

Executive Summary

1 Introduction

Maharashtra State Power Generation Company Limited (MAHAGENCO) is a State owned Public Sector Unit of Government of Maharashtra engaged in power generation having its Head office situated in Bandra (East), Mumbai. MAHAGENCO has proposed developing Gare Palma Sector II Coal Mine located in Mand Raigarh Coalfield, Chhattisgarh for its captive use. The proposed site falls in Mand Raigarh Coalfield belt and the mine area / project area / applied ML area is 2583.48 Ha. The mining plan was approved vide letter no. 34011/16/2016-CPAM dated 12.08.2016.

2 Project Description

Project Location

The coal mine is located in villages Tihli Rampur, Kunjemura, Gare, Saraitola, Murogaon, Radopali, Pata, Chitwahi, Dholnara, JhinkaBahal, Dolesara, Bhalumura, Sarasmal and Libra villages in Raigarh district of Chhattisgarh state.

Size and Magnitude of the Project

The total mine area consists of undulating terrain, more resistant sedimentary rocks stand out as ridges. Both opencast and underground operations are envisaged. The total extractable reserves in this area are 655.15 Million Tonne (MT). Details of ore reserves in Open cast and Underground mine on east & west side of Kelo River are given in **Table 1**.

Table 1
Details of Coal Reserves

Mine	Particulars		Geological Reserves (MT)		Extractable Reserves (MT)	Percentage of recovery (%)
OC	Net geological reserves down upto seam VI with minimum coal thickness of >0.5m	>0.9 m thickness	682.57	736.10	553.17	75.15
		<0.9 m thickness but >0.5 m thickness	53.53			
UG	Net Geological Reserves below seam VI with minimum coal thickness of >0.9m	>1.5 m thickness	235.95	323.19	101.97	31.55
		<1.5 m but >0.9 m thickness	87.24			
Grand Total			1059.29		655.15	-
Source: Approved Mining Plan: June 2016, Page ES-11						

Need of the Project

The capacity of the proposed project is to produce coal by both opencast (22.0 MTPA) and underground (1.6 MTPA) mining with peak capacity of OC will be 23.6 MTPA before the UG becomes operational. The total cost of the project is Rs.7642 Crores. The entire mine lease area covering part of the 14 villages is mostly in the form of private, government and forest land. The anticipated land use at the end of 5th year and at the end of mining operations is given in **Table 2**.

Table 2
Land Use at the End of Fifth Year and at the End of Mine Life

S.No	Land Use	At the end of 5 th Year of Mine operation	At the end of the Last year of mine operation
1	Excavation	380.70	2440.55
2	Backfilling	0.00	2109.49
3	Void	380.70	331.06*
4	Surface dump	380.00	0.00
5	Bund/Embankment	5.20	5.20
6	Top Soil Dump	60.00	0.00
7	Settling Pond**	10.00	5.00
8	Diverted Road	30.30	30.30
9	Facilities (West Part)	50.94	50.94
10	Facilities (East Part)	68.54	0.00
11	7.5 m green belt around ML boundary	12.44	12.44
12	Green belt along Kelo river 45 m west side and 15 m east side	23.63	23.63
13	Under Kelo river	15.42	15.42
14	Undisturbed area / Indirectly affected area/area for exploration	1566.31	0.00
Total		2583.48	2583.48

Source: Approved mining plan June 2016, Page 14-11

*331.06=195.15 Ha in East Pit with 170m depth + 135.91 Ha in West Pit with 60m depth

**Settling Pond 10 Ha in 5th Year (5 Ha for mine water + 5 Ha for dump runoff)

Topography & Drainage

The coal field is characterized by undulating and rolling topography, consisting of hills interspersed with broad valleys. The general elevation in the block area ranges from 242 m to 303 m above MSL and the surrounding area (upto 10 km) varies from 242 m and 640 m above MSL. The slope is towards south. The hills are relict type and rise about 450m above MSL.

The southerly flowing perennial Mand River with its tributaries constitute the main drainage of the area. The Kelo River, a tributary of Mahanadi flows from north to south through the south eastern part of the block and drains the eastern part of the coalfield. A few ponds are present within the block.

