop |             |                  | 30 x 20           | 8 m                | 15/2 te - 1 no.                   |
| <b>FIELD WORKSHOP</b>      |             |                  |                   |                    |                                   |
| Dumper Maintenance Shop    | 5           | 12 x 18          | 65 x 26           | 13 m               | -                                 |
| Dozer Maintenance Shop     | 2           | 12 x 14          | 30 x 20           | 8 m                | -                                 |

**Table No. 8.2 Option-II (Partial Outsourcing)**

| Major Shops                | No. of bays | Bay size (m x m) | Shop size (m x m) | Bracket height (m) | EOT Crane Capacity (t)            |
|----------------------------|-------------|------------------|-------------------|--------------------|-----------------------------------|
| <b>EXCAVATION WORKSHOP</b> |             |                  |                   |                    |                                   |
| Dumper Repair Shop         | 5           | 10 x 18          | 55 x 32           | 11.5 m             | 25/5 te.-1 no.<br>10/2 te - 1 no. |
| Face Equipment Repair Shop |             |                  | 30 x 20           | 8 m                | 15/2 te - 1 no.                   |
| <b>FIELD WORKSHOP</b>      |             |                  |                   |                    |                                   |
| Dumper Maintenance Shop    | 3           | 10 x 18          | 35 x 26           | 11.5 m             | -                                 |
| Dozer Maintenance Shop     | 2           | 12 x 14          | 30 x 20           | 8 m                | -                                 |

### 8.5.2 E&M WORKSHOP

Size of major functional shops of E&M workshop for option-I and option-II shall be as under:

**Table No. 8.3**

| Major Shops     | Shop size   |             | Bracket height |
|-----------------|-------------|-------------|----------------|
|                 | Option-I    | Option-II   |                |
| E&M Repair Shop | 60 m x 24 m | 60 m x 24 m | 6 m            |

### 8.6 WORKSHOP PLANT & MACHINERY

The selection of workshop plant and machinery (machine tools) for workshop have been 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, trolleys, chain pulley blocks, jacks etc. has been made for quick and effective handling of heavy materials and tyres within and outside the shops.

## **8.7 PROJECT STORE**

The project report has envisaged 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. Due consideration has also been given for proper working environment, cleanness and safety measures. Proper equipment and material handling facilities have also been provided.

- The entire operation of the project store will be controlled and coordinated by material management division. The project store will be located adjacent to the workshop complex near the mine entry.

## **8.8 WASHERY**

There is no proposal by MCL for Washery of Balram OC. Expansion (15Mty), However 7MTPA coal will be linked to APGENCO Washery. The Hingula washery (10Mty) was proposed in excavation area of Balram OCP (8Mty). Total area proposed for Hingula washery is 17.65 Ha out of which 16.13 Ha is non-forest land and 1.52Ha is forest land. MCL Management mentioned the above area as non-viable and taken decision to use it for infrastructure development. Accordingly Hingula washery has been proposed over the area. The area under proposed washery may be excavated in future if viable after exhaustion of washery life as the life of the mine is 49 years. Location proposed for APGENCO washery is with in Excavated area of Balram OCP (8Mty).

Refer GEN-III for surface Layout plan for Location of the Infrastructure.

## Chapter - 9

### LAND REQUIREMENT

#### 9.1 LAND REQUIREMENT

Implementation of proposed Balram Expansion Project 15Mty will require 2779.00 Ha of total lease area out of which 2574.00 ha of land is required for its operation (Mining lease). This includes the area required for Actual excavation, blasting zone, other infrastructural facilities etc. In addition there will be requirement of 205 ha of land for R&R, colony and others. The balance land requirement for the expansion area (Ext + Expansion) have been estimated as 1265.00 ha as mining lease and 1399.00 Ha as total lease, which is over and above the land already envisaged in approved P.R and E.C of Balram OCP (8Mty).

#### 9.2 LAND

##### PRE MINING LAND USE DETAILS OF TOTAL MINING LEASE AREA

Particulars of Pre mining land details based on the data provided by MCL.

All Fig. in Ha

| Agricultural | Township | Grazing | Barren | Water bodies | Roads  | Forest  | Total  |
|--------------|----------|---------|--------|--------------|--------|---------|--------|
| 1909.302     | 97.757   | 49.527  | 76.265 | 117.040      | 45.289 | 278.855 | 2574.0 |

Village wise type and quantity of Pre mining land details are given in annexure- 8



Particulars of Total land uses for the project as submitted by Project authorities are given below :

**All Fig. in Ha.**

| S.No | Particulars                               | As per Approved P.R and E.C of Balram OCP (8Mty) (A) |                |                | Additional land for Balram Expansion OC. project (15Mty) (Ext + Exp) REVISION-1 (B) | Total Land for Balram Expansion OC. project (15Mty) (8Mty + Ext + Exp) REVISION-1 (C)<br>C = A+B |
|------|---|--|----------------|----------------|---|--|
|      |   | Forest   | Non-Forest     | TOTAL          |   |  |
| 1    | EXCAVATION AREA                           | 58.33  | 609.67         | 668.00         | 1195.70   | 1863.70  |
| 2    | EXT.OB DUMP                               | 0  | 32.2           | 32.20          | 0   | 32.20  |
| 3    | BLASTING SAFETY ZONE (300m)               | 26.68  | 343.32         | 370.00         | 0   | 370.00*  |
| 4    | SAFETY BARRIER OF 7.5 Mt                  | 0  | 0              | 0              | 9.30  | 9.30   |
| 5    | INFRASTRUCTURE                            | 0  | 14.80          | 14.80          | 60.00   | 74.80  |
| 6    | OTHERS (MAGZINE+SERV. ROAD Etc.)          | 0  | 224.00         | 224.00         | 0   | 224.00   |
| 7    | <b>TOTAL MINING LEASE AREA</b>            | <b>85.01</b>   | <b>1223.99</b> | <b>1309.00</b> | <b>1265.00</b>  | <b>2574.00</b>   |
| 8    | COLONY                                    | 0  | 32.00          | 32.00          | 0   | 32   |
| 9    | R&R                                       | 0  | 18.6           | 18.60          | 134   | 152.60   |
| 10   | OTHERS (RAT.MINE BOUNDARY+A PPROACH ROAD) | 0  | 20.4           | 20.40**        | 0   | 20.40  |
| 11   | SUB TOTAL                                 | 0  | 71.00          | 71.00          | 134   | 205.00   |
| 12   | <b>TOTAL LEASE AREA</b>                   | <b>85.01</b>   | <b>1294.99</b> | <b>1380.00</b> | <b>1399.00</b>  | <b>2779.00</b>   |

\* 100.79 Ha of land in Blasting Danger/safety zone (300m) of existing Balram OCP (8Mty) project will be converted to excavation zone of Expansion project. This converted excavation zone is over and above 1195.70 Ha of the additional excavation area of Expansion Project.

\*\* 20.40 Ha of land in the head others has been considered outside the Mining lease area but included in total lease/Project area as per plan and land data provided by Project Proponent.

# **LAND USE OF EXPANSION PROJECT AREA (APPROVED MP&MCP VS REVISION-1)**

Comparative table of land use as per approved MP&MCP of Balram expansion OCP (15Mty) and proposed Land use of MP&MCP of Balram expansion OCP(15Mty),Revision-1 is given below:

All Fig. in Ha

| S.No | Particulars                             | Additional Land as per Approved MP & MCP of Expansion OC. project (15Mty) (Ext + Exp) |                |                | Additional Land as per MP & MCP of Expansion OC. project (15Mty) (Ext + Exp), (Revision-1) |                 |                |
|------|---|---|----------------|----------------|--|-----------------|----------------|
|      |   | Forest  | Non-Forest     | Total          | Forest   | Non-Forest      | Total          |
| 1    | EXCAVATION AREA                         | 179.80  | 1018.72        | 1198.52        | 186.765  | 1008.935        | 1195.70        |
| 2    | EXT.OB DUMP                             | 0   | (\$\$) 20.8    | 0              | 0  | 0               | 0              |
| 3    | BLASTING SAFETY ZONE (300m)             | (\$)<br>14.2  | 14.50          | 14.50          | 0  | 0               | 0              |
| 4    | SAFETY BARRIER OF 7.5 Mt                | 0   | 0              | 0              | 1.851  | 7.449           | 9.30           |
| 5    | INFRASTRUCTURE                          | 0   | 0              | 0              | 5.229  | 54.771          | 60.00          |
| 6    | OTHERS                                  | 0   | 0              | 0              | 0  | 0               | 0              |
|      | <b>TOTAL MINING LEASE AREA</b>          | <b>179.80</b>   | <b>1033.22</b> | <b>1213.02</b> | <b>193.845</b>   | <b>1071.155</b> | <b>1265.00</b> |
| 7    | COLONY                                  | 0   | 0              | 0              | 0  | 0               | 0              |
| 8    | R&R                                     | 0   | 0              | 0              | 0  | 134.00          | 134.00         |
| 9    | OTHERS (RAT.MINE BOUNDARY+COLO NY ROAD) | 0   | 0              | 0              | 0  | 0               | 0              |
|      | SUB TOTAL                               | 0   | 0              | 0              | 0  | 134             | 134.00         |
| 10   | <b>TOTAL LEASE AREA</b>                 | <b>179.80</b>   | <b>1033.22</b> | <b>1213.02</b> | <b>193.845</b>   | <b>1205.155</b> | <b>1399.00</b> |

(\$ ) 14.2 Ha of forest land in the safety zone of existing project has been taken in the excavation area of Expansion project as per MP&MCP of Balram Expn. OC project (15Mty).

(\$\$) 20.8 Ha of non-forest land of external OB dump area of existing project has fallen in the area of expansion project as per MP&MCP of Balram Expn. OC project (15Mty).

As per the plan provided by MCL, Hingula washery (10 Mty) consists of 17.65 Ha of land was proposed in excavation area of Balram OCP (8Mty), hence the washery area is not mentioned in above table as its part of approved lease area.

Temporary Reject storage area (10Ha) was proposed on back filled area of Balram OCP (8Mty).

(Refer GEN-III & IV for Surface lay out plan and Landuse plan)

### **9.3 VILLAGES AFFECTED**

There are 07 nos. of villages affected by the Expansion project (excluding villages affected by Balram 8 Mty and its extension) as mentioned below:

- 1) Banabasapur
- 2) Telipur
- 3) Solada
- 4) Satyabadipur
- 5) Gopalprasad Khamar
- 6) Birabarpur
- 7) Khuringa

The location of R&R for these villages is yet to be identified and acquired.

### **9.4 LATEST STATUS OF PAF AS PROVIDED BY MCL**

- No. of PAF required to be resettled - 3715
- No. of PAF allotted resettlement site (Jamunali) - 365
- No. of PAF availed cash in lieu of plot - 567
- Balance no. of PAFs required to be resettled - 2783

## Chapter - 10

### ENVIRONMENTAL MANAGEMENT

#### 10.1 INTRODUCTION

##### 10.1.1 BACKGROUND

Kalinga OCP of 8 MTPA capacity (renamed as Balram OCP in 2005-06) was opened in 1991 to supply coal to North Madras and Tuticorin power houses by rail. The environmental clearance was granted vide letter number J-11015/4/87-IA dated 24.10.1990. However, MoEF & CC issued gazette notification number S. O. 1530(E) dated 6th April, 2018 on the issue of validity of Environmental Clearance (EC). The gazette states that ECs issued under EIA Notification, 1994 are no longer valid. As the EC for this project is still older, fresh EC for this project needs to be applied.

In view of above and as directed by MoEF & CC, application in Form-I (under EIA Notification, 2006) has to be made within six months from the date of issue of this notification for grant of EC. Although this project was granted EC in 1990 and as such is affected by recent notification, it is prudent to apply for EC renewal.

EAC meeting held on 27/05/2019 given comments/observations regarding proposed Hingula washery and reject site in Lease hold area of Balram OCP, in which it is advised to revise the Mining plan.

However, as this project is also planned to be expanded to 15 MTPA from 8 MTPA, in any case, Form-I needs to be submitted for 15 MTPA capacity.

### **10.1.2 IDENTIFICATION OF PROJECT & PROJECT PROPONENT**

The project under consideration, i.e. Balram OCP is administratively under Hingula Area of MCL headed by General Manager, Hingula Area. The mailing address of the Project Officer is given below:

Project Officer,  
Balram Expansion OCP, Hingula Area, MCL  
P.O- Danara, Talcher  
District- Angul, Odisha, PIN-759103

### **10.1.3 LOCATION & COMMUNICATION**

The Kalinga East and Kalinga West Blocks lie on the south central part of Talcher Coalfield. The area of the combined block is about 30.5 sq. Km. It is found in the Survey of India Toposheet Map 73 H/1 on RF 1:50,000.

The blocks are well connected by metaled road and all weather roads passing through the block and are approachable all through the years. Angul and Talcher are the district headquarter and nearest towns. The nearest rail head of East Coast Railways is at Angul as well as at Talcher. The state capital Bhubaneswar and also the nearest airport are at a distance of about 160 & 165 km from the blocks.

## **10.2 ENVIRONMENTAL IMPACT & MANAGEMENT**

### **10.2.1 IMPACT ON AIR QUALITY AND ITS MANAGEMENT**

The mining and its related activities will cause ambient air pollution. The ambient air will be polluted due to presence of RPM, SPM, SO<sub>2</sub> & NO<sub>x</sub> which will be generated due to various activities related to the project. The concentration of pollutants will vary depending upon micro-meteorological parameters of area.



Appropriate air pollution control measures have been taken so that the ambient air quality is maintained within stipulated standards. Both preventive and suppressive measures which have been taken are elaborated below:

#### **10.2.2 IMPACT ON WATER QUALITY AND ITS MANAGEMENT**

The likely sources of water pollution from this project will be as follows:

- \* Sanitary (Domestic) wastewater.
- \* Industrial wastewater from workshop.
- \* Mine discharge water.
- \* Surface run-off passing through coal stockpiles and OB dump.
- \* Storm water from leasehold and built-up areas.

The impact of mining at this project on both surface water source and ground water resource has been assessed as follows:

##### **➤ 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 and flooding problem in the area

#### **10.2.3 GROUND WATER RESOURCES**

Due to excavation, ground water aquifers are disrupted.

- \* Due to pumping of mine water, the water table of the region may get lowered.

#### **10.2.4 NOISE IMPACT**

The adverse effect of high noise level like health effect (both auditory and non-auditory), masking effect, sleep interference, change in personal behavior.

#### 10.2.5 FLORA AND FAUNA

A detailed study and its impact on flora & fauna will be done at the time of preparation of EIA/EMP.

#### 10.2.6 IMPACT ON LAND USE

The major direct impacts on existing land use during the pre-mining phase area the removal of vegetation and resettlement of displaced population. There may also be land use changes with respect to agriculture, fisheries, recreation sites, housing, forestry areas, etc. Land reclamation / restoration of mined out lands may give rise to enhanced beneficial land use.

There exists major environment impacts due to landscape disruption particularly visuals (unsightly huge dumps, voids, mine structures, subsidence, mine fires, etc.). During mining and post-mining phases drastic changes in landscape with landforms take place. The major associated impacts are soil-erosion, loss of topsoil, change in complete geology, creation of huge dumps & voids, disposal of wastes, deforestation, etc.

Irrespective of the type of mining used for extracting coal, mining invariably results in enormous land disturbance – e.g. large scale excavation, removal of top soil, dumping of solid wastes, cutting of roads, creation of derelict land, etc. Opencast mining has more potential impact on land than underground mining. With improved technology, opencast coal mining is being used extensively because of its cost effectiveness and productivity; though it results in large-scale land disturbance. The alteration in land use pattern due to infrastructure is not to be considered as true change as these facilities can be utilized for some other purposes after the mining operation is over. The alteration in land use pattern due to activities of quarrying and external dumping of OB materials may be considered as true change in land use pattern.

### 10.2.7 IMPACT ON SOCIO-ECONOMIC

The major adverse impact will be displacement and rehabilitation / resettlement of affected people including change in culture, heritage & related features. The crime and illicit activities also prop-up due to sudden economic development of the area.

#### **SOCIAL IMPACT**

- **POPULATION GROWTH**

Skilled manpower required for the project may not be available in the area. Only semi-skilled and unskilled workers will be available from the local population. So people will migrate to this segment both from within and outside the district as well as the state due to creation of new employment opportunities.

- **EDUCATIONAL FACILITIES**

A number of educational institutes are already there in the buffer zone and its neighbourhood. The facilities already provided in the neighbouring projects will cater to the need of this project. So migration of population will not strain the local educational facilities already available. Further, the educational institutes owned by MCL are also accessible to local population.

- **HEALTHCARE FACILITIES**

The coal company has a number of healthcare centres including a well equipped Regional Hospital and a specialised “referral” hospital in the coalfield area. Provision of healthcare facilities have been provided in the project report. Healthcare facilities have been provided in the neighbouring projects. The above facilities will cater to the need of employees of this project. The local people can also avail these healthcare facilities.

- **ECONOMIC IMPACT**
  - Loss of agricultural land
  - General improvement of economy of the area
  - Increase in revenue of the state exchequer

## **10.3 ENVIRONMENT MANAGEMENT**

### **10.3.1 AIR QUALITY MANAGEMENT**

Appropriate air control measures will be adopted to maintain the ambient air quality within the stipulated standard. The control measures will be adopted for various operations like drilling operation, blasting operation, loading and transport, coal handling plant, fires at coalfaces and coal stock yard, OB dump(s) and workshop and stores, etc.

#### ➤ **DRILLING OPERATION**

All drills will be equipped with dust extraction.

#### ➤ **BLASTING OPERATION**

The operation shall be conformity to the extent laws with more closure control of blasting parameters.

#### ➤ **LOADING & TRANSPORTING**

- Surfacing all service roads by asphalt.
- Unmettled roads shall be kept free of ruts.
- Provision has been made for instant shower system.
- Development of greenbelt.
- Provision of silo system.

#### ➤ **COAL HANDLING PLANT & TRANSPORTATION SYSTEM**

- All coal will be produced through eco-friendly Surface Miners.
- Suppression of dust by fixed sprinklers in all critical points.
- Covered conveyor belts.
- Provision for Silo loading has been proposed.
- Total coal will be transported to silo from the CHP directly by covered conveyor belts.

- **FIRES AT COALFACES, COAL STOCK YARD**
  - Provision of adequate fire fighting.
  - Storage of water at all critical points.
  - Regular supervision.
- **OB DUMPS**
  - Blanketing with OB materials to put off the oxygen supply
- **WORKSHOP & STORE**
  - Proper ventilation system.

### 10.3.2 WATER QUALITY

- \* Sedimentation ponds/tanks to treat mine discharge water for suspended solids.
- \* Oil and grease traps and sedimentation tanks for industrial wastewater.
- \* The domestic wastewater will be treated for Bio-chemical Oxygen Demand (BOD) and Total Suspended Solids (TSS).
- \* Garland drains with settling tanks for surface run-off.

### 10.3.3 NOISE MANAGEMENT

- \* Proper designing of plant & machinery by providing inbuilt mechanism like silencers, mufflers and enclosures for noise generating parts and shock absorbing pads at the foundation of vibrating equipment.
- \* Greenbelts around infrastructure site, service building area and township.
- \* Adoption of personal protective devices like earplugs, etc.

### 10.3.4 FLORA AND FAUNA MANAGEMENT

- The enhancement of forest area occurs due to measures like biological reclamation of backfilled area, arboriculture / afforestation, compensatory afforestation creation of greenbelt and avenue plantation.



- Water body created by the final voids will be beneficial to flora as the area is prone to water scarcity.
- This project will have no detrimental impact on diversity of floral species within terrestrial and aquatic habitats.