Proposed Schedule

The mining will begin with an aim of producing 11.80 MTPA from 5th year and peak capacity of 23.6 MTPA by 7th year onwards from OC. The total coal production in the first five years will be 20.30 MT. However, the production from OC will be reduced from 12th year with the start of UG mining operations such that the total production from the mine is continued at 23.6 MTPA. A higher production of 23.6 MTPA from opencast operation is feasible in some early years when the depth of mine and the lead lesser as compared to the sustained production of 22 MTPA envisaged from opencast operation. The UG mine is proposed to achieve a peak capacity of 1.6 MT of coal from the 15th year onwards. Accordingly the production from the OC will be kept steady at 22 MTPA from 15th year onwards.

The life of the OC mine will be about 29 years at annual production rate of 22 MT as per the calendar programme of production. The underground production is envisaged to start from 12th year and end in 77th year. Thus, including 3 years of construction (incline drive and shaft sinking etc.) the life of underground mine will be 69 years at production rate of 1.6 MTPA.

Method of Mining

In opencast mining shovel dumper combination has been recommended as an equipment system which is capable of dealing many layers at a time (flexibility of operations). Coal production will be done by surface miners while two rippers will be provided for use in isolated locations or thinner seams where deployment of CSMs may not be advisable due to time factors and economic factors. In underground mining mechanized bord and pillar mining with low height continuous miner and shuttle cars could be one of the suitable systems for an annual coal production of 1.60 MTPA by underground method in spite of disadvantage of high capital cost.

Transport of Coal

Coal will be transported to the TPPs through rail from the nearest available railway siding. A coal stack facility has been provided for accommodating about 3 days production. In opencast mining the coal from surface miners will be transported by 100T/150T coal body trucks and will not require any crushing. Front end loading machines with 8 m³ coal bucket will load the coal into trucks from coal heaps created by the surface miners to transport upto the hoppers within

the mine while 5 m³ bucket capacity front end loaders will be used for handling coal from the coal stack on the surface.

In underground mining a 1200mm “fire resistant” conveyor at around 3m/s with a duty equivalent to average 500 Tonne per hour (TPH) would be installed in the centre roadway to ensure equal tramming distances and cable lengths on each side of the loading point. Peaks of 750 TPH are expected.

Manpower

Around 3400 number of local personnel including land losers would be recruited in unskilled and semi-skilled categories after giving proper training and orientation before project starts. Skilled and highly skilled personnel if not available locally will be taken from outside. I.T.I. qualified young people from the region can be recruited for operation and maintenance job of plant and machinery after proper training

Blasting

In opencast mining shot holes are drilled into the horizontal bench cut by the shovel, the overburden benches are blasted using ANFO/SME/SMS with booster explosives and detonators or TLD and DTH combination. In the blasting operations, shaking blast practices are proposed using low powder factor. Short delay detonators shall be used. The control blasting techniques will be adopted at the time of blasting to reduce noise, ground vibrations and fly rocks. The daily requirement of explosives for coal production by opencast method will be 117.82 Te/day with maximum 135 Mcum annual overburden removal.

In underground mining it is planned to work by board & pillar underground mining method and the galleries are driven with the help of continuous miner. Hence no blasting is required for winning coal except drifting in stone. However, wedge cut is generally practiced and in section of 4.8X2.0 by putting around 18 holes, a pull of 1.5 m could be obtained getting muck around 32 tonnes in one round of blast, charging the holes between 0.5 to 0.6 kg each with permitted explosive like Soligex etc. Blasting efficiency could be achieved to over 3 tonne/kg.

Generation of Solid waste

In opencast mining the total overburden generated is around 2761.1 M Cum, which will be disposed in three disposal sites like Surface dumps, Backfill dump and Top soil dump which are located within the mine site. All the overburden generated will be rehandled by the end of the mine closure.

In underground mining the waste generated will be hauled through the inclines (using mine tubs or conveyor as applicable) or shaft (using mine tubs) to the pit top from where loaded into

dumpers through appropriate arrangement and disposed of on to the surface dumps (constructed for OC operations) or backfilled into the de-coaled area if available

Energy and Water Requirement

The estimated connected load comes to the tune of 70000 kW. The power will be fed to the project by 11 kV overhead line from the existing grid sub-station at Tamnar. Most of the HEMM equipment will be diesel operated except the high capacity shovels. Electrical power supply will be needed for coal handling plant, illumination, pumping, workshop and residential colony. The total water requirement for mining and allied activities is estimated as 2785 m³/day. Out of this 1239 m³/day will be potable water and the rest will be required for industrial use. The wastewater generated from the colony and working place will be treated in STP and will be reused greenbelt and dust suppression

Mine Drainage

The coalfield is characterized by undulatory and rolling topography, consisting of hills interspersed with broad valleys. The southerly flowing perennial Mand River with its tributaries constitute the main drainage of the area. The Kelo River, a tributary of Mahanadi, drains the eastern part of the coalfield.

In opencast mine the ultimate depth of the west pit will reach around 200 m. It will be planned to intercept the rain water as well as the seepage water at upper benches to the extent possible so that the water can be accumulated in sumps at 2-3 different elevations and the pumping can be accordingly planned with pumps of appropriate capacity and head.

In underground working the water will be automatically drained to the sump at the lower most part of the mine. Adequate provision for draining out the seepage water from the sump will be provided and the working face will be kept dry. The face pumps will pump the water to the intermediate stage sumps from where the pumps will be finally pumping the water to the surface reservoir.

3 Baseline Environmental Status

The baseline data was collected for various environmental components to compute the impacts that are likely to be arising out of the mining activities covering an area of 10 km radius from the proposed mine.

Meteorology (Climate)

Meteorological data was collected for the study area during the months of post monsoon season (October to December 2016). Wind speed, wind direction, temperature, and relative humidity were recorded on hourly basis during the study period.

The winds were predominantly recorded from E followed by ESE, ENE and NE. Calm conditions prevailed for 32.97% of the total time and the average wind speed is 1.34 m/sec. The average maximum temperature is 35.6⁰C and minimum is 12.7⁰C. The relative humidity is highest in the month of October at 90 %.

Air Quality

Around ten Ambient Air Quality Monitoring locations were monitored for SO₂, NO_x and Particulate Matter (PM) <2.5 µm and <10 µm in the study area.

- Range of 98th percentile of PM <2.5 µm is 19.6 to 27.5 µg/m³ and the range of PM<10 µm is between 36.7 to 49.8 µg/m³.
- Range of 98th percentile of SO₂ is 16.2 to 23.4 µg/m³ and the range for NO_x is between 23.6 to 30.5 µg/m³

The observed air pollutants were within the limits as per NAAQ standards.

Water Quality Status

Around 10 ground and 9 surface water samples were collected to assess the water quality. The ground water samples were drawn from bore wells of villages being used for domestic needs. Surface water samples were taken from lakes.

Ground Water

- The pH is varying from 6.71 to 7.19, indicating within acceptable limits.
- TDS levels are varying from 104 mg/l to 302 mg/l, indicating all samples are within the acceptable limit.
- Chloride levels are ranging from 16 mg/l to a maximum of 74 mg/l which are within acceptable limits.
- Hardness is varying from 70 mg/l to 205 mg/l. Hardness in one sample is falling above the acceptable limit but within the permissible limit and remaining nine samples are within the acceptable limit.
- The fluoride levels are in the range of 0.51 mg/l to 0.58 mg/l indicating all samples are within the acceptable limit.

Surface Water

- pH is varying between 6.51 to 7.12.
- The total dissolved solids are in the range of 72 mg/l to 328 mg/l.
- The chlorides are in the range of 12 mg/l to 53 mg/l.
- The hardness is varying between 69 mg/l to 188 mg/l.
- Fluoride levels of all samples were <0.5 mg/l.

Noise Quality

Baseline noise levels were monitored at 10 locations, using continuous noise measurement device. Day levels were monitored during 6 am to 10 pm and the night levels during 10 pm to 6 am. The day equivalents are ranging between 49.3 to 54.2 dB (A) whereas the night equivalents were in the range of 38.2 to 42.6 dB (A). From the results it can be seen that the day and Night equivalents were within the ambient noise standards of residential and commercial.