#### **CONTROL MEASURES TO REDUCE IMPACT ON FAUNA**

- The balance in the regional population will be maintained in natural course, owing to existing undisturbed forest areas in the vicinity of the project. The increase in green cover due to implementation of various measures like biological reclamation of backfilled area, arboriculture / afforestation adopted by the mine establishment will be an added bonus, though expected in distant future.
- The mine will be a “**zero-discharge**” one. If required, water will be discharged only after suitable treatment. No adverse impact on downstream aquatic life of surface water courses will be expected.
- The project will not likely to have impact on the faunal species diversity within the terrestrial and aquatic habitats.

#### **10.3.5 LAND RESOURCE MANAGEMENT**

- Solid waste generated due to coal extraction will be dumped externally and internally. The external dump and internal dump should be reclaimed biologically and technically.
- During the process, the geometrical shape of the dumps will be altered to make it amenable to effective biological reclamation and also to provide safety and stability.
- The face slopes of the dump will be maintained at the natural angle of repose of the material and at overall slope angle of 28°.
- Suitable drainage arrangement for smooth disposal of storm water.
- Appropriate garland drain will be provided to collect run-off.
- Backfilled area will be reclaimed bio-logically and technically.

- Topsoil shall be progressively and concurrently utilized during physical/technical reclamation of external OB dumps and backfilled area, thus obviating the necessity of storage of topsoil separately.
- Arboriculture will be carried out in the vacant areas.
- Proper afforestation/plantation will be carried out for greenbelt development.

## **10.4 ENVIRONMENTAL MANAGEMENT SYSTEM**

Environmental management system is a system for maintaining and reviewing the sustainable development in the environment. It is the part of the overall management system which includes on organization structure, planning activities responsibilities, practices, procedures process and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy.

### **AIMS OF ENVIRONMENTAL MANAGEMENT SYSTEM**

- Identification and control of aspects, impacts and risks.
- Establishing an environmental policy, objectives and targets including compliance with legislation.
- Identifying environmental opportunities.
- Monitoring and continual improvement of environmental performance.

### **PROCEDURES FOR IMPLEMENTATION**

- For the implementation of the Environmental Management System within an organization, the first step is to define the environmental policy.
- The top management of the organization should define and document its environmental policy.
- The second step is to conduct an initial environmental reviews like legislative and regulatory requirement, an identification of significant environmental aspects, an examination of all existing environmental

management practices and procedures and an evaluation of feedback from the investigation of the previous incidents to assess the company's environmental conditions.

## **ESTIMATED COST FOR SOCIAL RESPONSIBILITY**

For MCL fund for the CSR should be allocated based on 2% of the average net profit of the Company for the three immediate preceding financial years or Rs. 2.0 per tonne of coal production of previous year which ever is higher. Different peripheral development and community development works will be taken.

### **– Nature of Peripheral Development and Community Development Works**

#### **(A) DRINKING WATER SUPPLY**

- (i) Renovation / installation of handpump
- (ii) Renovation / construction of well
- (iii) Renovation / digging of ponds
- (iv) Water supply through pipe line in some villages around the mining area.

#### **(B) EDUCATION**

- (i) Construction / repair of educational building.
- (ii) Providing additional facilities, furniture, lab instruments, etc.

#### **(C) RURAL HEALTH CARE**

- (i) Organizing camps for eye operations / post operation care / welfare camps.
- (ii) Providing medical instruments to the village hospitals
- (iii) Providing medical facilities to the rural population through mobile medical van.

**(D) ROADS**

- (i) Construction and repair of rural roads.
- (ii) Construction and repair of roads connecting mining area
- (iii) Construction and repair of culverts
- (iv) Construction and repair of bridges

**(E) RECREATION CENTRES**

- (i) Construction of community centers
- (ii) Providing financial aid to the various social institutions
- (iii) Preparation of play grounds & organising sports.

**(F) ENVIRONMENT**

- (i) Plantation of various species in the nearby villages of mining area
- (ii) Distribution of saplings – fruit bearing plants, medical plants & avenue plants

**(G) OTHER MISCELLANEOUS HEADS**

- (i) Street lighting
- (ii) Providing facilities to various institutions
- (iii) Providing facilities to district administration offices

**10.5 ENVIRONMENTAL MANAGEMENT PLAN**

Mahanadi Coalfields Limited, the owner of this project has already set-up an Environmental Cell headed by the General Manager at its HQs. The Cell provides necessary support that is required for Environmental Management of various projects and mines under the jurisdiction of the company. It is suggested that all control

measures for EC compliance should be supervised, for effective implementation, by the GM, Hingula Area. The Area GM will be assisted by the Nodal Officer, Environment, at the Area level.

If any additional control measures are proposed by EAC of MoEF &CC at the time of issuing EC for Balram Expn. OCP (15 MTPA), financial provision for the same will be approved by MCL Board as and when required.

Commitment from project proponent that the company will comply with the E.C & F.C conditions need to be provided after getting conditions.



## Chapter- 11

# PROGRESSIVE AND FINAL MINE CLOSURE PLAN

## 11.1 INTRODUCTION

### A. NAME OF THE MINE OWNER/ COMPANY

Mahanadi Coalfields Limited.

### B. ADDRESS FOR COMMUNICATION

#### REGISTERED OFFICE

Mahanadi Coalfields Limited (A Subsidiary Company of Coal India Limited) Jagriti Vihar, Burla, Sambalpur--768020, Odisha.

#### ADDRESS FOR COMMUNICATION

Office of the General Manager, Hingula Area, Mahanadi Coalfields Limited, Dist: Angul, Odisha.

### C. LOCATION OF THE MINE

#### C.1 LOCATION

Balram Expansion OCP, formed by combining Kalinga East and Kalinga West Blocks, lies on the south central part of Talcher Coalfield of MCL. It is found in Survey of India Toposheet Map 73 H/1 on RF 1:50,000. The coordinates of the two blocks are as follows:

Co-ordinates:

Kalinga East:

|           |   |           |                |
|-----------|---|-----------|----------------|
| Latitude  | - | 20°53'33" | :20°59'05" (N) |
| Longitude | - | 85°03'56" | :85°06'57" (E) |

Kalinga West:

|           |   |           |                |
|-----------|---|-----------|----------------|
| Latitude  | - | 20°56'02" | :20°59'05" (N) |
| Longitude | - | 85°02'52" | :85°03'56" (E) |

## **C.2 ACCESSIBILITY/COMMUNICATION**

As mentioned in Chapter-3, the block is well connected by metal road and all weather roads passing through the block and is approachable all through the years. Angul and Talcher are the district headquarters and nearest towns. The distances of Kalinga East and Kalinga West blocks from the nearest Railway station, Angul, are 16km and 24km respectively. The state capital Bhubaneswar and also the nearest airport are at a distance of about 160 & 165 km respectively from the blocks.

## **D. EXTENT OF LEASE AREA**

This has been described in Chapter 9.

## **E. TYPE OF LEASE AREA**

The total area for OCP is 2779.00 Ha out of which Mining lease is 2574.00Ha. The lease area consists of Govt. land & non-Govt. land and Forest land. The details of the type of lease area are given in Chapter 9.

## **E.1 PRESENT LAND USE PATTERN**

Present land use and land requirement for the project has been given at Chapter 9.

## **F. METHOD OF MINING**

### **F.1 MINING METHOD**

Mining Method has been provided at Chapter- 5.

### **F.2 CAPACITY OF THE MINE**

The project has been planned for a targeted production capacity of 15.00 Mt. of coal per annum. The target has been assessed based on geological constraints like steep gradient of coal seams, optimization of mining operations, total mineable

coal reserve, size of the quarry, rate of deepening, etc. The total mineable reserves of 712.134 Mt have been estimated as on 01.04.2020 within the proposed quarry boundaries. With this mineable reserves, the life of the proposed Balram Expansion OCP has been estimated as 49 years, for a rated capacity of 15.00 Mt of coal per year. The nominal incremental capacity of the project would be 7 Mty.

#### **11.1.1 REASONS FOR CLOSURE**

The mine will be closed due to the exhaustion of coal reserve i.e. after 49 years. 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 organization 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.

The statutory obligations as above and those specified by MoC or MOEF for mine closure will be adhered to.

## **11.2 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 and subsequent amendments thereafter.

### **11.2.1 GEOLOGY**

Geology has been described in Chapter 4.

#### **11.2.1.1 TOPOGRAPHY**

Topography has been described in Chapter-3.

#### **11.2.1.2 GENERAL GEOLOGY**

General Geology has been described in Chapter-4.

### **11.2.2 RESERVES**

Reserves have been described in Chapter -5.

#### **11.2.3 MINING METHOD**

Mining Method has been provided at Chapter-5.

### **11.2.4 LAND DETAILS**

The other details of land has been provided at Chapter-9.

## 11.3 PROGRESSIVE MINE CLOSURE

Mine closure operation is a continuous series of activities starting from day one of the initiation of mining project. Therefore, progressive mine closure plan will be a continuous process throughout the life of mine which will be reviewed periodically. This includes various land reclamation activities to be done continuously and sequentially during the entire life of the mine. This is a life time of mine process which starts from commencement of mining operations and leads to the final closure of the mine.

### 11.3.1 ACTIVITIES OF PROGRESSIVE MINE CLOSURE PLAN

- **OB DUMP RECLAMATION**
  - Handling & dozing of OB dumps & backfilling
  - Technical and Bio-reclamation including plantation
- Landscaping of the open space in leasehold area for improving its esthetics and eco value
- Grass carpeting/ Plantation around the quarry area and in safety zone
- Grass carpeting/ Plantation over the external OB Dump
- Entrepreneurship Development (Vocational/skill development training for sustainable income of affected people)
- Miscellaneous and other mitigative measures

Progressively mine will be advanced with increase in depth and excavation area. Mine stage plans are included in this report showing status of excavation and backfilling. Part of this excavation area will be backfilled and grass carpeted. Similarly all the activities associated with this backfilling like levelling, compaction, spreading of top soil and grass carpeting and maintaining the same throughout the mine life should be properly monitored. A suitable action plan and activity implementation schedule should be formed by company to implement and monitor the same. Provision of fund can be utilized from mine closure fund which will be returned to company from time to time. Rehabilitation of displaced manpower, training for them who are eligible for employment should also be carried out as per schedule.

Total mine lease area is 2574.00 Ha (Total Project area is 2779.00 Ha inclusive of land for R&R site, colony and others). Presently internal dumping has been started. In future years more internal dumping space will be generated and total overburden will be backfilled. The backfilled area of the quarry & external dump will be technically and biologically reclaimed and grass plantation will be done on this reclaimed area.



### 11.3.2 MANAGEMENT OF WASTES

#### 11.3.2.1 NON-TOXIC SOLID WASTE

Balram OCP will have a life of 49 years as on 01.04.2020. The total overburden generated at the end of mine from 01.04.2020 is 1496.257 Mcum. **Total overburden will be back filled as there is no requirement of external dump from 01.04.2020 onwards.** Approximately 0.786 Mcum of top soil generated and utilized up to 2019-20.

**Waste Management from 2020-21 to till end of the mine life**

| YEAR            | Top Soil (M Cum) | Internal Dump<br>(excluding Top Soil )<br>(Mcum) | Total OB<br>(Mcum) | Total OB<br>Cumulative<br>(Mcum) |
|-----------------|------------------|--|--------------------|----------------------------------|
| 1 (2020-21)     | 0.086            | 17.914   | 18                 | 18                               |
| 2               | 0.09             | 23.91  | 24                 | 42                               |
| 3               | 0.092            | 28.908   | 29                 | 71                               |
| 4               | 0.092            | 32.908   | 33                 | 104                              |
| 5               | 0.092            | 32.908   | 33                 | 137                              |
| 6               | 0.092            | 32.908   | 33                 | 170                              |
| 7               | 0.092            | 32.908   | 33                 | 203                              |
| 8               | 0.092            | 32.908   | 33                 | 236                              |
| 9               | 0.092            | 32.908   | 33                 | 269                              |
| 10              | 0.092            | 32.908   | 33                 | 302                              |
| 11              | 0.092            | 32.908   | 33                 | 335                              |
| 12              | 0.092            | 32.908   | 33                 | 368                              |
| 13              | 0.092            | 32.908   | 33                 | 401                              |
| 14              | 0.092            | 32.908   | 33                 | 434                              |
| 15              | 0.092            | 32.908   | 33                 | 467                              |
| 16              | 0.092            | 32.908   | 33                 | 500                              |
| 17              | 0.092            | 32.908   | 33                 | 533                              |
| 18              | 0.092            | 32.908   | 33                 | 566                              |
| 19              | 0.092            | 32.908   | 33                 | 599                              |
| 20              | 0.092            | 32.908   | 33                 | 632                              |
| 21              | 0.092            | 32.908   | 33                 | 665                              |
| 22              | 0.092            | 32.908   | 33                 | 698                              |
| 23              | 0.092            | 32.908   | 33                 | 731                              |
| 24              | 0.092            | 32.908   | 33                 | 764                              |
| 25              | 0.092            | 32.908   | 33                 | 797                              |
| <b>26 TO 48</b> | <b>1.895</b>     | <b>690.555</b>                                   | <b>692.45</b>      | <b>1489.45</b>                   |
| <b>49</b>       | <b>0</b>         | <b>6.807</b>                                     | <b>6.807</b>       | <b>1496.257</b>                  |
| <b>Total</b>    | <b>4.187</b>     | <b>1492.07</b>                                   | <b>1496.257</b>    |                                  |

However till 31.03.2020, in total 155.20 Mcum of OB was back filled and 11.28 Mcum of OB was externally dumped.

Total volume of waste to be generated and managed since inception to till end of the mine life is given below:

| Top Soil<br>(M Cum) | Internal Dump<br>(Mcum) | External Dump<br>(Mcum) | Total OB<br>(Mcum) |
|---------------------|-------------------------|-------------------------|--------------------|
| 4.97                | 1647.27                 | 11.28                   | 1663.52            |

### 11.3.2.2 LAND RECLAMATION PLAN

Land reclamation is carried out in two distinct phases:

- Physical/technical reclamation.
- Biological reclamation.

### 11.3.2.3 PHYSICAL / TECHNICAL RECLAMATION

During the process, the geometrical shape of the dumps is altered to make it amenable to effective biological reclamation and also to provide safety and stability.

*Table*

#### Technical reclamation of land Degraded due to Mining activities

All Fig. in Ha

| Stage/ Year                 |         | Land Degraded | Technically Reclaimed Area |
|-----------------------------|---------|---------------|----------------------------|
| Up to 2019-20               |         | 736.63        | 261.90                     |
| Up to Yr-1                  | 2020-21 | 790.48        | 293.76                     |
| Up to Yr-3                  | 2022-23 | 874.67        | 331.38                     |
| Up to Yr-5                  | 2024-25 | 930.73        | 438.9                      |
| Up to Yr-10                 | 2029-30 | 1283.44       | 661.19                     |
| Up to Yr-49<br>(Final year) | 2068-69 | 2080.79       | 1586.44                    |
| Post Closure                |         |               |                            |
| Yr-52                       | 2071-72 | 2080.79       | 1586.44                    |

**Table**

**Biological reclamation of Mining lease area**

| Stage/ Year                 |         | All Fig. in Ha<br>Biological reclamation |
|-----------------------------|---------|--|
| Up to 2019-20               |         | 122.98                                   |
| Up to Yr-1                  | 2020-21 | 154.84                                   |
| Up to Yr-3                  | 2022-23 | 192.46                                   |
| Up to Yr-5                  | 2024-25 | 299.98                                   |
| Up to Yr-10                 | 2029-30 | 522.27                                   |
| Up to Yr-49<br>(Final year) | 2068-69 | <b>1586.44</b>                           |
| Post Closure                |         |  |
| Yr-52                       | 2071-72 | 1996.78                                  |

Biological reclamation is more than technical reclamation as it is proposed to biologically reclaim the area which is with in M.L but out side of excavation area.

Out of tentative additional area of 205 Ha( for colony,R&R etc), 41 Ha will be covered with plantation & remaining 164 Ha will be for public/company use. Proposed technical & biological reclamation at different stages are very tentative & will actually vary as per actual site conditions & mining method.

#### **11.3.2.4 TOXIC WASTE**

Toxic wastes like used oil, used batteries, oily sludge, besides filter and filter materials containing oil during maintenance of vehicles will be generated from this project.

Used oil will be stored in drums safely in store either for disposal through auction to the authorized reprocessors or for use as lubricant in UG mines. Used batteries will be stored safely for auction to the authorized reprocessors. As regards oily sludge besides filter and filter materials, the same will be disposed off in impervious layer lined pits without causing environmental hazards.

### 11.3.3 TOP SOIL MANAGEMENT

Topsoil shall be progressively and concurrently utilized during physical/technical reclamation of ext. OB dumps and backfilled area, thus obviating the necessity of storage of topsoil separately. However, during initial years, topsoil will be stored temporarily with proper preservation measures for utilization during technical reclamation of external OB dump areas and backfilled areas.

Depth of top soil depends on following:

- i) Physiography.
- ii) Climatic conditions like temperature, rainfall etc.
- iii) The uses to which the land has been put before.

In a mining block it is necessary to have a close soil survey to determine its depth. From the soil analysis available the approximate depth of the topsoil of various mining blocks of Talcher Coalfield varies from 200-300 mm.

#### 11.3.3.1 STORAGE AND PRESERVATION OF TOPSOIL

- (A) Topsoil undergo many changes during preservation. These are changes in topsoil due to storage.
- i) Stockpiling has profound effects on the physicochemical and biological properties.
  - ii) Biological activity deteriorates after 3 to 6 months of storage.
  - iii) Stockpiling reduces organic content and affects the organic compound on cerned in soil aggravation.
  - iv) Aggregate stability is reduced to some extent due to storage.
  - v) Following three zones are developed in the topsoil mound during storage:
    - Aerobic zones: Soil is active in this zone
    - Transition zone: Fluctuates between predominantly aerobic and anaerobic status.

- This zone is inactive and low in biological activity as well as organic content.
- (B) **Methology of Stripping:** The method of stripping should be normally by the scrappers/ small excavators only. The routing of scrappers/excavators during this operation must be planned to minimise the travel of machines to avoid compaction and damage of soil structure. Further careful control of operation is necessary to ensure planned stripping depths of the topsoil and sub-soil. These soils should be stripped and stored separately. Intermingling of these soils during stripping must be avoided.
- (C) It is essential that topsoil stripping should be carried out when it is dry as far as possible to reduce the risk of compaction and damage to the soil structure by smearing and remolding. Prolonged rainfall is unsuitable. The best part of the year is when evapo-transportation exceeds precipitation i.e during the months of March-September.
- (D) **Geometry of Topsoil Heap:** The heap should be constructed to facilitate the following:
- To provide the maximum surface area for maintaining greater level of Biological activity.
  - To have slopes capable of sustaining vegetation to avoid erosion and gully formation.

Space constraints imposed by the site factors and soil texture would generally dictate the overall size and shape of the heap.

As a rule of the thumb, the following stack geometry may be maintained as far as possible to preserve the topsoil and increase the shelf life.

- a) Height:**
- i) 4.0m (Max) for sand soil
  - ii) 2.0 to 3.0 for loamy soil
  - iii) 1.0 for heavy clayey soil
  - iv) 0.5 to 1.0 for intermediate soil texture.



**b) Slope:**

Wide slope of 1 in 3 (i.e 18.50 degree to the horizontal)

If there is constraint in the availability of area, one or both of the following strategies can be adopted:

**ALT-I**

An acoustic barrier of topsoil may be constructed in the safety zone near the working face. When the working face advances, the embankment away from it may be reclaimed and respread over the subsoil of the technically reclaimed area. This would abate the noise pollution besides preservation of topsoil and reduction of the demand on the land requirement.

**ALT-II**

Initial topsoil may be spread over the area to be mined. When the scope for progressive reclamation is available, the respread topsoil along with the insitu one may be stripped carefully and utilised. This method would also preserve the topsoil and reduce the demand on land intake.