Soil Quality

Around 10 sampling locations were selected to assess the existing soil conditions representing various land use and geological features. The results are:

- pH values are varying from 6.56 to 7.23 indicating that all samples are falling in normal to saline class.
- Electrical conductivity is varying from 131 to 162 $\mu\text{s}/\text{cm}$ indicating Normal category soils.
- The organic carbon is varying from 0.12 – 0.96 % indicating 5 samples are in low range, 2 samples are in medium range and 3 samples are showing high range of carbon.
- Available nitrogen as N is varying from 264 to 341 kg/ha indicating 5 samples are falling in low range and remaining 5 samples are falling in medium range.
- Available phosphorus as P is varying from 10 to 21 kg/ha, which indicates that all samples are falling in medium range.
- Available potassium as K in the study area is varying between 287 to 370 kg/ha which indicates that all samples are falling in high range.

Flora & Fauna

Ecological survey was done to understand baseline ecological status, important floristic elements, fauna structure. Secondary data was collected from Forest Department, Raigarh

The dominant tree species found in the study area are Sal (*Shorea robusta*) is the major tree species forming top canopy, Aam (*Mangifera indica*), Imli (*Tamarindus indica*), Karanj (*Pongamia pinnata*), kekar (*Garuga pinnata*), Khor (*Acacia catechu*), Peepal (*Ficus religiosa*), Dhobin (*Dalbergia paniculata*) & Neem (*Azadirachta indica*) etc. Few climbers and twiners like *Acacia caesia*, *Celastrus paniculata*, *Cocculus hirsutus*, *Conbretum decandrum*, *Cissus quadrangularis*, *Aristolochia indica*, and *Asparagus racemosus* are also observed. Shrubs like *Calotropis procera*, *Calotropis gigantea*, *Cassia auriculata*, *Tecoma stans*, *Dodonaea viscosa*, *Gardenia gummifera*, *Clerodendrum serratum* etc., are a part of this type of vegetation. The dominant grasses & bamboos include species like *Aristida setaceae* *Apluda mutica*, *Andropogon* etc. The ground flora is chiefly seasonal.

There is no national park, wildlife sanctuary, biosphere reserve within 10 km of the study area. The project site does not have any species which fall under the Schedule I of The Indian Wildlife (Protection) Act, 1972 or under threatened category of the IUCN Red List of Threatened Species.

Socio-economics

Sample survey was done to collect qualitative information about the socio economic environment of the area. The Study area is mostly inhabited by economically weaker section people. Lack of amenities such as roads, drinking water, dwellings, lavatories, and education, employment, medical and electricity facilities was evident during the site visit.

As there will be displacement of 1679 families in all fourteen villages, a rehabilitation programme is required. The rehabilitation and resettlement benefits will be according to the Govt. of Chhattisgarh Policies and prevailing practice in industries in the Vicinity.

There will be less impact on surrounding villages due to the proposed project because the proposed mine is surrounded by other mine areas all around the project.

4 Anticipated Environmental Impacts and Mitigation Measures

Impact on Air Quality

The predicted maximum ground level concentrations of 24 hour average of particulate matter, SO₂ and NO_x concentrations are superimposed on the maximum baseline concentrations obtained during the study period to estimate the post project scenario, which would prevail at the post project operational phase.

The predicted incremental rise of combined industrial area for particulate matter is 9.7 µg/m³, for SO₂ the value is 0.3 µg/m³ and for NO_x the predicted value is 4.0 µg/m³. The overall post project scenario along with existing baseline concentrations of particulate matter, SO₂ & NO_x are found to be 59.5 µg/m³, 23.7 µg/m³ and 34.5 µg/m³ respectively, against the NAAQ standards of 100 µg/m³ and 80 µg/m³ for particulate matter, SO₂ & NO_x respectively.

Mitigation Measures

- Wet drilling method will be employed while carrying out the mining to decrease the dust generation.
- The underground workings of the mine will be well ventilated by adequate ventilation arrangements. The requirements and standards specified in this regard by Director General of Mines Safety (DGMS) would be adhered.
- Effective water spraying arrangements will be done in underground working places, at haulage junctions, ore loading bunkers at pithead on surface, at main haul roads within the mine, approach roads to the mine and other transfer points.

- Water sprinkling will be carried out by both fixed and mobile sprinklers on internal transport road, transfer points, critical areas, loading and unloading points.
- Periodic maintenance of machinery and vehicles etc. will be carried out
- All the vehicles carrying raw materials will be covered with tarpaulin/plastic sheet, unloading and loading activity will be stopped during windy period.

Impact on Water Quality

The total water requirement for mining and allied activities is estimated as 2785 m³/day. The domestic wastewater generated in mine area will be treated in STP. The wastewater from the machines and vehicle washing will be treated for oil & grease removal and suspend solids. The treated water will be used for greenbelt development and dust suppression.

Mitigation Measures

- The mine seepage water, which may contain ore fines needs sedimentation before discharge into the natural water course/ open land. The treatment facilities such as sedimentation, filtration and chlorination (as per the end use) will be provided for mine seepage water.
- Rainwater harvesting structures will be constructed to collect the rooftop rainwater from the admin buildings. The rainwater which is drained into the mine workings will be collected and will be stored in overhead tank after appropriate treatment and the same will be utilized for mining activities.
- The excess mine seepage water is proposed to be pumped into overhead tank and from this it will be discharged into nearby natural streams which will be used by local villagers for agricultural purpose. This also augments recharge of the ground water regime.

Impact on Noise Environment

The mining activities generate noise mainly on account of operating mining machinery, use of explosives and moving vehicles.

Mitigation Measures

- Effective noise enclosures will be provided to attenuate the noise level. All the mining machines and equipments will be maintained and lubricated as per maintenance schedule.
- Fixed equipments such as pumps, compressors, fans, etc. where practicable is located in positions where noise effects to residents in the vicinity are minimized.
- In the high noise intensity working areas/zones, earmuffs or earplugs or any other suitable personal protective equipment would be provided to the workmen.

- Regular noise level monitoring would be done periodically for taking corrective action, wherever required.
- Greenbelt will be developed around the mine site, office buildings and all along the internal road to create a barrier or screen between the source and the receiver so that the noise is absorbed and the exposure level is minimized.
- It is therefore expected with these measures the exposure level will be within the permissible limits.

Impact on Land Use

The total mine lease area is 2583.48 Ha. At the end of 5th year 1621.40 Ha i.e. 62.76 % of land will remain undisturbed. The disturbed area within ML will comprise excavated land, external dumps, area occupied by infrastructure, diverted road, inclines, green belt etc.

Mitigation Measures

- Compensation and rehabilitation of affected / displaced people would reduce the distress caused by the loss of land and land-based livelihood.
- Implementing adequate protection and conservation plan for conserving topsoil will be planned.
- During the planning stage identification of OB dump area and topsoil dump area would be done based on slope and runoff characteristics.
- In-pit dumping of mine waste should be promoted wherever possible rather than external dumping. In case of external dumping, it should be stabilized by suitable plantations.
- Overburden dumps would be stabilized by mechanical and biological reclamation.
- Planned compensatory afforestation will be taken up to improve the catchments in core and buffer zone.
- Run-off from mine overburden dump, coal stockpiles etc. would be prevented to avoid being discharged to surroundings, particularly to agricultural land.
- Productive land should not be utilized for waste / ore dumping/ for construction of structures.

Impact on Solid Waste

Dumping will start from 1st year and continue upto 6th year however the exclusive dumping into this surface dump will be upto 5th year after which part of the OB will be backfilled in 6th year. The full height of the dump will be 90m in 6th year. No OB will be required to be disposed over the surface dump after 6th year. Total excavated area will be fully used for back filling. The back filled area will be levelled and ameliorated for afforestation. Domestic waste generated from colony and mine operations are 3060 kg/day and 680 kg/day respectively.

Solid Waste Management

- The waste rock generated will be used as a platform for workers while digging into deeper levels of the mine.
- A strong wall shall be constructed with cement masonry to act as a safety barrier leaving the holes for seepage of water.
- The domestic solid waste generated from the Admin office and colony will be segregated. The bio-degradable waste will be used for composting and non-bio degradable waste will be handover to authorised dealers.
- The sludge that will be generated from STP will be used as manure for greenbelt development.

Greenbelt Development

The lease area of the mine is a revenue, forest and agriculture land with sparse cover of trees and bushes. Revenue Forest and Protected Forest located within site will be disturbed, since the proposed mine is Opencast and Underground Mine, However to compensate the losses greenbelt (36.07 Ha) will be developed in phased manner during open cast mining activity is in process, and at the end of the opencast mining maximum amount of the land will be brought under agriculture (2265.3 Ha) after cutting trees and an certain area (175.25 Ha) is left for forestation.