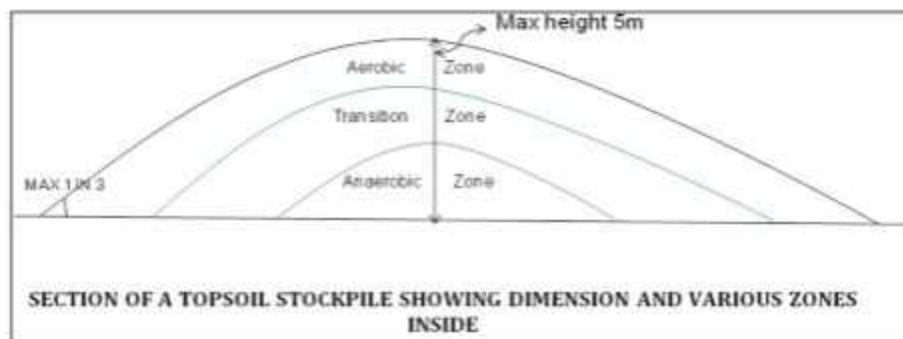
- a) It is advisable to avoid the topsoil storage, specifically the long term one. However if storage is unavoidable upon completion of the surface of the heap, the following steps are to be followed to keep the soil in good health and to increase its shelf life :
- b) Surface ripping with suitable sub-soiling machine for the purpose of aeration and relieving surface compaction.
- c) Immediate cultivation of suitable low maintenance species like dwarf grasses to prevent erosion and gully formation.
- d) Maintenance of surface vegetation actively by seeding, mowing, and weed control operation.

### 11.3.3.2 TOPSOIL CARPETING

The following golden rules need to be observed:

- i) Overburden, sub-soil and topsoil should be respread to correct sequence putting the topsoil on the top of the back filled area.
- ii) Top soil should be respread over the restoration area at an even depth so as to achieve the final level and suitable configuration for drainage.
- iii) As far as possible progressive top soil reclamation technique should be practiced. The topsoil from the area lying just ahead of the advancing opencast mine edge should be scrapped off by scrapper and immediately placed over the technically reclaimed area.
- iv) Compaction of topsoil after respreading over reclaimed area should be avoided by properly planning the movement of Earth Moving Machinery and carrying out the operation in dry period only.
- v) If topsoil is to be reclaimed from the heap for spread in the backfilled area and OB dump area, the reclamation should be planned in such a way that materials from aerobic, transition and anaerobic zones are taken simultaneously. The above zones should not be taken out separately as it is essential to use the active surface layer as 'inoculum' during soil respreading to recover the inactive portion of the mound as quickly as possible.
- vi) Revegetated topsoil dumps with legumas (Stylosanthus) and grasses, which not only protect the stockpiles from wind and water erosion, but also maintain active soil microbes population and help restoring the nutrient cycling.
- vii) Mulching: If possible, after the application of topsoil, a layer of mulch(2-3" or 5-8 cm thick) may apply to cover topsoil and provides organic matter initially. The mulch layer will prevent soil to dry out and crusted,

reduce evaporation, ameliorate extreme temperature, prevent erosion and creates congenial microhabitat for soil biological community.



#### DETAILS OF TOP SOIL REMOVAL & USE

| Year/ Stage        | Cumulative Top Soil Removal "in MCum" | Top Soil Used (Cumulative) |                                    |                                      |                                    | in MCum                             |                                     |
|--------------------|---------------------------------------|----------------------------|------------------------------------|--------------------------------------|------------------------------------|-------------------------------------|-------------------------------------|
|                    |                                       | Embankment                 | Spreading over the backfilled area | Spreading over the Ext. OB dump area | Using for Green Belt area & Others | Total utilised Topsoil (Cumulative) | Temp. Top soil Storage (Cumulative) |
| Up to year 2019-20 | 0.786                                 |                            | 0.33                               | 0.15                                 | 0.289                              | 0.771                               | 0.012                               |
| Yr-1               | 0.872                                 | 0                          | 0.41                               | 0.15                                 | 0.29                               | 0.852                               | 0.025                               |
| Yr-3               | 1.054                                 | 0                          | 0.530                              | 0.15                                 | 0.31                               | 0.992                               | 0.060                               |
| Yr-5               | 1.238                                 | 0                          | 0.644                              | 0.15                                 | 0.33                               | 1.126                               | 0.100                               |
| Yr-10              | 1.698                                 | 0                          | 0.980                              | 0.15                                 | 0.37                               | 1.502                               | 0.200                               |
| Final Stage        | 4.973                                 | 0                          | 4.310                              | 0.15                                 | 0.511                              | 4.973                               | 0                                   |

However yr-1 onwards i.e from 01.04.2020, total 4.187 Mcum of topsoil will be used for reclamation.

The above figures are tentative and derived after calculations based on working plan provided by Project authorities and stage plans. Actual figures may vary as per ground reality and requirement. Tentative area for Temporary storage/preservation of top soil was shown in stage plans.

### 11.3.3 MANAGEMENT OF AIR QUALITY

The average values of Routine Environmental Monitoring data of the existing Balram OCP project for SPM, RPM, SO<sub>2</sub>, NO<sub>x</sub> and PM<sub>2.5</sub> has been observed that all the value are well within permissible limit except PM<sub>2.5</sub>.

Details of existing air quality controls measures are described in chapter-10 which are summarized below:

#### DETAILS OF CONTROL MEASURES

- Dust extraction in drill machines
- Fixed water sprinklers at CHP, haul road
- Mist spraying in feeder breakers at CHP.
- Mobile water sprinkler for haul roads, transportation roads
- Black topping roads, colony roads, approach road to service buildings and to projects
- Greenbelt cover development

### 11.3.4 WATER QUALITY MANAGEMENT

Detailed water quality data & it's management are described in chapter-10.

#### DRAINAGE ARRANGEMENT FOR EXTERNAL OB DUMP

##### ▪ CATCH DRAIN

An open drain of appropriate size is provided on all terraces at the foot of next bench to receive the storm water from upper benches. This is then discharge to the lower benches through masonry chute, thus minimizing gully formation in the slope of external dump.

##### ♦ FOOT DRAIN

A foot drain of proper size is provided around the external OB dump (portion exposed to outside only). This drain collects run-off from dump and direct it to settling tank/sedimentation pond before discharge to nearby natural watercourses.

#### **DRAINAGE ARRANGEMENT FOR INTERNAL OB DUMP**

- During working stage, the run-off is collected from internal dump by foot drain for diverting to mine sump 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 as a measure for water harvesting.

#### **MEASURES FOR CONTROL OF POLLUTION (DETAILS FOR POLLUTION CONTROL ARRANGEMENT)**

The details of water pollution control measures are described in chapter-10.

#### **11.3.5 DIFFERENT ACTIVITIES TO BE MONITORED DURING PROGRESSIVE MINE CLOSURE**

Major activities for the project during mine closure should be decided in detail by project authority, some of these activities are described below:

- Backfilling
- Levelling
- Land scaping
- Spreading of top soil
- Biological reclamation
- Grass carpeting/ tree plantation (if the dumps are rehandled during mine closure the same should be grass carpetted instead of bigger size tree plantation)
- Fencing, supervision of the reclaimed area
- Rehabilitation of displaced families, skill development programme for eligible persons.

### **11.4 FINAL MINE CLOSURE**

#### **11.4.1 POST-MINING LAND USE**

At the end of mine life, major part of the excavation area will be backfilled and biologically reclaimed. Post mining land use pattern is given below:



| Post-mining land use (at the end of mining activity) |                            |                  |              |   |               |                     |             |
|--|----------------------------|------------------|--------------|---|---------------|---------------------|-------------|
| Sl. No.  | Category                   | Land use (in ha) |              |   |               |                     |             |
|  |                            | Plantation       | Water body   | Dip side slope, Active dump & haul road | Undis- turbed | Public /Company use | Total       |
| 1  | Quarry excavation          | 1554.24          | 39.36        | 270.1                                   | 0             | 0                   | 1863.7      |
| 2  | Safety zone (7.5mt)        | 9.3              | 0            | 0                                       | 0             | 0                   | 9.3         |
| 3  | OB dumps (external)        | 32.2             | 0            | 0                                       | 0             | 0                   | 32.2        |
| 4  | Infrastructure             | 22.44            | 0            | 0                                       | 5.994         | 46.376              | 74.8        |
| 5  | Blasting Danger Zone(300m) | 244.2            | 0            | 0                                       | 25.75         | 100.05              | 370         |
| 6  | Other areas                | 134.4            | 0            | 0                                       | 17.92         | 71.68               | 224         |
|  | <b>MINE LEASE AREA</b>     | <b>1996.78</b>   | <b>39.36</b> | <b>270.1</b>                            | <b>49.654</b> | <b>218.106</b>      | <b>2574</b> |
| 7  | Residential colony         | 6.4              |              |   |               | 25.6                | 32          |
| 8  | Resettlement site          | 30.52            | 0            | 0                                       | 0             | 122.08              | 152.6       |
| 9  | Others                     | 4.08             | 0            | 0                                       | 0             | 16.32               | 20.4        |
|  | <b>TOTAL PROJECT AREA</b>  | <b>2037.78</b>   | <b>39.36</b> | <b>270.1</b>                            | <b>49.654</b> | <b>382.106</b>      | <b>2779</b> |

#### 11.4.2 UNDERGROUND WATER/QUARRY WATER MANAGEMENT AFTER CLOSURE (SPECIFY ITS USAGE LIKE DOMESTIC WATER SUPPLY, IRRIGATION, PISCICULTURE OR STABILIZING THE GROUND WATER REGIME)

Maximum effort are being made and will be made to recycle or reuse the treated effluents totally to the extent possible by keeping the make of water in different sumps or low lying areas of the mine. The final voids of the quarries will be left as a water reservoir for **water harvesting** and also recharging the aquifer in the surrounding area which will serve following purposes :

- Source of supply of water for industrial and fire fighting purposes of near by mines.
- Source of supply of potable water after necessary treatment.
- Pisciculture.
- For recharging the aquifer in the area.

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 which will be developed as a water reservoir for **water harvesting** and also recharging the aquifer in the surrounding area.

All these activities will have to be continued till the area will be mined again for extraction of lower seams.

**11.4.3 WATER QUALITY MONITORING FOR THREE YEARS AFTER CLOSURE THE SAMPLING STATIONS SHALL BE ONE NO. MINE WATER WITH FORTNIGHTLY FREQUENCY AND TWO NUMBERS GROUND WATER SAMPLES IN CORE AND BUFFER ZONE WITH MONTHLY FREQUENCY**

At present water samples covering surface water, ground water and effluent are being analysed in the core and buffer zones of the project. Out of the above, three sample points will be utilized for Water quality monitoring for three years after closure of the mine.

**11.4.4 DETAILS OF SURFACE STRUCTURES PROPOSED FOR DISMANTLING**

All equipment and buildings erected on site for the mining operation should be dismantled and removed as part of the reclamation process, unless they form part of the future land use infrastructure.

**BUILDINGS/ ADMINISTRATION OFFICES**

Buildings shall be constructed to last depending on the anticipated life of the mine operation. Buildings for short term use should preferably be prefabricated structures that can be easily dismantled at the time of closure and reclamation. Such structures should be totally removed from the site and may be disposed of at an approved facility or reused elsewhere. Foundations comprised of concrete should be broken up, buried or removed in accordance with applicable waste management regulations.

**WEIGHBRIDGE**

Fixed equipment and structures such as weigh scales may also have concrete pads or footings and these should be broken up, buried on site or removed in accordance with applicable waste management regulations.

**SUB STATIONS/POWER LINES**

All power lines, cables, towers and guy wires should be removed as well as any concrete footings or slabs where appropriate. If access roads were necessary for construction or decommissioning of power lines, they should be ripped and revegetated.

## **ROADS**

Access and on-site roads should be properly designed and constructed as part of the initial operating plan to minimize adverse environmental effects and facilitate reclamation. In the operating plan, roads should fit the topography to minimize unnecessary earth moving for road cuttings and embankments. All culverts and drains should be removed and original drainage restored as much as possible in accordance with future land use planning.

### **11.4.5 DISPOSAL OF PLANTS & MACHINERIES**

All the P&M will be reused in dipside mine or other projects of the company after the mine closure, in case not useful for company then Possibility shall be explored for handing over to state Govt. (including residential & non-residential buildings) for the benefit of local villagers and strengthening the area infrastructures. The end use of these facilities shall be decided by State Govt. with the help of local Govt. and village Panchayat.

#### **a) DISPOSAL OR REUSE OF EXISTING HEMM, CHP AND WORKSHOP**

HEMMs which will have balance life may be deployed in dipside mine or some other project of the company if possible, or otherwise will be disposed off. CHP, workshop at the end of mine life will be dismantled and disposed off. Every effort will be made to restore the area to economic utilisation value as per the mine closure plan.

#### **b) DISPOSAL OR REUSE OF TRANSMISSION AND SUBSTATION**

The transmission line and substation will be used by neighbouring mines or local community. The transmission line and transformers will be dismantled and removed from the site if not required for purposeful use by the local community or nearby mines.

### **11.4.6 CONTROL MEASURES TO RESTORE LAND USE & LANDSCAPE**

- The face slopes of the dump will be maintained at the natural angle of repose of the material and at overall slope angle of 26°.
- The newly backfilled area may be covered with suitable grass plants, plantation for bigger trees should be avoided as all these dumps will be rehandled while extraction of lower seams.
- Suitable drainage arrangement for smooth disposal of storm water.
- Appropriate garland drain is to be provided to collect run-off.

- Topsoil shall be progressively and concurrently utilized during physical/ technical reclamation of external OB dumps and backfilled area, thus obviating the necessity of storage of topsoil separately.
- Arboriculture carried out in the vacant areas which will not be mined in future.
- Proper grass carpeting/afforestation/plantation is carried out for greenbelt development.

#### **11.4.7 SAFETY AND SECURITY ARRANGEMENT**

##### **a) DETAILS OF FENCING AROUND ABANDONED QUARRY INDICATING THE LENGTH OF THE FENCING**

Fencing around abandoned quarry will be done as per details given in D.G.M.S Circulars.

##### **b) MINE ENTRY SEALING ARRANGEMENTS AND SUBSIDENCE MANAGEMENT FOR UG MINES**

Not Applicable.

##### **c) PROVIDING ONE TIME LIGHTING ARRANGEMENT**

Sufficient lighting as per standard will be provided at all the required places, i.e. working faces, OB dump area, haul road, coal transfer points, loading points, CHP, workshop, etc., to avoid accidents and to create efficient working conditions.

After closure of the mine, the lighting arrangements will be kept maintained at all locations which are not required to be demolished or dismantled like sub-stations, transformers, community services, pump-houses, water-treatment/ filtration plants, waterlines, power lines, roads etc. to be utilized for the neighbouring projects and at critical places for safety point of view.

The guidelines/instructions from DGMS will be followed in case of discontinuance of mine operation, if any.

##### **d) SLOPE STABILITY ARRANGEMENT FOR HIGH WALL AND BACKFILLED DUMPS**

During the process, the geometrical shape of the dumps is altered to make it amenable to effective biological reclamation and also to provide safety and stability & high wall will be maintained and stabilized as per norms.

The details of the final Mine Closure plan alongwith the details of the updated cost estimates for various mine closure activities and the Escrow account already set up shall be submitted to the Ministry of Coal for final approval at least five years before the intended final closure of the mine.

## **11.5 ECONOMIC REPERCUSSIONS OF MINE CLOSURE**

### **11.5.1 MANPOWER OF THE MINE**

The manpower has been furnished in Chapter- 6.

Apart from the above mentioned direct employment potential, the proposed mining project will generate secondary and tertiary employment for the local people.

### **11.5.2 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. If required at the time of closure, some jobs may be outsourced. Manpower required for the same is given in Table below:

**Manpower for monitoring & implementation of Mine Closure**

| <b>Sl. No.</b> | <b>Manpower</b>                         | <b>No.</b> |
|----------------|---|------------|
| 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          |

### **11.5.3 ASSESSMENT OF INCOME SCENARIO OF THE 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.

## **11.6 TIME SCHEDULING FOR ABANDONMENT**

BALRAM EX. OCP is an opencast mine with life of 49 years. The time schedule envisaged for completion of all closure activities is presented in Table below in the form of bar chart.

**11.6.1 IMPLEMENTATION SCHEDULE FOR MINE CLOSURE IN BALRAM EXPANSION OC (LIFE OF THE OC MINE: 49 YEARS)**  
**Table : IMPLEMENTING SCHEDULE FOR MINE CLOSURE**

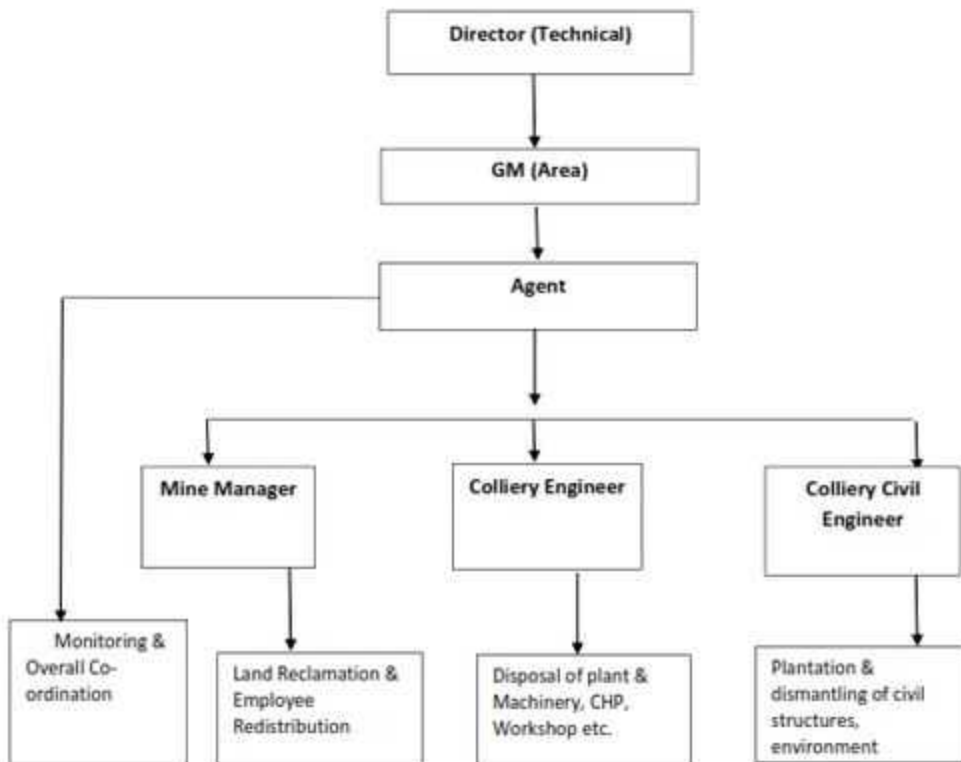
| Sl.No    | Activity   | Time Frame  | Remarks                                   | 1 <sup>st</sup> Phase |  |  |  | 2 <sup>nd</sup> Phase |  |  |  | 3 <sup>rd</sup> Phase |  |  |  | Post Closure Phase |     |     |
|----------|--|---|---|-----------------------|--|--|--|-----------------------|--|--|--|-----------------------|--|--|--|--------------------|-----|-----|
|          |  |   |   | 1 to 16 years         |  |  |  | 17 to 32 years        |  |  |  | 33 to 49 years        |  |  |  | PC1                | PC2 | PC3 |
| <b>A</b> | <b>Dismantling of Structures</b>   |   |   |                       |  |  |  |                       |  |  |  |                       |  |  |  |                    |     |     |
|          | Service Buildings  | 2 years   | To be included in Final Mine closure Plan |                       |  |  |  |                       |  |  |  |                       |  |  |  |                    |     |     |
|          | Residential Buildings  | 3 years   |   |                       |  |  |  |                       |  |  |  |                       |  |  |  |                    |     |     |
|          | Industrial structures like CHP, Workshop, field sub-station, etc.                                    | 2 years   |   |                       |  |  |  |                       |  |  |  |                       |  |  |  |                    |     |     |
| <b>B</b> | <b>Permanent Fencing of mine void and other dangerous area</b>                                       |   |   |                       |  |  |  |                       |  |  |  |                       |  |  |  |                    |     |     |
|          | Random rubble masonry of height 1.2 m including levelling up in cement concrete 1:6:12 in mud mortar | 2 years   | To be included in Final Mine closure Plan |                       |  |  |  |                       |  |  |  |                       |  |  |  |                    |     |     |
| <b>C</b> | <b>Grading of high wall slopes</b>   |   |   |                       |  |  |  |                       |  |  |  |                       |  |  |  |                    |     |     |
|          | Levelling &grading of high wall slopes   |   | To be included in Final Mine closure Plan |                       |  |  |  |                       |  |  |  |                       |  |  |  |                    |     |     |
| <b>D</b> | <b>OB Dump Reclamation</b>   |   |   |                       |  |  |  |                       |  |  |  |                       |  |  |  |                    |     |     |
|          | Handling/Dozing of OB Dump and backfilling   | Throughout life of mine including 3 Years after cessation of mining operation | Progressive and Final Mine closure Plan   |                       |  |  |  |                       |  |  |  |                       |  |  |  |                    |     |     |
|          | Technical and Bio-reclamation including plantation and post care                                     |   |   |                       |  |  |  |                       |  |  |  |                       |  |  |  |                    |     |     |

| Sl.No | Activity  | Time Frame  | Remarks                                   | 1 <sup>st</sup> Phase |  |  |  | 2 <sup>nd</sup> Phase |  |  |  | 3 <sup>rd</sup> Phase |  |  |  | Post Closure Phase |     |     |
|-------|---|---|---|-----------------------|--|--|--|-----------------------|--|--|--|-----------------------|--|--|--|--------------------|-----|-----|
|       |   |   |   | 1 to 16 years         |  |  |  | 17 to 32 years        |  |  |  | 33 to 49 years        |  |  |  | PC1                | PC2 | PC3 |
| E     | <b>Landscaping</b><br>Landscaping of the open space in the leasehold area for improving its aesthetics and eco. value | Throughout life of mine including 3 Years after cessation of mining operation | Progressive and Final Mine closure Plan   |                       |  |  |  |                       |  |  |  |                       |  |  |  |                    |     |     |
| F     | <b>Plantation</b>   |   |   |                       |  |  |  |                       |  |  |  |                       |  |  |  |                    |     |     |
|       | Plantation over cleared area obtained after dismantling   | 2 years   | To be included in Final Mine closure Plan |                       |  |  |  |                       |  |  |  |                       |  |  |  |                    |     |     |
|       | Plantation around the quarry area and in safety zone  | Throughout life of mine including 3 yrs. after cessation of mining operation  | Progressive and Final Mine closure Plan   |                       |  |  |  |                       |  |  |  |                       |  |  |  |                    |     |     |
|       | OB Dump Plantation  |   |   |                       |  |  |  |                       |  |  |  |                       |  |  |  |                    |     |     |
| G     | <b>Post Closure Env Monitoring / testing of parameters for 3 years</b>  |   |   |                       |  |  |  |                       |  |  |  |                       |  |  |  |                    |     |     |
|       | Air Quality   | 3 years   | To be included in Final Mine closure Plan |                       |  |  |  |                       |  |  |  |                       |  |  |  |                    |     |     |
|       | Water Quality   | 3 years   |   |                       |  |  |  |                       |  |  |  |                       |  |  |  |                    |     |     |
| I     | <b>Miscellaneous and other mitigative measures</b>  | Throughout life of mine including 3 yrs. after cessation of mining operation  | Progressive and Final Mine closure Plan   |                       |  |  |  |                       |  |  |  |                       |  |  |  |                    |     |     |
| J     | <b>Post Closure Manpower cost for supervision</b>   | 3 years   | To be included in Final Mine closure Plan |                       |  |  |  |                       |  |  |  |                       |  |  |  |                    |     |     |

PC1: Post Closure Year 1  
PC2: Post Closure Year 2  
PC3: Post Closure Year 3

## 11.7 ORGANIZATIONAL STRUCTURE

For implementing the mine closure activities, the following organizational 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.

## **11.8 ABANDONMENT COST**

### **11.8.1 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 JUNE 2020 is estimated to be Rs. 8.866 lakh per hectare. The amount per Ha considering the escalation factor= Rs. 9.0 lakh (Source: Guidelines of 16 December 2019, Ministry of Coal, Govt. of India)

(considering the base year as 01.04.2019, WPI, Apr 2019 = 121.1 & WPI, June 2020 = 119.3 respectively. Indexing factor = 0.9851

WPI Index of Apr 2019 is 121.1 vs WPI Index of June 2020 is 119.3 , Hence the index factor fixed at 0.9851 , subsequently cost/Ha is fixed at 8.866 lakh.

- \* The amount has been escalated based on WPI of June 2020, vis-à-vis Apr 2019 based on the Mine Closure Guidelines of MoC, Dec16, 2019).

|   |                         |
|---|-------------------------|
| Total project area involved   | : 2779.00 Ha.           |
| Mine closure cost per Ha  | : Rs. 8.866 lakh        |
| Total mine closure cost<br>(as on June- 2020)                             | : Rs. 24638.614lakh     |
| Mine closure cost already deposited<br>(without interest) (up to 2019-20) | : <b>3954.56 Lakhs</b>  |
| Balance Mine closure cost to be Deposited                                 | : <b>20684.054Lakhs</b> |
| Life of the mine  | : 49 years              |
| Fund to be deposited in first year (2020-21)                              | : 422.124 Lakhs         |

### **11.8.2 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.49 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, less money already deposited is given in the Table below:

| Year | CLOSURE COST (LAKHS) |
|------|----------------------|
| 1    | 422.124              |
| 2    | 443.23               |
| 3    | 465.39               |
| 4    | 488.66               |
| 5    | 513.09               |
| 6    | 538.74               |
| 7    | 565.68               |
| 8    | 593.96               |
| 9    | 623.66               |
| 10   | 654.84               |
| 11   | 687.58               |
| 12   | 721.96               |
| 13   | 758.06               |
| 14   | 795.96               |
| 15   | 835.76               |
| 16   | 877.55               |
| 17   | 921.43               |
| 18   | 967.5                |
| 19   | 1015.88              |
| 20   | 1066.67              |
| 21   | 1120                 |
| 22   | 1176                 |
| 23   | 1234.8               |
| 24   | 1296.54              |
| 25   | 1361.37              |
| 26   | 1429.44              |
| 27   | 1500.91              |
| 28   | 1575.96              |
| 29   | 1654.76              |
| 30   | 1737.5               |
| 31   | 1824.38              |
| 32   | 1915.6               |
| 33   | 2011.38              |
| 34   | 2111.95              |
| 35   | 2217.55              |
| 36   | 2328.43              |

|              |                  |
|--------------|------------------|
| 37           | 2444.85          |
| 38           | 2567.09          |
| 39           | 2695.44          |
| 40           | 2830.21          |
| 41           | 2971.72          |
| 42           | 3120.31          |
| 43           | 3276.33          |
| 44           | 3440.15          |
| 45           | 3612.16          |
| 46           | 3792.77          |
| 47           | 3982.41          |
| 48           | 4181.53          |
| 49           | 4390.61          |
| <b>TOTAL</b> | <b>83759.874</b> |

**Total mine closure cost to be deposited is 83759.874 Lakhs**

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.

### 11.8.3 MAJOR ACTIVITY WISE MINE CLOSURE COST

| S.N      | ACTIVITY  | Mine Closure Cost in Rs. lakh | Remarks                                     |
|----------|---|-------------------------------|---|
| <b>A</b> | <b>Dismantling of Structures</b>  |                               | To be included in final mine closure plan   |
|          | Service Buildings   |                               |   |
|          | Residential Buildings   |                               |   |
|          | Industrial structures like CHP, Workshop, field sub-station, etc.                                       |                               | To be included in final mine closure plan   |
| <b>B</b> | <b>Permanent fencing of mine void and other dangerous area</b>  |                               |   |
|          | Random rubble masonry of height 1.2 meter including leveling up in cement concrete 1:6:12 in mud mortar |                               | To be done throughout the life of the mine. |
| <b>C</b> | <b>Grading of high-wall slopes</b>  |                               |   |
|          | Leveling and grading of high-wall slopes  |                               |   |

|          |  |                  |   |
|----------|--|------------------|---|
| <b>D</b> | <b>OB Dump Reclamation</b>   |                  |   |
|          | Handling/Dozing of OB Dump and backfilling   |                  | To be done throughout the life of the mine  |
|          | Technical and Bio-reclamation including plantation and post care.  |                  | Equal weightage throughout life of the mine |
| <b>E</b> | <b>Landscaping</b>   |                  |   |
|          | Landscaping of the open space in leasehold area for improving its esthetics an eco-value                             |                  | Equal weightage throughout life of mine     |
| <b>F</b> | <b>Plantation</b>  |                  |   |
|          | Plantation over cleared area obtained after dismantling  |                  | To be included in final mine closure plan   |
|          | Plantation around the quarry area and in safety zone   |                  | Equal weightage throughout life of mine     |
|          | Plantation over the OB Dump  |                  | Equal weightage throughout life of mine     |
| <b>G</b> | <b>Post Closure Env. Monitoring/testing of parameters for three years</b>  |                  |   |
|          | Air Quality  |                  | For three years after mine closure          |
|          | Water Quality  |                  |   |
| <b>H</b> | <b>Entrepreneurship Development (Vocational/skill development training for sustainable income of affected people</b> |                  | Equal weightage throughout life of mine     |
| <b>I</b> | <b>Miscellaneous and other mitigative measures</b>   |                  | Equal weightage throughout life of mine     |
| <b>J</b> | <b>Post Closure Manpower cost for supervision</b>  |                  | To be included in final mine closure plan   |
|          | <b>TOTAL, Rs. lakh</b>   | <b>83759.874</b> |   |

## 11.9 FINANACIAL ASSURANCE

Mahanadi Coalfields Limited (MCL) shall strictly adhere to the following:

1. For financial assurance Mahanadi Coalfields Limited (MCL) 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. Mahanadi Coalfields Limited (MCL) shall cause payment to be deposited in such Escrow Account at the rate computed as indicated in above Table. Mahanadi Coalfields Limited (MCL) 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 50% of the total deposited amount including interest accrued in the Escrow Account may be released after every five year in line with the periodic examination of the closure plan as per 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 50% 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 conditions of operating the Escrow Account, shall be executed among Mahanadi Coalfields Limited (MCL), 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.

## **11.10 RESPONSIBILITY OF THE MINE OWNER**

It is the responsibility of the Mahanadi Coalfields Limited (MCL) 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.


Mahanadi Coalfields Limited (MCL) shall submit to the Coal Controller a yearly report before 1<sup>st</sup> July of every year setting forth the extent of protective and rehabilitative work carried out as envisaged in the approved mine closure plan.

## **11.11 PROVISION FOR MINE CLOSURE**

- 1) Mahanadi Coalfields Limited (MCL) shall be required to obtain a mine closure certificate from the 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 following a laid down procedure as in vogue at that point of time.
- 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 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 Mahanadi Coalfields Limited (MCL) 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.

|   |  |   |
|---|--|---|
|  <p><b>MCL</b><br/>City Municipal Corporation<br/>Bhubaneswar</p>  | <p>मुख्यालय (परियोजना एवं योजना) का कार्यालय<br/>Office of The General Manager (P&amp;P)<br/>MCL, Jagatpalli, Bhubaneswar, Odisha<br/>Dist. Khurda - 751 030 (India)<br/>CIN: U10100OR1920GCC000038<br/>Ph. +91 (067) 254 2888<br/>Fax: +91 (067) 254 2747<br/>e-mail: <a href="mailto:gm@cmpdl.org">gm@cmpdl.org</a> <a href="mailto:gm@cmpdl.org">gm@cmpdl.org</a><br/>Website: <a href="http://www.mclbhubaneswar.in">www.mclbhubaneswar.in</a></p> | <p><b>नियंत्रीत पत्र / NOTING SHEET</b></p>                           |
| <p>परियोजना एवं योजना विभाग<br/>PROJECT &amp; PLANNING DEPARTMENT</p>   |  | <p>परियोजना एवं योजना विभाग<br/>PROJECT &amp; PLANNING DEPARTMENT</p> |
| <p>क्रमांक: 76-H-<br/>दिनांक: 23/04/2019</p>  | <p>आमर हुसैन, GM(P&amp;P)</p>  |   |
| <p><b>विषय: Approval of Annual Work Programme of CMPDL, RI-VII, Bhubaneswar, for the year 2019-20</b></p>   |  |   |
| <p>Annual Programme related to all the user departments including E&amp;M, Excavation, Civil, Washery, and Environment &amp; Forest etc for RI-VII, CMPDL, Bhubaneswar are received by P &amp; P Department.</p>  |  |   |
| <p>The requirement of all the user departments are compiled and a tentative Annual Work Programme was prepared at P&amp;P dept., (enclosed as Annexure-A). Timeline for the jobs of P &amp; P Department are set based upon the present status of the job and information available in this department which may be taken into consideration.</p> |  |   |
| <p>Submitted to Director (Tech/P&amp;P), MCL for kind approval of the above Annual Work Programme of CMPDL, RI-VII, Bhubaneswar for the year 2019-20.</p>   |  |   |
| <p>सहायक सचिव</p>   | <p>23-04-2019<br/>मुख्य प्रबंधक (परियोजना एवं योजना)</p>   |   |
| <p>सहायक प्रबंधक (परियोजना एवं योजना)</p>   | <p>May be approved<br/>23/04/2019</p>  |   |
| <p>निदेशक, तकनीकी/सी एवं पी, एम सी एवं</p>  | <p>23/04/2019</p>  |   |

**ANNUAL WORK PROGRAMME OF COMPDI- 2019-20**
**DRILLING:**

| Sl. No.  | Block   | Meterage for 2019-20 (Approx.) |
|----------|---|--------------------------------|
| <b>A</b> | <b>COMPDI (CIL)</b>   |                                |
| 1        | Dip Extension of Samaleswari, 1b valley CF  | 4,000                          |
| 2        | Belpahar & Dip Side, 1b valley CF   | 6,000                          |
| 3        | Kulda-Garjanbahal West Extn. 1b valley CF   | 3,000                          |
| 4        | Balabhadra West Extension, Talcher CF   | 1,500                          |
| 5        | Balabhadra North Extension, Talcher CF  | 1,500                          |
| 6        | Trikira, Talcher CF   | 1,500                          |
| 7        | Production Support Drilling (Talcher/1b valley CF)                                      | 5,000                          |
|          | <b>SUB-TOTAL COMPDI (CIL)</b>   | <b>22,500</b>                  |
| <b>B</b> | <b>DGO (CIL)</b>  |                                |
| 1        | Madhupur, 1b valley CF  | 1,500                          |
|          | <b>SUB-TOTAL DGO (CIL)</b>  | <b>1,500</b>                   |
|          | <b>TOTAL COMPDI+DGO (CIL)</b>   | <b>24,000</b>                  |
| <b>C</b> | <b>Analysis of Drilling Reports, Geophysical Logging, Physico-Mechanical Tests etc.</b> |                                |

**REPORTS:**

| Sl. No.  | Particulars   | Tentative Schedule    |
|----------|---|-----------------------|
| <b>A</b> | <b>Project Report</b>   |                       |
| 1        | Lajkura-Orient OC Expn.   | Sep-2019              |
| 2        | West of Gopalprasad West & Utkal A  | Dec-2019              |
| 3        | Balabhadra  | Mar-2020              |
| 4        | Gopalji-Kaniba OC Expn. 30 MTY  | Till final approval   |
| 5        | Bhubaneswari OC Expn. 40 MTY  | Till final approval   |
| <b>B</b> | <b>Mining Plan and Mine Closure Plan</b>  |                       |
| 1        | Bhubaneswari OC Expn. 40 MTY  | Jul-2019              |
| 2        | Kulda-Garjanbahal OC Expn. 40 MTY   | Mar-2020              |
| 3        | Gopalji-Kaniba OC Expn. 30 MTY  | Mar-2020              |
| 4        | Reorganisation of Bhorampur OC Expansion 25 MTY   | Jun-2019              |
| 5        | Baharam OC Expansion 15 MTY   | Nov-2019              |
| 6        | Kulda OC 18.75 MTY  | Apr-2019              |
| 7        | West of Gopalprasad West & Utkal A  | Mar-2020              |
| <b>C</b> | <b>Revised Cost Estimate /Updated Cost Estimate ( as applicable)</b>  |                       |
| 1        | Ananta OC Expn. Phase-III 15 MTY  | Jun-19                |
| 2        | Hingula -II OC Expansion Phase-III 15 MTY   | Jun-19                |
| <b>D</b> | <b>Ancillary Jobs - Operational Plans, Vetting of files ( OIR Proposal, Coal &amp; Oil outsourcing proposals etc)</b> | As and when required. |



Contd. Page 2

| Sl. No.  | Particulars  | Tentative Schedule     |
|----------|--|------------------------|
| <b>E</b> | <b>Preparation of Form-1 and PFR</b>   |                        |
| 1        | Bhubaneswari OCP Expansion (28.0 to 40.0 Mty)  | As per requirement     |
| 2        | Bharatpur OCP Expansion (20.0 to 24.0 Mty) - (name to be changed from Re-organization to Expansion)  | As per requirement     |
| 3        | Kulda OCP Expansion (Including the Lalma forest)   | As per requirement     |
| 4        | Updated Form-1 for Lakhanpur OCP 21.0 Mty for extension in validity of EC.   | As per requirement     |
| 5        | Updated Form-1 for Kulda OCP obtaining EC for 15.0 Mty capacity.   | As per requirement     |
| 6        | Updated Form-1 for Bhubaneswari OCP 28.0 Mty for extension in validity of EC.  | As per requirement     |
| 7        | Bairam OCP Expansion   | As per requirement     |
| <b>F</b> | <b>Baseline Data Generation</b>  |                        |
| 1        | Integrated Lakhanpur-Belpahar-Lilari OCP (15-03-19 to 15-06-19)  | As per requirement     |
| 2        | Kulda OCP Expn. (Including the Lalma forest)   | As per requirement     |
| 3        | Nandira UG 0.33 Mty  | As per requirement     |
| <b>G</b> | <b>Preparation of ELA-EMP</b>  |                        |
| 1        | Integrated Lakhanpur-Belpahar-Lilari OCP   | As per requirement     |
| 2        | Kulda OCP Expn. (Including the Lalma forest)   | As per requirement     |
| 3        | Nandira UG 0.33 Mty  | As per requirement     |
| <b>H</b> | <b>E&amp;M Jobs</b>  |                        |
| 1        | Final e-Tender document & Cost Estimate/ Drawing scrutiny for the job of 2X4 MVA, 33/3.3kv sub-station at Ananta OCP in Expansion Phase-III.   | May-2019 to Jan-2020   |
| 2        | Drawing scrutiny for Hingola CHP with silo loading arrangement.  | March-2020 (ongoing)   |
| 3        | Drawing scrutiny for Bhubaneswari CHP with silo loading arrangement by-passing Jagannath Washery.  | March-2020 (ongoing)   |
| 4        | Preparation of scheme/ e-Tender document & cost estimate for dispatch of 15Mty coal from Transfer House-7 & 8 of under construction CHP by constructing a Silo near siding V&VI of Bhubaneswari OCP and construction of alternate truck loading system for elimination of pay loader loading in Road Sale at Bhubaneswari OCP. | Aug-2019 to March-2020 |