Improvement in Socio Economic Environment

- The mining and allied activities will provide job opportunities for eligible persons and many will find employment in service sector and marketing of day-to-day needs viz. poultry and other agricultural products.
- The proposed long term activity will open up market and opportunities growth for self-employment and cultivators.
- The proposed mining activity will provide employment to nearly 3400 people in both direct and indirect way.
- The company has a well laid corporate social responsibility plan which will provide/full fill the basic needs of the villagers. There will be change in the social and economic conditions of the people due to the proposed project.
- Around Rs. 35 Crores has been provided for CSR and other developmental activities as part of Enterprise Social Responsibility. This fund shall be utilized over a period of 3 years. Thereafter the company shall allot 2% of the annual profit towards the same.

5 Environmental Monitoring Program

Constructional Phase

The proposed project envisages construction of admin building, workshop and compressor shed. The constructional activities are expected to last for a short period and would involve clearing of vegetation, mobilisation of constructional material and equipments. Dust suppression will be done by regular sprinkling of water and providing mobile STP for treating waste water at the site.

Operational Phase

During operational phase of mine continuous air emissions (particulate matter emissions) and wastewater generation are expected. The following attributes will be regularly monitored based on the nature of industry and activities

- Source emissions and ambient air quality,
- Groundwater levels, groundwater quality and soil quality,
- Water and wastewater quality (water quality, effluent & sewage quality etc.),
- Solid waste characterisation,
- Noise levels in and around the proposed project (equipment and machinery noise levels, occupational exposures and ambient noise levels), and
- Ecological preservation and afforestation.

6 Risk and Hazards

The proposed mining activities are subjected to various risks like outbreak of fire, inundation, air blast, sudden rush of back fill material, machineries, heavy materials, electrical installation etc. Along with these there is possibility of accidents during material transport. A proper risk management plan is proposed to avoid any kind of accident/disaster.

7 Project Benefits

During primary data collection in the study area it has been noticed that there are good number of unemployed local youth in the surrounding villages, an action plan will be proposed to train the local employable youth, so that after relevant training they will be employed in the proposed project based on the requirement of different stages. Following are the future commitments in study area villages.

- Education Development Activities
- Sport Art and Culture promotion activities
- Health & Sanitation (aarogya) programme
- Financial Assistance for self-sustenance and other need based activities.
- Improving the Infrastructure facilities in the study area villages

- Creation of employment/vocational opportunities for local people with education, skill development & training programme.

8 Environmental Management Plan

In order to keep a watch on the local environmental conditions (air quality, water quality and noise levels) monitoring shall be done regularly every year by taking measurements near the mine and residential areas preferably close to some of the earlier stations so as to keep a comparative check with respect to the base line data. Continuous air quality monitoring on 24 hours sampling basis should be done for two days per week and analytical checks made for PM₁₀, PM_{2.5}, SO₂ and NO_x. For effective management of the environment, it is envisaged to have an organizational set-up under the administrative supervision of the mines management where responsibilities can be delegated to technical personnel like Environmental Engineer, Scientist/Chemist and Horticulturist with regard to specific aspects of environment management plan.

Budget provision for EMP implementation and monitoring

The approved mining plan of proposed coal mine includes a financial assessment of the cost of development of the mine and its operation. Sufficient fund allocation has been made towards environmental management and monitoring by way of direct capital. A number of other environmental management and control measures are also included in indirect cost under various other capital heads. The fund provision made towards direct cost and revenue costs for implementation and monitoring of Environment Management Plan in the proposed mine. An amount of Rs. 148453.76 lakhs has been allocated under EMP budget in which 102766.47 lakhs for Progressive Closure and 45687.29 lakhs for Final Closure of Mine.

9 Conclusion

It can be concluded from overall assessment of the impacts, in terms of positive and negative effects on various environmental components, that the mining activities will not have major adverse effects on the surrounding environment.

To mitigate any impacts due to the mining activities, a well-planned EMP and a detailed post-project monitoring system is provided for continuous monitoring and immediate rectification at site. Due to the mining activities, socio-economic conditions in and around the project site are expected to improve substantially.