Contd. Page 3

| Sl. No. | Particulars  | Tentative Schedule    |
|---------|--|-----------------------|
| 5       | Preparation of e-NIT & Cost estimate and drawing scrutiny for the job of erection of 33 kV overhead line from 132/33 kV Mandira Sub-station to new quarry sub-station and supply, erection, installation & commissioning of new quarry sub-station near access trench of Jagannath OCP, Jagannath Area, MCL on pre-Engineered Turnkey Execution basis. | May-2019 to Dec-2019  |
| 6       | Preparation of Scheme/ e-NIT and cost estimate for Construction of Alternative Truck Loading System for elimination of pay loader loading in Road Sale at Lakhanpur Area.  | Aug-2019              |
| 7       | Preparation of e-NIT and cost estimate for Construction of Alternative Truck Loading System for elimination of pay loader loading in Road Sale at Lingaraj Area.   | Sept-2019             |
| 8       | Preparation of Scheme/ e-NIT and cost estimate for Construction of Alternative Truck Loading System for elimination of pay loader loading in Road Sale at Ib Valley Area.  | Sept-2019             |
| 9       | Preparation of NIT & Cost estimate for the job of 2X10 MVA, 33/6.6 kV sub-station at Garijohari OCP, Sarmal Area.  | October-2019          |
| 10      | Drawing Scrutiny for the job of Conversion of Steam Drive Unit to Electrical Drive Unit of the existing winch at Pit no. 2 of Talcher Colliery, Talcher Area, MCL on turnkey execution basis.  | Sept-2019             |
| 11      | Preparation of NIT and cost estimate & drawing scrutiny for the job of Design & Engineering, Supply, Erection, Installation, Testing & Commissioning of fire fighting system for 4X20MVA, 132/33 kV Central Substation at Jorhaga, Lakhanpur Area of MCL on Pre-Engineered Turnkey Execution Basis.  | May-2019 to Dec-2019  |
| 12      | Preparation of NIT & Drawing scrutiny for the job of Design, Supply, Erection, Installation, Testing & Commissioning of civil & electrical works of 2X4 MVA, 33/2.3 kV S/s at SOCP, Ib Valley Area, MCL.   | May-2019 to Jan-2020  |
| 13      | Preparation of Scheme, e-NIT & cost estimate for the job of provision of Fire Fighting arrangement with fire detection and alarm annunciation for Regional Sub-station, Kalinagar under Orient sub-area, MCL.  | Apr-2019 to Sept-2019 |
| 14      | Preparation of Scheme, e-NIT & cost estimate for the job of Automatic Fire Fighting System as per IS-3034-1983 for oil filled transformers of BG Area (i) Batundhara West OCP s/s 2X 3.15 MVA 33/6.6 kV & (ii) Kulda OCP s/s 2X3 MVA, 33/6.6 kV, MCL.  | Apr-2019 to Sept-2019 |
| 15      | Preparation of Scheme, e-NIT & cost estimate for Supply, Installation and Commissioning of 02(two) nos. Elemental Cross-Belt Analyzer required to be installed at Coal Handling Plant of Jagannath Colliery.   | Aug-2019 to Feb-2020  |
| 16      | Energy Audit/ Benchmarking of energy consumption of Baram OCP & Samaleswari OCP, MCL.  | July-2019 to Dec-2019 |

Contd. Page 4

*R*



| Sl. No. | Particulars   | Tentative Schedule |
|---------|---|--------------------|
| 1       | <b>Washery Deptt. Jobs</b>  |                    |
| 1       | Scrutiny of Drawings of L1 Bidder and Assistance during Trial Run & Performance Guarantee Test (PGT) for setting up of Jagannath Washery (10 Mty) on BOM Concept.   | Continuing         |
| 2       | Scrutiny of Drawings of L1 Bidder and Assistance during Trial Run & Performance Guarantee Test (PGT) for setting up of Hingula Washery (10 Mty) on BOM Concept.   | Continuing         |
| 3       | Scrutiny of Drawings of L1 Bidder and Assistance during Trial Run & Performance Guarantee Test (PGT) for setting up of Basundhara Washery (10 Mty) on BOM Concept.  | Continuing         |
| 4       | <b>Civil Deptt. Jobs</b>  |                    |
| 1       | Design and drawing for Deter Repair Shop for Garjanbhal OCP of Basundhara Area.   | Dec-2019           |
| 2       | Design of Sewage Treatment Plant (STP) for Basundhara Colony, MCL.  | Dec-2019           |
| 3       | Design and estimation of VIP Guest House at Basundhara Area.  | Dec-2019           |
| 4       | Design of Heavy Repair Shop (Machine Shop) at Garjanbhal OCP.   | Dec-2019           |
| 5       | NDT/Structural Stability Test of all the industrial buildings inside the workshop premises at CWS (X), Talcher.   | Mar-2020           |
| 6       | NDT/Structural Stability Test of 84 nos. of Watch Towers at CWS (X), Talcher.   | Nov-2019           |
| 7       | NDT/Structural Stability Test of 61 no. Overhead Water Tank at CWS (X), Talcher.  | Sept-2019          |
| 8       | Preparation of fresh e-Tender document for transportation of raw coal by pipe conveyor to Ib Valley Washery (10 MTY) and construction of SILO/CHP with conveyor to dispatch washed coal at Lakhimpur OCP. | July 2019          |
| 9       | Preparation of scheme/e-Tender document of CHP (15 MTY) with Rapid Loading System with surge bin arrangement for Ananta OCP, Jagannath Area.  | Oct. 2019          |
| 10      | Preparation of e-Tender document of CHP (10 MTY) and Rapid Loading System with Surge Bin (Not SILO) of Gopali-Kanha OCP, Kanha Area.  | Dec. 2019          |
| 11      | Preparation of tender document for construction of SILO/BLS for Harpal hulu at BG Area.   | Dec. 2019          |
| 12      | <b>Excavation Deptt Jobs</b>  |                    |
| 1       | Diesel benchmarking of 12 OC mines (Basundhara, Garjanbhal, Lajkora, Samalpur, Belpahar, Lakhimpur, Hingula, Balaram, Ananta, Jagannath, Bharatpur & Lingara)   | As per requirement |

XXXXXXXXXXXXXXXXXXXX

WITH REPLY  
पर्यावरण एवं वन विभाग  
Government of India  
Ministry of Environment & Forests

CGM (I/W)

संख्या : 360478  
दिनांक : 24/10/90  
प्राप्तकर्ता : पर्यावरण विभाग, को. बी. को. कम्प्लेक्स,  
पर्यावरण भवन, ए.ओ. कॉम्प्लेक्स  
लोदी रोड, नई दिल्ली-110003  
24th October, 1990

Office Memorandum

Sub: Kellogg Spacecast Project (a M.I.P.A.) - Environmental Clearance.

This has reference to letter No. 43011/18/85-CPA dated 21.9.90 on the above subject. The environmental aspects of the project have been examined and clearance is accorded subject to the following conditions:-

- (i) The emission levels should be maintained below the prescribed standard limit. In the event of levels of emissions exceeding the limit, the particular operation should be stopped and should not be started until the levels are brought back within permissible limit.
- (ii) The quality of effluents finally discharged into the main water course should conform to the standards prescribed by the Central/State Pollution Control Board. Regular monitoring of quality of effluents should be done at different points and recorded data furnished to this Ministry quarterly.
- (iii) The ultimate slopes of external dump should be maintained at a maximum of 28 degree.
- (iv) The forest land use for the proposed activity should be restricted to 85.201 ha. only. No change in land use plan as submitted to this Ministry vide letter No. 43011/18/85-CPA dated 21.9.90 should be made without the approval of this Ministry.
- (v) The rehabilitation package for the displaced person should be in conformity with the Government of India decision on rehabilitation.
- (vi) The reclamation of mined areas shall be implemented to make it compatible with the pre-mining land use pattern. The progress in this regard should be made available to this Ministry half-yearly for review. The strategies for release of land should be furnished within six months.
- (vii) The right of way for the proposed MCR should not fall on any Reserve Forest area.
- (viii) Noise levels should be maintained within the permissible limit, to avoid occupational health hazard to the persons working within the plant.
- (ix) All other pollution control measures listed in the EMP should be strictly implemented as per schedule.

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-2-

- (x) The depth of the water bodies must be kept to the minimum and approach slopes to the water should be made gentle to enable the water for fishery utilization.
- (xi) Regular safety audit should be done for fire hazards on any other major accident in the workshop.
- (xii) The capacity of the project shall not be increased without prior environmental clearance from this ministry.
- (xiii) A separate environmental management cell with suitably qualified people to carry out various functions relating to environmental management should be set up under the control of senior technical person who will directly report to Chief Executive. A Laboratory facility should be set up for collection and analysis of samples.
- (xiv) Adequate fund provision (Capital and recurring expenditure) Provided towards environmental control measure should not be diverted for any other purpose.
- (xv) The ministry or any other competent authority may stipulate any further condition at any stage.
- (xvi) This Ministry may revoke the clearance if implementation of stipulated condition is not satisfactory.

The above conditions will be enforced inter-alia under the water (Prevention & Control of Pollution) Act, 1974, the air (Prevention and Control of Pollution) Act, 1986 and the environment (Protection) Act, 1986.

(S.K. DAS)  
SCIENTIST 'SE'

Secretary,  
Deptt. of Coal  
Shastri Bhavan,  
New Delhi-110001

Copy for information to:-

1. Shri G.C. Mittal, Chairman-cum-Managing Director, South Eastern Coalfields Ltd., Sanpat Rd., P.O. Bilaspur, B.P. 495 01.
2. Shri A.K. Chatterjee, Conservator of Forests (Central), National Office (Western Zone), L-3/40, Anna Colony, Bhopal (M.P.).

(S.K. DAS)  
SCIENTIST 'SE'

22

No. S-143/89-FC  
Government of India  
Ministry of Environment & Forests  
Deptt. of Environment, Forests & Wildlife

Paryavaran Bhavan, CGO Complex,  
Lodi Road, New Delhi-110003.

September 28, 1990.

To

The Secretary  
Forest Department  
Govt. of Orissa,  
Bhubaneswar.

Subject:- Diversion of 85.81 ha. of forest land for Kalinga,  
opencast coal mining project in Dhenkanal Distt.

Sir,

I am directed to refer to your letter No.10F/CONS/9/  
88/2420 dated 1.2.89 on the above mentioned subject  
seeking prior approval of the Central Govt. in  
accordance with Section 2 of the Forest(Conservation)  
Act, 1980 and to say that the proposal has been  
examined by the Advisory Committee constituted by the  
Central Government under Section 3 of the aforesaid Act.

2. After careful consideration of the proposal of  
the State Government and on the basis of the recommen-  
dation of the above mentioned Advisory Committee, the  
Central Government hereby conveys its approval under  
Section 2 of the Forest(Conservation) Act, 1980 for  
release of 85.81 ha. of forest land for Kalinga opencast coal  
mining project in Dhenkanal District, subject to the follow-  
ing conditions :-

- i) The legal status of the forest land will remain unchanged
- ii) Compensatory plantation to be raised over equivalent  
non-forest land at the cost of the project. The non-  
forest land identified for this purpose should be handed  
over to the Forest Deptt. and notified as protected  
forests before the release of forest lands being  
diverted by these orders.
- iii) Mined over area to be reclaimed/restored after mining/  
quarrying is over.
- iv) In order that the construction labour and staff while  
working on the project in the forest area may not  
cause destruction to the forest area for meeting their  
fuelwood needs, the user agency will establish fuelwood  
deposits and will provide the fuelwood to them free of  
cost.
- v) Arrangements to be made by the project authorities for  
free supply of fuelwood or other sources of energy  
to the staff and labourers engaged in the project free  
of cost.
- vi) No explosives should be allowed to be stored in the  
forest area.
- vii) The conditions/safeguards proposed by the Environ-  
ment Wing of this Ministry while clearing the project.

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-2-

to be followed rigidly.

Yours faithfully,

*W*

( BHAGWAN SINGH )  
ASSTT. INSPECTOR GENERAL OF FORESTS.

Copy to :-

1. Principal CCF, Govt. of Orissa, Bhubaneswar.
2. CCF(Central), Regional Officer, Bhubaneswar.
3. Regional Office(RO), New Delhi.
- ✓ 4. Guard File.

*W*

( BHAGWAN SINGH )  
ASSTT. INSPECTOR GENERAL OF FORESTS.

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**Nó. 34012/(04)/2011-CPAM**  
**Government of India**  
**Ministry of Coal**

**New Delhi, the 9<sup>th</sup> March, 2016**

**To**

✓ **Shri M.L. Prajapati,**  
General Manager (Planning),  
Mahanadi Coalfields Limited,  
P.O. Jagruti Vihar, Burla,  
Distt. **SAMBALPUR-768020 (ODISHA)**(E-mail: [gmpl@mahadi.co.in](mailto:gmpl@mahadi.co.in))

|                |  |
|----------------|--|
| <b>Subject</b> | <b>Mining Plan and Mine Closure Plan for Balram Expansion OCP (Normative Capacity-15 Mty, Peak Capacity - 20 Mty) dated March, 2016.</b> |
|----------------|--|

Sir,

I am directed to refer to MCL's letter No MCL/HQ/Sambalpur/General Manager (Project)/16/1758 dated 06/09-03-2016 on the above cited subject and to forward herewith **04** copies of **Mining Plan and Mine Closure Plan for Balram Expansion OCP (Normative Capacity-15 Mty, Peak Capacity-20 Mty) dated March, 2016** of Mahanadi Coalfields Limited duly approved and signed on all pages by Adviser (Projects), Ministry of Coal.

Encl: As above.

  
**[J.P. Nagpal]**

Under Secretary to the Govt. of India



महानदी कोयला लिमिटेड

महानदी कोयला लिमिटेड

Mahanadi Coalfields Limited

(A subsidiary of Coal India Limited)

Office of the Company Secretary

Adm. Jagat Singh, B-2, MCL

Dist. Sambalpur - 751020 (Odisha)

CIN: U10102OR1987COIC000000

TeleFax No. 06622543077

Email id: secymcl@gmail.com

Website: www.mahanadi.coal.in



**MCL**

Ref. No. MCL/SBP/CS/BD-222/Ext/2020/406

Date: 21.02.2020

गोपनीय/CONFIDENTIAL

सेवा में,

महाप्रबंधक (P&P)

एम सी एल मुख्यालय, समबलपुर।

**Sub: Extract from the minutes of the 222nd meeting of Board of Directors of MCL held at 11.00 AM on Monday the 3rd February, 2020 at Eco Retreat, Ramchandi, Konark, Puri, Odisha – 752111.**

प्रिय महोदय,

आप के सूचनाई एवं उचित कार्यवाही हेतु एम.सी.एल. निदेशक मण्डल की 222 वी बैठक का उद्घृत दिया जा रहा है।

**222.C/20 Project Report, Balaram OC Expansion (15.0 Mty, 7.0 Mty incremental), Hingula Area.**

20.1 A presentation on the Project Report for Balaram Expansion OCP (Normative capacity 15.0Mty) (Peak Capacity 20.0 Mty) was made by CMPDI HQ, Ranchi. The suggestions/recommendations made in the Technical Sub-Committee meeting were also discussed.

20.2 MCL Board directed to incorporate the following:  
i) Minor deviations like Change in type/capacity of machines, method of coal handling/evacuation can be approved by CMD of the Subsidiary Company.  
ii) Any future requirement that may arise during the execution of the project, for which there is no capital provision mentioned in the Project Report, will be done through outsourcing only.

20.3 Thereafter, the MCL Board deliberated on the proposal in detail and based on the presentation and clarification offered by GM (P&P) and Planning Team of CMPDI, Ranchi, recommended the Project Report for Balaram Expansion OCP (Normative Capacity 15.0Mty-7 Mty incremental) with Partial Outsourcing Variant for an additional capital investment of Rs. 3,504.21 Crore as per the details brought out in the agenda note to CIL Board for further deliberation and approval.

20.4 The Chairman directed CS, MCL to assign the job to Dy. Manager (Finance), Company Secdt. for verification of the extra item, which are being approved by the FDs in anticipation of inclusion in the revised / expansion PFR of the project and required to be put up to Board for information.

**222.D/4 Information to Board of Directors of MCL regarding MoU 2019-20 duly signed between Mahanadi Coal fields Limited and Coal India Limited and Progress in achievement upto 3<sup>rd</sup> Quarter.**

Deferred. The Board directed to make a detailed presentation on the subject.

सचिव

*(Signature)*  
कंपनी सचिव

File No.34012/1/2015-CPAM

No. No.34012/01/2015  
Government of India  
Ministry of CoalNew Delhi, the 05<sup>th</sup> October, 2017

To

Shri Shekhar Saran,  
Chairman-cum-Managing Director,  
Central Mine Planning & Design Institute Limited,  
Gondwana Place, Kanks Road,  
Ranchi (Jharkhand) / FAX:0651-2230003 /  
E-mail:cmd.cmpdi@coalindia.in

|         |  |
|---------|--|
| Subject | Application from CMPDI for seeking recognition to their 42 Officers as Recognized Qualified Person (RQP) to prepare Mining Plans/Mine Closure Plans under Rule 226 of Mineral Concession Rule, 1960. |
|---------|--|

Sir,

I am directed to refer to CMPDI Ref. No. CMPDI:TS:2017/41.01/U/1043 dated 25.02.2017 and CMPDI:TS:2017/41.01/1042 dated 25.02.2017 on the above cited subject and to convey approval of the Central Government in the grant of recognition in favor of the following persons as competent person to prepare Mining Plan/ Mine Closure Plan for Coal/Lignite block(s) under Rule 22(c) of Mineral Concession Rule, 1960 for the assignment/ jobs undertaken by CMPDI up to 10 years from the date of issue of this letter or duly perform to the Company.

- (1) Anandji Prasad (2) Chiranjib Patra (3) Arvind Kumar Sharma (4) Shambhu Sharan (5) Pramod Kumar (6) Vivek Singh (7) Devendra Pratap Singh (8) Pankaj Pandey (9) Ashish Verma (10) Irshad Ahmad (11) Subrata Kundu (12) Partha Das (13) Sankat Chatterjee (14) Uma Shankar Singh (15) Manoj Kumar (16) P.R. Suresh (17) Ghanashyam Singh Gahlot (18) G.Y. Padmanabha Reddy (19) Sudhanshu Mishra (20) Rajesh Abuja (21) S.Jayakumar (22) Sanjeev Murlidhar Singh (23) Birendra Kumar Thakur (24) Sadanand Mahapatra (25) Badal Mausa (26) Siddhartha Shankar Banu (27) Gunter Srinivas (28) Shri Rajesh Rathan (29) Shri Arun Kr. Bal.
- (2) Shri G.Y. Padmanabha Reddy has been recognized as RQP for making Mining Plans/Mine Closure Plan for Opencast Coal Mines only.
- (3) RQP is required to comply with the provisions of all the concerned statutes and guidelines/circulars of the Govt. issued from time to time in regard to preparation of Mining Plans.

Yours Faithfully

Signature valid

Digitally signed by ANANDA  
KUMAR MANDAL  
Date: 2017.10.05 13:21:19 IST(A.K. Mandal)  
Under Secretary to the Govt. of India  
Tel: 011-23073937

✓ Copy to TD, NIC, Ministry of Coal for including in the list of RQP in Ministry of Coal's Web Site.

## CERTIFICATE

1. *Certified that the provisions of Mineral Conservation and Development Rules, 1988 and MCR, 1960 have been observed in the preparation of "Mining Plan and Mine Closure Plan of BALRAM OC EXPANSION (15.0 Mty) of MCL" and wherever specific permissions are required, the applicant will approach the concerned authorities.*
2. *Certified that provisions of Mines Act, 1952 and of the Rules and Regulations made thereunder have been observed in the preparation of this Mining Plan and that wherever specific permission is required the applicant will approach Director General of Mines Safety in the matter.*
3. *Certified further that the information furnished in this Mining Plan is based on approved Project Report of Balram OC Expansion (15Mty) and Mining stage plans prepared by COMPDI (HQ). Land details considered as per data provided by Project proponent (MCL). Certified further that the information furnished in this Mining Plan is true and correct to the best of my knowledge.*

GUNTUR SRINIVAS,  
RQP NO.34012/(01)/2015-CPAM DTD. 05.10.2017.

Place : Bhubaneswar  
Date :

# Annexure - 8

## Land Particulars:-

| Sl No | Particulars                              | As per approved PR & EC of Balaram OCP 8Mty | Additional Land of Balaram Expansion OC Project (15.00Mty) (Ext + Exp) | Additional Land of Balaram Expansion OC Project (15.00Mty) (8Mty + Ext + Exp) |
|-------|--|---|--|---|
| 1     | EXCAVATION AREA                          | 668.00                                      | 1195.70  | 1863.70   |
| 2     | EXTERNAL OB DUMP                         | 32.20                                       | 0.00   | 32.20   |
| 3     | BLASTING SAFETY ZONE (300 mtr)           | 370.00                                      | 0.00   | 370.00  |
| 4     | SAFETY BARRIER OF 7.5 mtr                | 0.00  | 9.30   | 9.30  |
| 5     | INFRASTRUCTURES                          | 14.80                                       | 60.00  | 74.80   |
| 6     | OTHERS (MAGAZINE SER, ROAD ETC)          | 224.00                                      | 0.00   | 224.00  |
| 7     | TOTAL MINING LEASE AREA                  | 1309.00                                     | 1265.00  | 2574.00   |
| 8     | COLONY                                   | 32.00                                       | 0.00   | 32.00   |
| 9     | R&R SITE                                 | 18.60                                       | 134.00   | 152.60  |
| 10    | OTHERS (RAT.MINE BOUNDARY + COLONY ROAD) | 20.40                                       | 0.00   | 20.40   |
| 11    | SUB TOTAL                                | 71.00                                       | 134.00   | 205.00  |
| 12    | TOTAL LEASE AREA                         | 1380.00                                     | 1399.00  | 2779.00   |

Manager (Survey)  
Balaram OCP

Project Officer  
Balaram OCP

SO(L&R)  
Hingula Area

General Manager  
Hingula Area

# Annexure - 8 (Cont..2/-)

| ADDL. LAND BALRAM EXPANSION PROJECT(15.0 MTY) |  |           |                |                 |                 |
|---|--|-----------|----------------|-----------------|-----------------|
| SL NO   | PARTICULARS  | UNIT      | TYPE OF LAND   |                 |                 |
|   |  |           | FOREST         | NON-FOREST      | TOTAL           |
| 1   | Quarry Excavation Area   | Ha        | 186.765        | 1008.935        | 1195.700        |
| 2   | Safety Zone  | Ha        | 1.851          | 7.449           | 9.300           |
| 3   | External OB Dump   | Ha        | 0.000          | 0.000           | 0.000           |
| 4   | Infrastructure(approach road,CHP,Workshop,Project Office,Etc.) | Ha        | 5.229          | 54.771          | 60.000          |
| 5   | Residential Colony   | Ha        | 0.000          | 0.000           | 0.000           |
| 6   | Rationalisation of project boundary                            | Ha        | 0.000          | 0.000           | 0.000           |
|   | <b>Sub- Total</b>  |           | <b>193.845</b> | <b>1071.155</b> | <b>1265.000</b> |
| 7   | R & R Site   | Ha        | 0.000          | 134.000         | 134.000         |
|   | <b>Grand Total</b>   | <b>Ha</b> | <b>193.845</b> | <b>1205.155</b> | <b>1399.000</b> |

**NB:-**

Land for R & R Site i.e=134.000Ha to be acquired beyond Mine lease hold Area

*[Signature]*  
 24/12/2020  
 Manager (Survey)  
 Balaram OCL

Chapter - 9

Pre-mining land use Details.

| 9.2 - LAND PRE-MINING LAND DATA IN RESPECT OF MP & MCP OF BALARAM EXPANSION PROJECT 15 MTY |                 |                |               |                |                |                |             |                |                |
|--|-----------------|----------------|---------------|----------------|----------------|----------------|-------------|----------------|----------------|
| Village  | Agriculture     | Township       | Grazing       | Barren         | Water bodies   | Roads          | Forest land | Total in Ac    |                |
| Banbaspur  | 121.80          | 7.16           | 8.26          | 39.709         | 10.482         | 2.978          | 23.52       | 213.909        |                |
| Brahmanbahal   | 228.65          | 20.26          | 26.37         | 24.72          | 11.63          | 6              | 76.25       | 393.88         |                |
| Birahapur  | 64.41           | 6.64           | 3.25          | 3.81           | 2.3            | 0.92           | 10.76       | 92.09          |                |
| Daniel   | 82.811          | 0.83           | 0             | 0.36           | 2.969          | 0              | 4.17        | 91.14          |                |
| Danara   | 901.67          | 1.76           |               | 16.58          | 13.24          | 6.15           | 51.62       | 991.02         |                |
| GP Khumar  | 119.99          | 4.54           | 2.87          | 0.96           | 2.89           | 0.8            | 0           | 132.05         |                |
| Kalamchhuin  | 1308.5          | 61.485         | 10.58         | 11.82          | 53.89          | 39.31          | 66.17       | 1551.755       |                |
| Khuringga  | 142.20          | 3.41           | 6.81          | 0.36           | 5.88           | 2.31           | 7.72        | 166.69         |                |
| Majhika  | 67.52           | 43.94          | 5.5           | 1.98           | 5.14           | 8.79           | 26.71       | 159.58         |                |
| Nathgaon   | 62.04           | 2.92           | 3.34          | 1.97           | 7.12           | 1.64           | 1.69        | 80.72          |                |
| Nakeipail  | 3.06            | 0.00           | 0.00          | 0.10           | 0.00           | 0.00           | 0.10        | 3.26           |                |
| Prasannagar  | 276.80          | 0.00           | 0.00          | 25.65          | 90.25          | 2.15           | 5.00        | 399.85         |                |
| Natada   | 123.41          | 0              | 0             | 0.46           | 1.25           | 1.14           | 0.11        | 126.37         |                |
| Salvabadipur   | 16.5            | 1.03           | 0.28          | 0.23           | 0.52           | 31.33          | 16.29       | 1181.74        |                |
| Solada   | 896.06          | 78.11          | 39.37         | 56.63          | 63.95          | 8.39           | 29.23       | 384.04         |                |
| Telpur   | 300.4           | 9.47           | 15.75         | 3.11           | 17.69          |                |             | 369.711        |                |
| GP Reserve Forest  |                 |                |               |                |                |                |             | 689.051        |                |
| <b>Total</b>   | <b>4717.821</b> | <b>241.555</b> | <b>122.38</b> | <b>188.449</b> | <b>289.201</b> | <b>111.908</b> | <b>Ha</b>   | <b>6360.37</b> | <b>2574.00</b> |

Total M.L. Area

23.7.20



CONFIDENTIAL**Mahanadi Coalfields Limited**

(A Subsidiary of Coal India Limited)

At/PO : Jagruti Vihar, Burla, Dist. Sambalpur-768020(Orissa)

Phone : PDX - 2542461 to 2542469, Fax : 0663-2542770

Ref. No. MCL/SBP/CS/BD-81/Excl/2006/ 3557

Date : July 14, 2006

To  
The CGM/CTS to CMD  
Mahanadi Coalfields Limited,  
Sambalpur.

Sub : Extract from the Draft Minutes of the 81<sup>st</sup> meeting of the Board of Directors of MCL held at 11.00 AM on Monday the 26<sup>th</sup> June, 2006 at Kolkata.

Dear Sir,

Reproduced below is the extract of minutes of the above meeting of the Board of Directors for your information and necessary action.

81.C/2 National Conference on India's Energy Security, Coal and Alternative Energy Resources at Kolkata- giving full page advertisement for Rs.2.00 lakh regarding.

The Board deliberated on the subject and in consideration of the facts highlighted in the agenda note and in recognition of the clarifications offered during deliberation, accorded its post-facto approval for the proposal of co-sponsorship for the National Conference and release of a full page advertisement for Rs.2.00 lakh in that context by MCL.

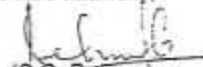
81.D/3 Re-organisation of Areas of MCL.

The Board noted the information as brought out in the agenda note.

81.D/4 Change of name of Kalinga CCP - regarding.

The Board noted the information as brought out in the agenda note.

Yours faithfully,

  
(S.C. Behera)  
Company Secretary

De

308

MAHANADI COALFIELDS LIMITED  
SAMBALPUR

Item No. 81.D/ 4

Note for the 81<sup>st</sup> Meeting of the Board of Directors of MCL

Sub : Change of name of Kalinga OCP - regarding.

The Functional Directors (FDs) of MCL in its 154<sup>th</sup> meeting held on 10<sup>th</sup> April, 2006 as regards to change of name of Kalinga OCP has decided as follows:

*"The FDs deliberated on the subject in detail and in consideration of the facts and circumstances highlighted in the proposed note and based on the clarifications offered during deliberation, approved the proposal to change the name of Kalinga OCP as Balram OCP placing the same under administrative control of Hingula Area with immediate effect.*

*This decision of change of name shall be informed to MCL Board, CIL and Ministry of Coal, Govt. of India, the FDs directed."*

A copy of Office Order No.MCL/HQ/ /EE/2006/4971 dt. 11<sup>th</sup> April, 2006 brought out consequent to above decision is attached for reference.

Submitted for kind information of the Board of Directors.

Company Secretary



ମହାନଦୀ କୋଲଫିଲ୍ଡସ୍ ଲିମିଟେଡ୍ 309  
 MAHANADI COALFIELDS LIMITED

(A Subsidiary of Coal India Limited)

P.O. - Jagruti Vihar, Burla, Dist-Sambalpur-768020 (Orissa)

Gram : SAMBCOAL, Fax: 0663-2542770

Phone: PBX:- 0663-2542461 to 2542469

Annexure - 9 (Cont..)

Ref. No. MCL/HQ/EE/2006/ 4971

Date: 11.04.2006

OFFICE ORDER

"Kalinga Opencast Project" is, hereby, renamed as "Bairam Opencast Project".

This issues with the approval of the competent authority.

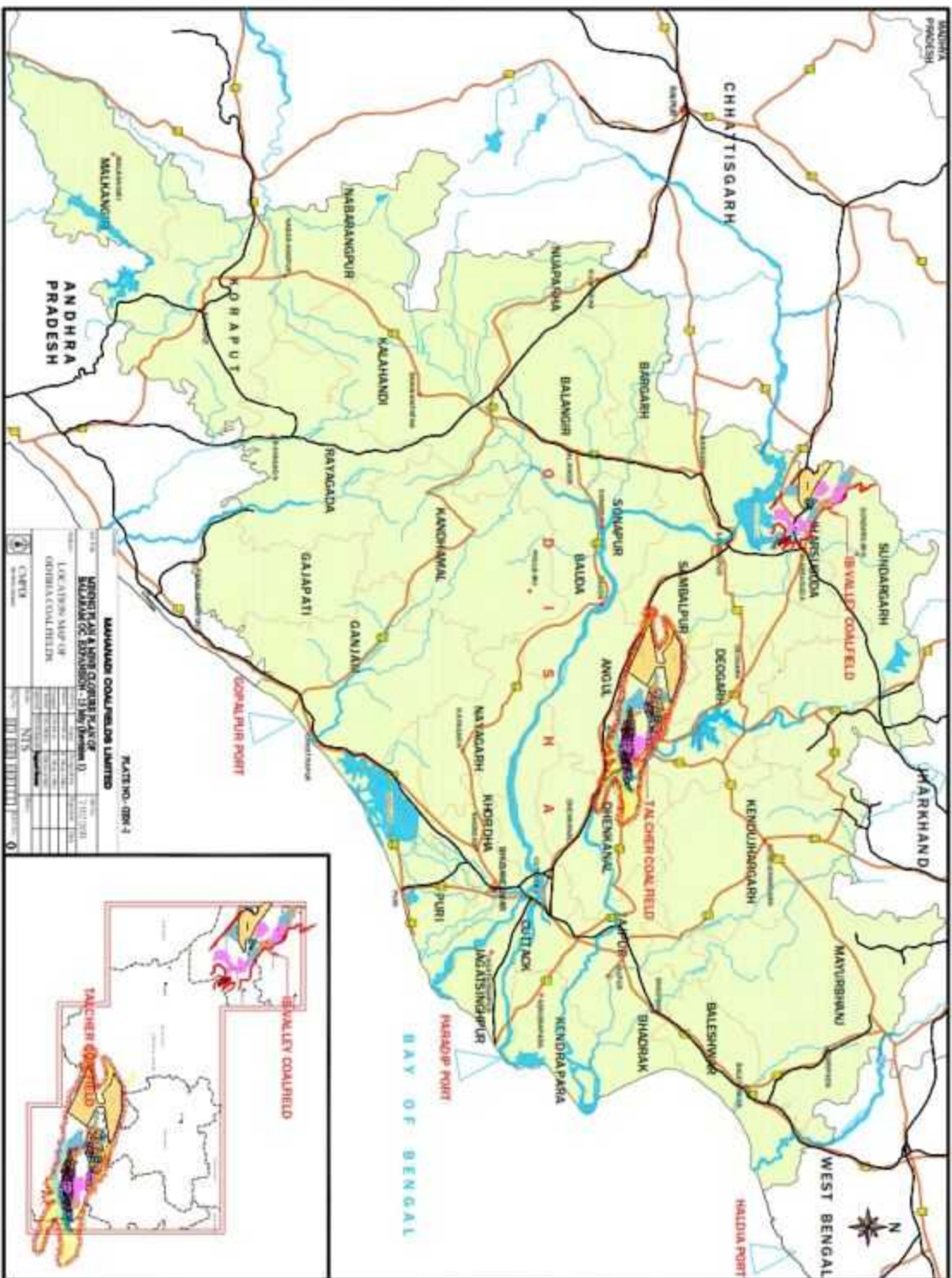
11-11-06

(D. E. Janolkar)  
 General Manager (A&EE)

Distributions:-

01. CVO, MCL
02. CGM/GMs, MCL, All Areas
03. All HODs MCL HQ.
04. TS to CMD/D(F)/D(P)/D(T), MCL (Company Secy.)
05. PM(PR), MCL HQ.
06. ES to CMD/Secy to D(F)/Secy to D(T), MCL HQ.
07. Company Secretary, MCL - For informing to MCL Board accordingly.
08. CC/IAF

Digitized by Srujanika@gmail.com



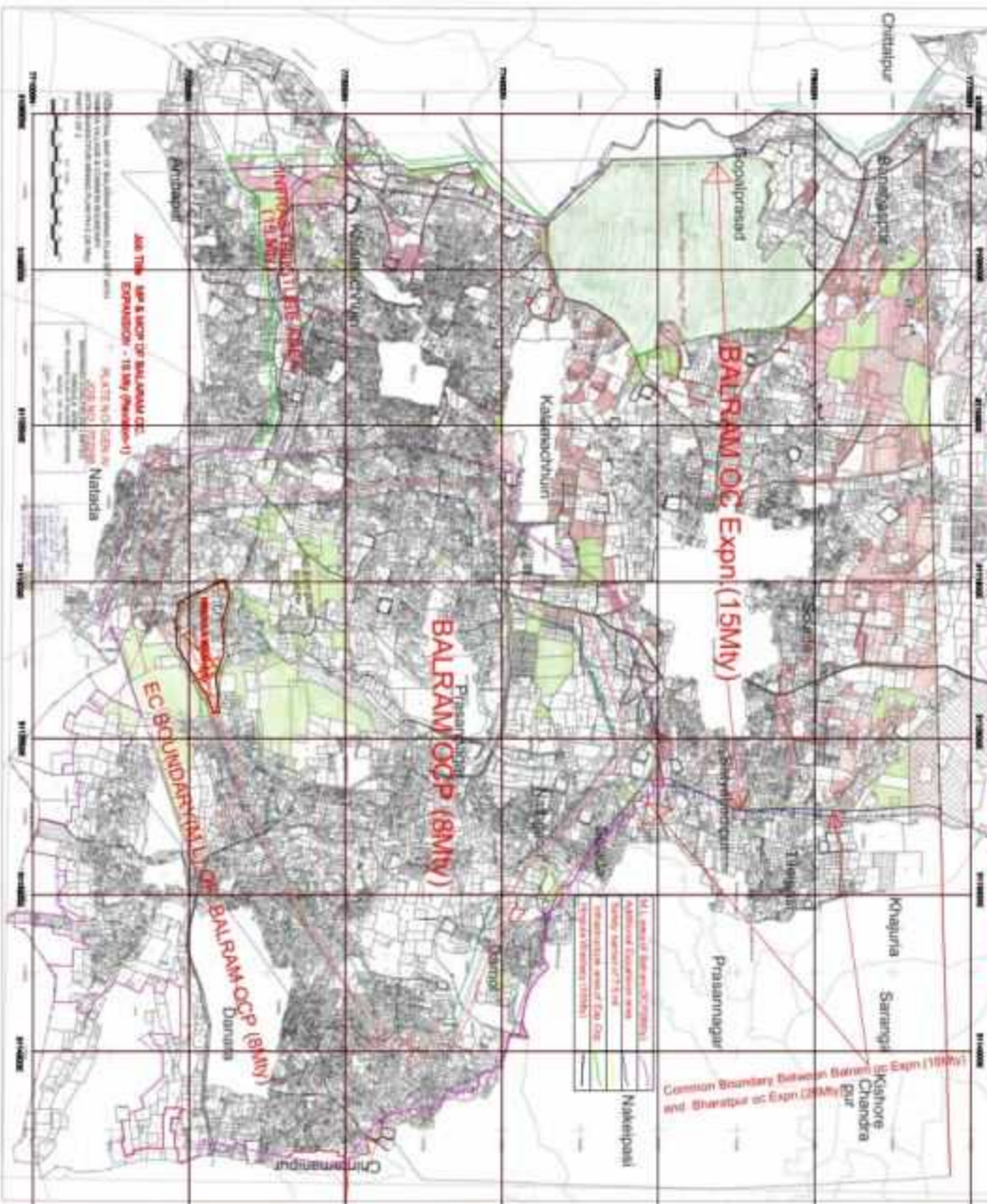








## Bairn



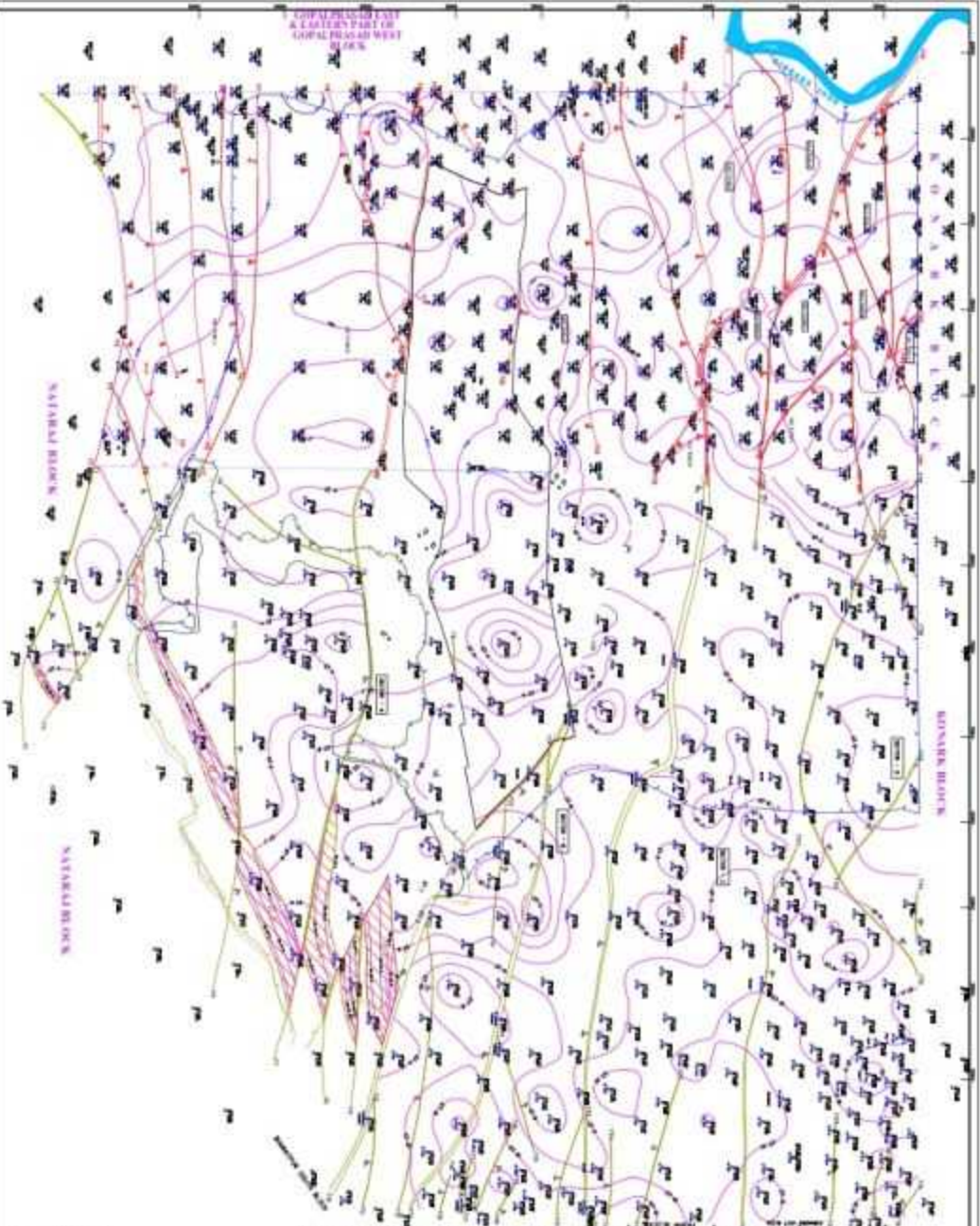








CONTOUR LINES EAST  
A EASTERN PART OF  
SOUTHERN PART OF  
SOUTHERN PART OF  
SOUTHERN PART OF



BOVARD BLOCK

NATURAL BLOCK

NATURAL BLOCK



| Legend              | Symbol |
|---------------------|--------|
| 1. Road             | —      |
| 2. River            | —      |
| 3. Contour line     | —      |
| 4. Boundary line    | —      |
| 5. Water body       | —      |
| 6. Forest area      | —      |
| 7. Cultivated land  | —      |
| 8. Unutilized land  | —      |
| 9. Water body       | —      |
| 10. Forest area     | —      |
| 11. Cultivated land | —      |
| 12. Unutilized land | —      |
| 13. Water body      | —      |
| 14. Forest area     | —      |
| 15. Cultivated land | —      |
| 16. Unutilized land | —      |
| 17. Water body      | —      |
| 18. Forest area     | —      |
| 19. Cultivated land | —      |
| 20. Unutilized land | —      |

| Legend              | Symbol |
|---------------------|--------|
| 1. Road             | —      |
| 2. River            | —      |
| 3. Contour line     | —      |
| 4. Boundary line    | —      |
| 5. Water body       | —      |
| 6. Forest area      | —      |
| 7. Cultivated land  | —      |
| 8. Unutilized land  | —      |
| 9. Water body       | —      |
| 10. Forest area     | —      |
| 11. Cultivated land | —      |
| 12. Unutilized land | —      |
| 13. Water body      | —      |
| 14. Forest area     | —      |
| 15. Cultivated land | —      |
| 16. Unutilized land | —      |
| 17. Water body      | —      |
| 18. Forest area     | —      |
| 19. Cultivated land | —      |
| 20. Unutilized land | —      |

| Legend              | Symbol |
|---------------------|--------|
| 1. Road             | —      |
| 2. River            | —      |
| 3. Contour line     | —      |
| 4. Boundary line    | —      |
| 5. Water body       | —      |
| 6. Forest area      | —      |
| 7. Cultivated land  | —      |
| 8. Unutilized land  | —      |
| 9. Water body       | —      |
| 10. Forest area     | —      |
| 11. Cultivated land | —      |
| 12. Unutilized land | —      |
| 13. Water body      | —      |
| 14. Forest area     | —      |
| 15. Cultivated land | —      |
| 16. Unutilized land | —      |
| 17. Water body      | —      |
| 18. Forest area     | —      |
| 19. Cultivated land | —      |
| 20. Unutilized land | —      |

Scale 1:50,000

Scale 1:50,000

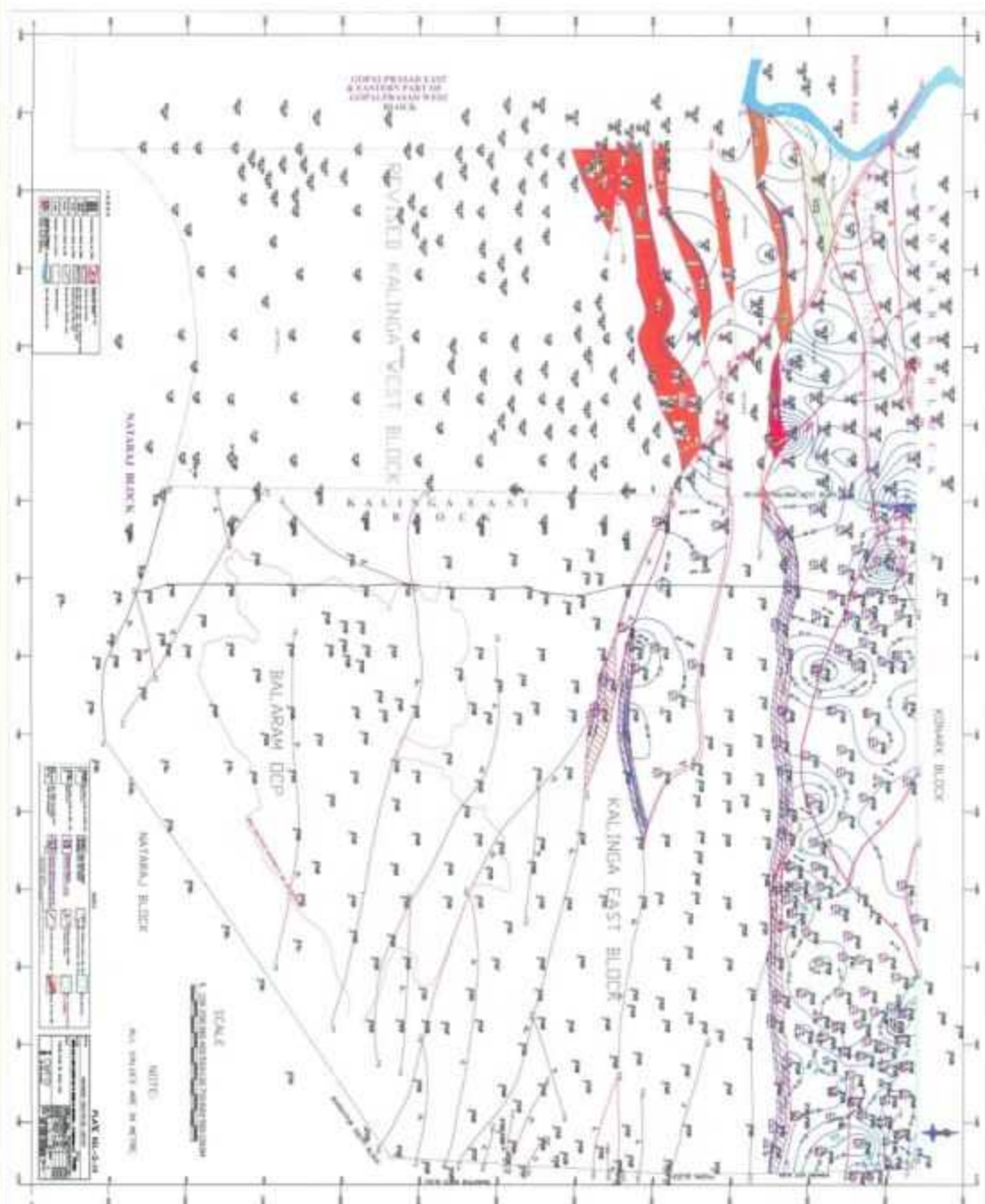
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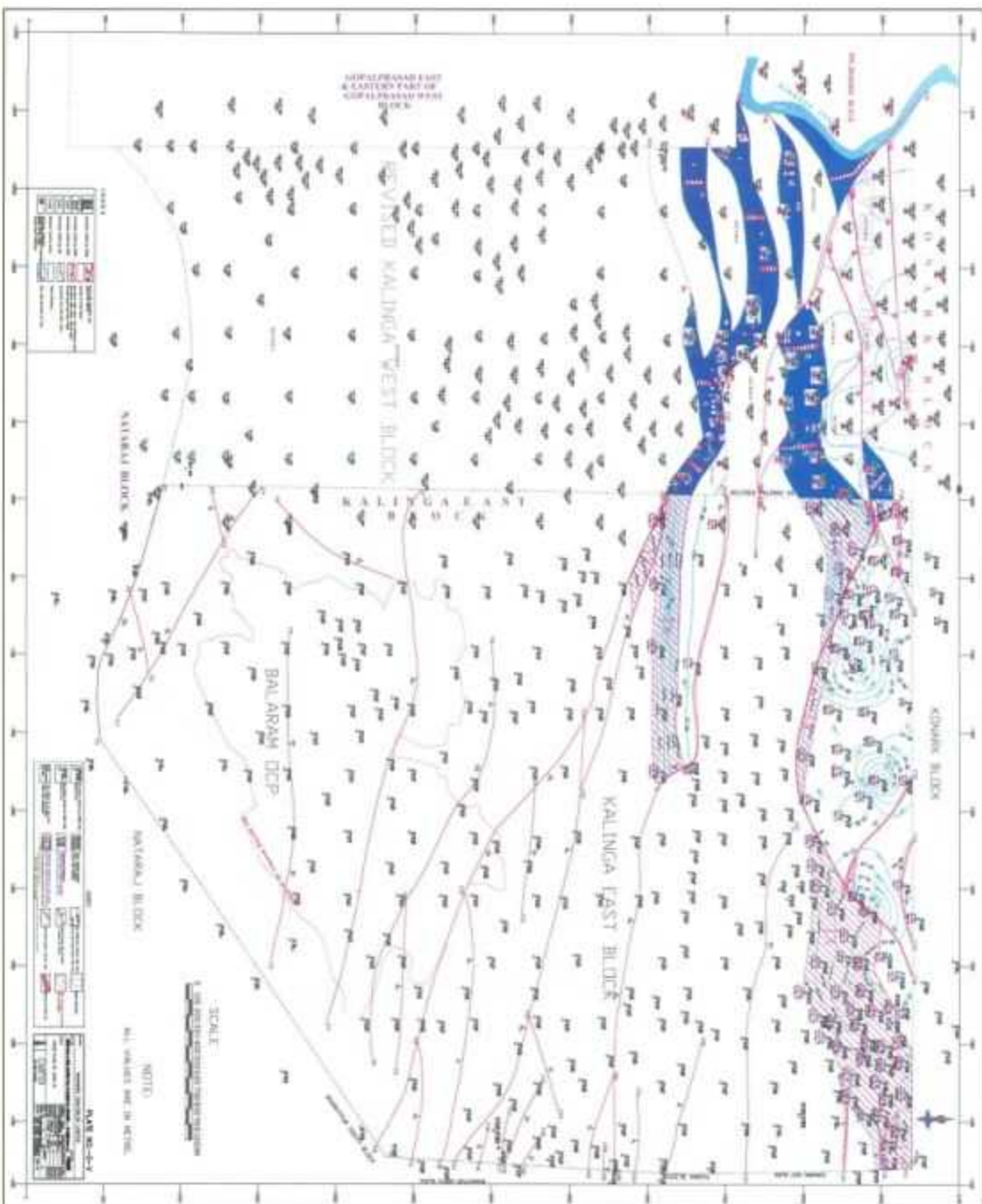
Scale 1:50,000

Scale 1:50,000

Scale 1:50,000

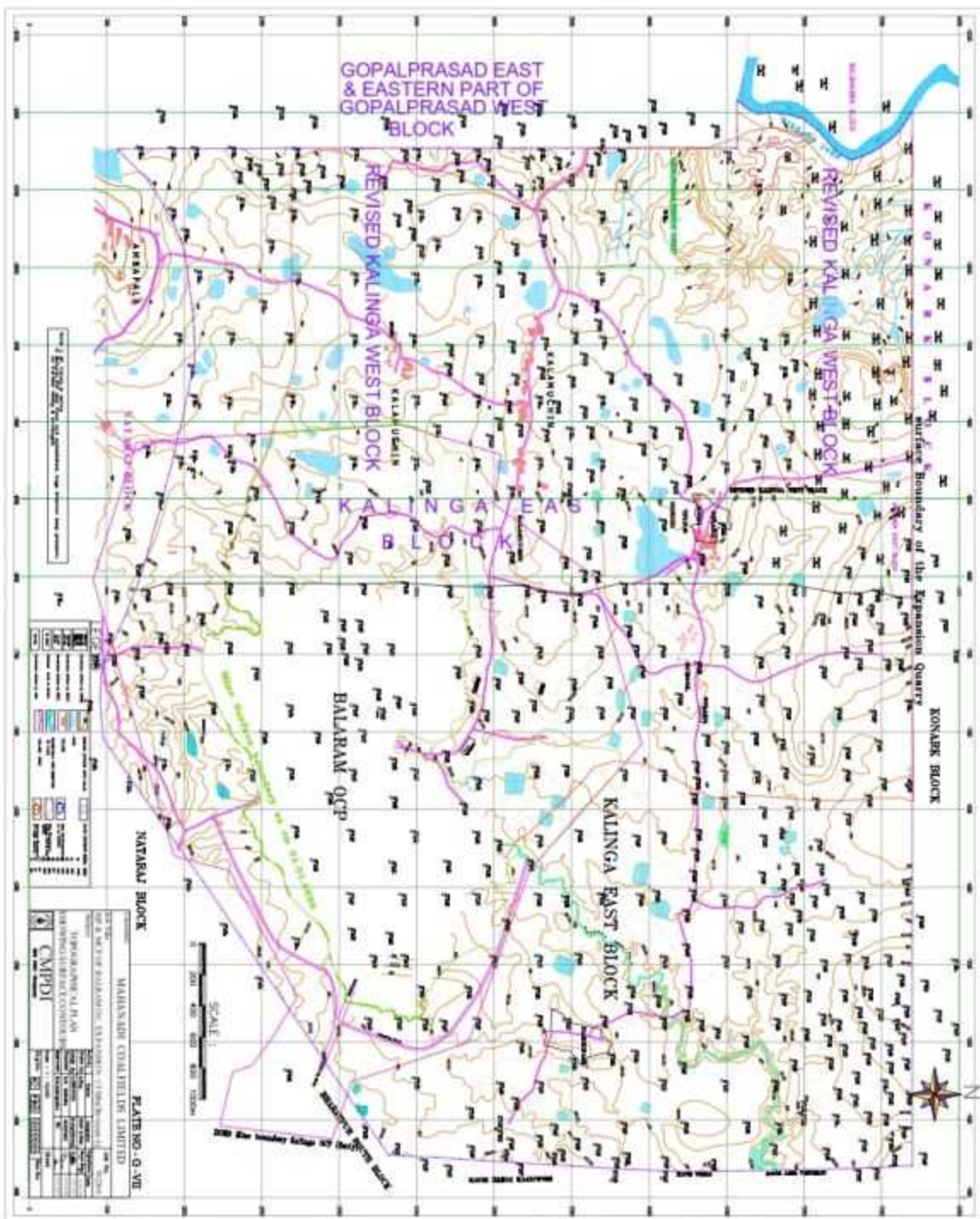


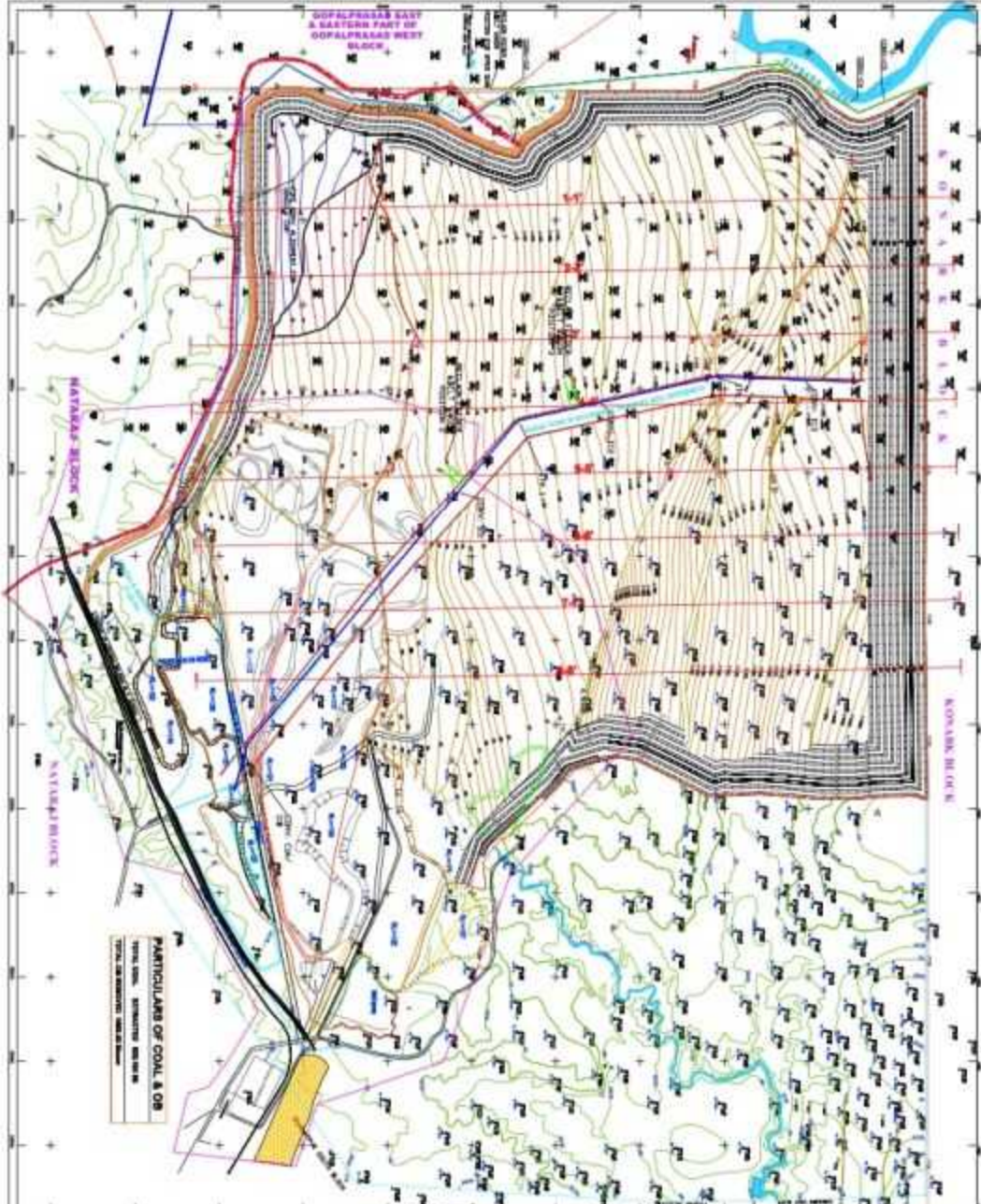












**Reference Drawings**

| No. | Particulars              | Ref. Number |
|-----|--------------------------|-------------|
| 1   | Scale                    | 1:100,000   |
| 2   | North Arrow              | N           |
| 3   | Particulars of Coal & Or | 1-50        |
| 4   | Legend                   | 1-50        |
| 5   | Scale                    | 1:100,000   |
| 6   | North Arrow              | N           |
| 7   | Particulars of Coal & Or | 1-50        |
| 8   | Legend                   | 1-50        |
| 9   | Scale                    | 1:100,000   |
| 10  | North Arrow              | N           |
| 11  | Particulars of Coal & Or | 1-50        |
| 12  | Legend                   | 1-50        |
| 13  | Scale                    | 1:100,000   |
| 14  | North Arrow              | N           |
| 15  | Particulars of Coal & Or | 1-50        |
| 16  | Legend                   | 1-50        |
| 17  | Scale                    | 1:100,000   |
| 18  | North Arrow              | N           |
| 19  | Particulars of Coal & Or | 1-50        |
| 20  | Legend                   | 1-50        |
| 21  | Scale                    | 1:100,000   |
| 22  | North Arrow              | N           |
| 23  | Particulars of Coal & Or | 1-50        |
| 24  | Legend                   | 1-50        |
| 25  | Scale                    | 1:100,000   |
| 26  | North Arrow              | N           |
| 27  | Particulars of Coal & Or | 1-50        |
| 28  | Legend                   | 1-50        |
| 29  | Scale                    | 1:100,000   |
| 30  | North Arrow              | N           |
| 31  | Particulars of Coal & Or | 1-50        |
| 32  | Legend                   | 1-50        |
| 33  | Scale                    | 1:100,000   |
| 34  | North Arrow              | N           |
| 35  | Particulars of Coal & Or | 1-50        |
| 36  | Legend                   | 1-50        |
| 37  | Scale                    | 1:100,000   |
| 38  | North Arrow              | N           |
| 39  | Particulars of Coal & Or | 1-50        |
| 40  | Legend                   | 1-50        |
| 41  | Scale                    | 1:100,000   |
| 42  | North Arrow              | N           |
| 43  | Particulars of Coal & Or | 1-50        |
| 44  | Legend                   | 1-50        |
| 45  | Scale                    | 1:100,000   |
| 46  | North Arrow              | N           |
| 47  | Particulars of Coal & Or | 1-50        |
| 48  | Legend                   | 1-50        |
| 49  | Scale                    | 1:100,000   |
| 50  | North Arrow              | N           |

**Scale:** 1:100,000

**North Arrow:** N

**Particulars of Coal & Or:**

| Coal | Or |
|------|----|
| 1    | 1  |
| 2    | 2  |
| 3    | 3  |
| 4    | 4  |
| 5    | 5  |
| 6    | 6  |
| 7    | 7  |
| 8    | 8  |
| 9    | 9  |
| 10   | 10 |
| 11   | 11 |
| 12   | 12 |
| 13   | 13 |
| 14   | 14 |
| 15   | 15 |
| 16   | 16 |
| 17   | 17 |
| 18   | 18 |
| 19   | 19 |
| 20   | 20 |
| 21   | 21 |
| 22   | 22 |
| 23   | 23 |
| 24   | 24 |
| 25   | 25 |
| 26   | 26 |
| 27   | 27 |
| 28   | 28 |
| 29   | 29 |
| 30   | 30 |
| 31   | 31 |
| 32   | 32 |
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| 34   | 34 |
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| 42   | 42 |
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| 46   | 46 |
| 47   | 47 |
| 48   | 48 |
| 49   | 49 |
| 50   | 50 |

**Scale:** 1:100,000

**North Arrow:** N

**Particulars of Coal & Or:**

| Coal | Or |
|------|----|
| 1    | 1  |
| 2    | 2  |
| 3    | 3  |
| 4    | 4  |
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| 12   | 12 |
| 13   | 13 |
| 14   | 14 |
| 15   | 15 |
| 16   | 16 |
| 17   | 17 |
| 18   | 18 |
| 19   | 19 |
| 20   | 20 |
| 21   | 21 |
| 22   | 22 |
| 23   | 23 |
| 24   | 24 |
| 25   | 25 |
| 26   | 26 |
| 27   | 27 |
| 28   | 28 |
| 29   | 29 |
| 30   | 30 |
| 31   | 31 |
| 32   | 32 |
| 33   | 33 |
| 34   | 34 |
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| 38   | 38 |
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| 47   | 47 |
| 48   | 48 |
| 49   | 49 |
| 50   | 50 |

**Scale:** 1:100,000

**North Arrow:** N

**Particulars of Coal & Or:**

| Coal | Or |
|------|----|
| 1    | 1  |
| 2    | 2  |
| 3    | 3  |
| 4    | 4  |
| 5    | 5  |
| 6    | 6  |
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| 48   | 48 |
| 49   | 49 |
| 50   | 50 |

**Scale:** 1:100,000

**North Arrow:** N

**Particulars of Coal & Or:**

| Coal | Or |
|------|----|
| 1    | 1  |
| 2    | 2  |
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| 27   | 27 |
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| 31   | 31 |
| 32   | 32 |
| 33   | 33 |
| 34   | 34 |
| 35   | 35 |
| 36   | 36 |
| 37   | 37 |
| 38   | 38 |
| 39   | 39 |
| 40   | 40 |
| 41   | 41 |
| 42   | 42 |
| 43   | 43 |
| 44   | 44 |
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| 46   | 46 |
| 47   | 47 |
| 48   | 48 |
| 49   | 49 |
| 50   | 50 |

**Scale:** 1:100,000

**North Arrow:** N

**Particulars of Coal & Or:**

| Coal | Or |
|------|----|
| 1    | 1  |
| 2    | 2  |
| 3    | 3  |
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| 48   | 48 |
| 49   | 49 |
| 50   | 50 |

**Scale:** 1:100,000

**North Arrow:** N

**Particulars of Coal & Or:**

| Coal | Or |
|------|----|
| 1    | 1  |
| 2    | 2  |
| 3    | 3  |
| 4    | 4  |
| 5    | 5  |
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| 16   | 16 |
| 17   | 17 |
| 18   | 18 |
| 19   | 19 |
| 20   | 20 |
| 21   | 21 |
| 22   | 22 |
| 23   | 23 |
| 24   | 24 |
| 25   | 25 |
| 26   | 26 |
| 27   | 27 |
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| 30   | 30 |
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| 37   | 37 |
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| 39   | 39 |
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| 49   | 49 |
| 50   | 50 |

**Scale:** 1:100,000

**North Arrow:** N

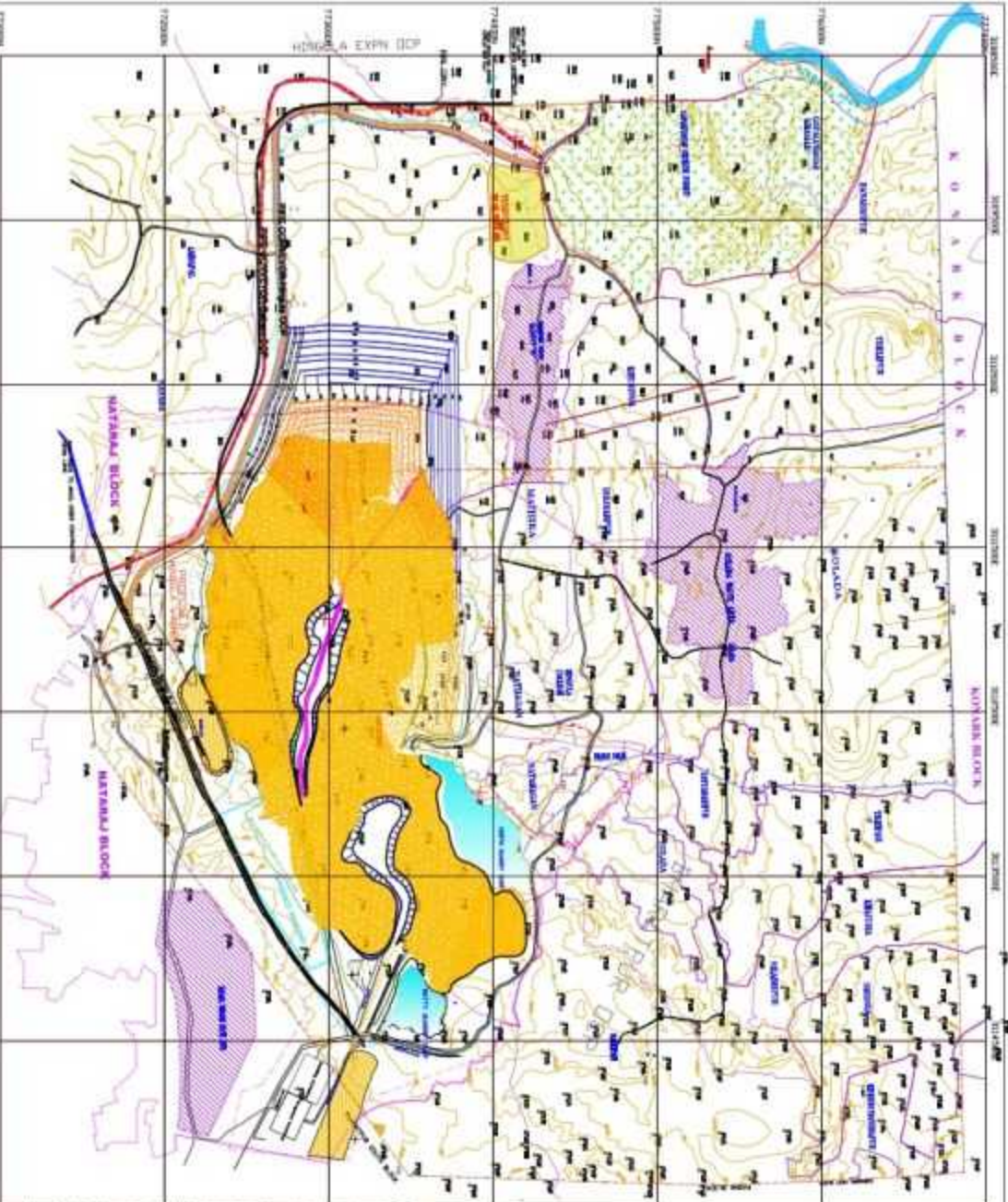
**Particulars of Coal & Or:**

| Coal | Or |
|------|----|
|------|----|





| Metadata  |                                     | Particulars              | Approved |
|---|-------------------------------------|--------------------------|----------|
| By  | For                                 | As shown on the drawings |          |
| Legend  |                                     |                          |          |
| Sl. No.   | Particulars                         | Symbol                   |          |
| 1   | Existing boundary                   | —                        |          |
| 2   | Proposed boundary                   | ---                      |          |
| 3   | Proposed boundary (to be confirmed) | ---                      |          |
| 4   | Proposed boundary (to be confirmed) | ---                      |          |
| 5   | Proposed boundary (to be confirmed) | ---                      |          |
| 6   | Proposed boundary (to be confirmed) | ---                      |          |
| 7   | Proposed boundary (to be confirmed) | ---                      |          |
| 8   | Proposed boundary (to be confirmed) | ---                      |          |
| 9   | Proposed boundary (to be confirmed) | ---                      |          |
| 10  | Proposed boundary (to be confirmed) | ---                      |          |
| 11  | Proposed boundary (to be confirmed) | ---                      |          |
| 12  | Proposed boundary (to be confirmed) | ---                      |          |
| 13  | Proposed boundary (to be confirmed) | ---                      |          |
| 14  | Proposed boundary (to be confirmed) | ---                      |          |
| 15  | Proposed boundary (to be confirmed) | ---                      |          |
| 16  | Proposed boundary (to be confirmed) | ---                      |          |
| 17  | Proposed boundary (to be confirmed) | ---                      |          |
| 18  | Proposed boundary (to be confirmed) | ---                      |          |
| 19  | Proposed boundary (to be confirmed) | ---                      |          |
| 20  | Proposed boundary (to be confirmed) | ---                      |          |
| Reference Drawings                                |                                     |                          |          |
| Sl. No.   | Particulars                         | Ref. Number              |          |
| 1   | Location Map                        | 1000-0000                |          |
| 2   | Location Map                        | 1000-0000                |          |
| 3   | Location Map                        | 1000-0000                |          |
| 4   | Location Map                        | 1000-0000                |          |
| 5   | Location Map                        | 1000-0000                |          |
| 6   | Location Map                        | 1000-0000                |          |
| 7   | Location Map                        | 1000-0000                |          |
| 8   | Location Map                        | 1000-0000                |          |
| 9   | Location Map                        | 1000-0000                |          |
| 10  | Location Map                        | 1000-0000                |          |
| 11  | Location Map                        | 1000-0000                |          |
| 12  | Location Map                        | 1000-0000                |          |
| 13  | Location Map                        | 1000-0000                |          |
| 14  | Location Map                        | 1000-0000                |          |
| 15  | Location Map                        | 1000-0000                |          |
| 16  | Location Map                        | 1000-0000                |          |
| 17  | Location Map                        | 1000-0000                |          |
| 18  | Location Map                        | 1000-0000                |          |
| 19  | Location Map                        | 1000-0000                |          |
| 20  | Location Map                        | 1000-0000                |          |
| Coal & O & B Details Up to Year-1 (up to 2020-21) |                                     |                          |          |
| Sl. No.   | Description                         | Quantity                 |          |
| 1   | Total Coal Estimated (Mt)           | 118.871                  |          |
| 2   | Total Coal Estimated (Mtpa)         | 118.871                  |          |
| 3   | Total Coal Estimated (Mtpa)         | 118.871                  |          |
| 4   | Total Coal Estimated (Mtpa)         | 118.871                  |          |
| 5   | Total Coal Estimated (Mtpa)         | 118.871                  |          |
| 6   | Total Coal Estimated (Mtpa)         | 118.871                  |          |
| 7   | Total Coal Estimated (Mtpa)         | 118.871                  |          |
| 8   | Total Coal Estimated (Mtpa)         | 118.871                  |          |
| 9   | Total Coal Estimated (Mtpa)         | 118.871                  |          |
| 10  | Total Coal Estimated (Mtpa)         | 118.871                  |          |
| 11  | Total Coal Estimated (Mtpa)         | 118.871                  |          |
| 12  | Total Coal Estimated (Mtpa)         | 118.871                  |          |
| 13  | Total Coal Estimated (Mtpa)         | 118.871                  |          |
| 14  | Total Coal Estimated (Mtpa)         | 118.871                  |          |
| 15  | Total Coal Estimated (Mtpa)         | 118.871                  |          |
| 16  | Total Coal Estimated (Mtpa)         | 118.871                  |          |
| 17  | Total Coal Estimated (Mtpa)         | 118.871                  |          |
| 18  | Total Coal Estimated (Mtpa)         | 118.871                  |          |
| 19  | Total Coal Estimated (Mtpa)         | 118.871                  |          |
| 20  | Total Coal Estimated (Mtpa)         | 118.871                  |          |



77°20'00"

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77°20'00"

77°20'00"





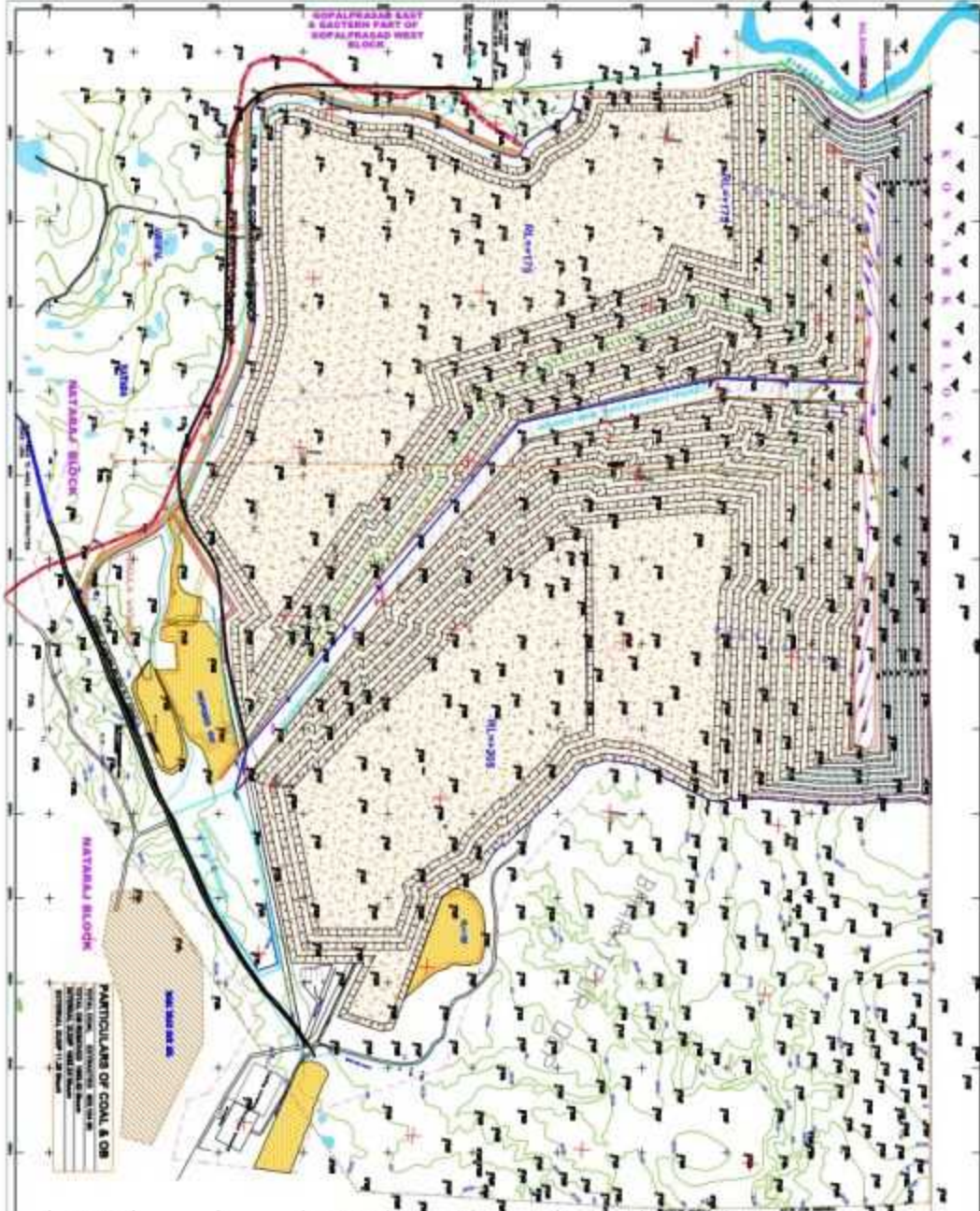












**PARTICULARS OF COAL & OS**

|             |       |       |       |
|-------------|-------|-------|-------|
| Block       | Area  | Coal  | OS    |
| SOPALPRASAD | 10000 | 10000 | 10000 |
| NATARAJ     | 10000 | 10000 | 10000 |
| SOPALPRASAD | 10000 | 10000 | 10000 |
| NATARAJ     | 10000 | 10000 | 10000 |

|   |  |   |
|---|--|---|
| <p><b>Legend</b></p> <p>1. Boundary of Block</p> <p>2. Boundary of Sub-block</p> <p>3. Boundary of Section</p> <p>4. Boundary of Mine</p> <p>5. Boundary of Road</p> <p>6. Boundary of River</p> <p>7. Boundary of Canal</p> <p>8. Boundary of Railway</p> <p>9. Boundary of Power Line</p> <p>10. Boundary of Telephone Line</p> <p>11. Boundary of Water Supply Line</p> <p>12. Boundary of Sewerage Line</p> <p>13. Boundary of Drainage Line</p> <p>14. Boundary of Other</p> |  | <p><b>Scale</b></p> <p>0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000</p> |
| <p><b>Particulars</b></p> <p>1. Block</p> <p>2. Sub-block</p> <p>3. Section</p> <p>4. Mine</p> <p>5. Road</p> <p>6. River</p> <p>7. Canal</p> <p>8. Railway</p> <p>9. Power Line</p> <p>10. Telephone Line</p> <p>11. Water Supply Line</p> <p>12. Sewerage Line</p> <p>13. Drainage Line</p> <p>14. Other</p>  |  | <p><b>Scale</b></p> <p>0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000</p> |





