DRAFT COMPREHENSIVE ENVIRONMENTAL IMPACT ASSESSMENT REPORT

FOR

LARA SUPER THERMAL POWER PROJECT, STAGE-II (2 X 800 MW)

AT

ARMUDA, CHHAPORA, BODAJHARIA, DEVALSURA, MAHLOI, RIYAPALLI, LARA, JHILGITAR AND KANDARGH VILLAGES IN PUSSORE TALUK, RAIGARH DISTRICT, CHHATTISGARH

EXECUTIVE SUMMARY

Project Proponent :

एनटीपीसी NTPC

A Maharatna Company

M/s. NTPC Limited, Noida
(A Government of India Enterprise)

Prepared by :

Vimta
Driven by Quality. Inspired by Science.

Vimta Labs Ltd. 142
IDA, Phase-II, Cherlapally
Hyderabad-500 051
env@vimta.com, www.vimta.com

(NABL Accredited and ISO 17025 Certified Laboratory, Recognized by MoEF&CC, New Delhi)

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1.0 EXECUTIVE SUMMARY

NTPC Limited (A Govt. of India Enterprise), is the largest power generating company in India. Government of India (GoI) set it up in November, 1975 with the objective of planning, promoting and organizing integrated development of thermal power in the country. In 1997, NTPC was conferred "Navratna" status by GoI and in 2010, it became the first public sector company to be granted "Maharatna" status. NTPC is now emerging as a well-diversified company on its way of becoming an Integrated Power Major, having entered into hydro power, coal mining, power trading, equipment manufacturing, power distribution business and renewable energy generation. Company also plans to enter into nuclear power development.

NTPC Ltd is proposing for the expansion of existing Lara Super Thermal Power Project of 1600 MW (2x800 MW (Stage-I)) to 3200 MW by addition of 1600 MW (2 x 800 MW (Stage-II) which is located in Armuda, Chhapora, Bodajharia, Devalsura, Mahloi, Riyapalli, Lara, Jhilgitar and Kandargh villages of Pussore C.D.block in Raigarh district of Chhattisgarh.

Lara Super Thermal Power Project (STPP), Stage-I (2x800 MW) units are in commercial operation, Unit-I since 1st Oct 2019 and Unit-II since 7th Nov 2020.

1.1 Purpose of the Report

As per Environmental Impact Assessment EIA Notification dated 14th September, 2006, commissioning or operation of thermal power plants (≥500 MW) falls under category 'A' under project type-1(D) and requires prior Environmental Clearance (EC) to be obtained from MoEF&CC before the commencement of any ground activity.

In line with the aforesaid notification, TOR online application (Form-1 & Pre-feasibility report) for Environmental Clearance (EC) was filed to MOEF&CC on 24.09.2018 vide proposal no. IA/CG/THE/75138/2012 dated 20.07.2018.

TOR for EIA Study for Lara STPP, Stage-II (2X800 MW) based on Air Cooled Condenser System was accorded by MoEF&CC vide letter No J-13012/11/2018-IA.I(T) dated 29.10.2018 which was valid for four years, i.e. up to 28.10.2022.

Subsequently, MoEF&CC vide notification dated 18.01.2021 notified that the period of 01.04.2020 to 31.03.2021 shall not be considered for validity of TOR, thereby extending the validity of TOR till 28.10.2023.

In view of the implementation issues faced in ACC Systems at its ongoing power projects, NTPC now proposes to setup 2X800 MW Power Plant with Water Cooled Condenser (WCC) instead of earlier proposed ACC.

There are no changes in emission norms or resource requirement except an increase of additional water requirement from 1600 m^3/hr to 4800 m^3/hr due to installation of WCC instead of ACC

Accordingly revised TOR for EIA Study for Lara STPP, Stage-II (2X800 MW) based on Water Cooled Condenser System was accorded by MoEF&CC vide letter No J-13012/11/2018-IA.I(T)dated 29.08.2022.

Comprehensive Environmental Impact Assessment (CEIA) report addresses the environmental impacts of the proposed expansion project and the mitigation measures. This report is prepared, based on the TOR conditions received from MoEF & CC. A copy of the TOR letter No J-13012/11/2018-IA.I(T) dated 29.10.2018, revised TOR letter No J-13012/11/2018-IA.I(T)dated 29.08.2022.

Vimta Labs Limited, Hyderabad, an accredited agency with Quality Council of India (QCI) / National Accreditation Board of Education and Training (NABET) vide registered no. NABET/EIA/1922/RA0226 dated 30.12.2021 is assigned to undertake an Comprehensive Environmental Impact Assessment (CEIA) study and preparation of Environment Management Plan (EMP) on various environmental components, which may be affected due to the impacts arising out of the proposed thermal power plant.

1.2 Environmental Setting

The project is located at villages Armuda, Chhapora, Bodajharia, Devalsura, Mahloi, Riyapalli, Lara, Jhilgitar and Kandargh villages in Pussore taluk, Raigarh district, Chhattisgarh.

The project site is located in Chhattisgarh state. However, the 10 km radius study area falls in Chhattisgarh and Odisha states. 35 villages are falling in K. Lakhanpur C.D block from Jharsuguda district and Ambahona C.D block from Barghar district of Odisha in the 10 km study area.

The proposed main plant and township are located between the coordinates 21°44'57" N to 21°46'19" N and 83°25'37" E to 83°27'56" E. The coordinates of ash pond are 21°43'7" N to 21°44'27" N and 83°27'37" E to 83°29'4" E.

The main plant, township, ash pond and other areas for Lara STPP Stage-II (2 x 800 MW) shall be accommodated in the land acquired for Lara STPP under Stage-I.

The topography of the project site is undulating. Elevation of the proposed thermal power plant ranges from 200 m to 210 m above Mean Sea Level (MSL) and the general slope is towards North to North East. The site involves 151.762 ha of forest land for which Stage-II forest clearance has been accorded by MOEF&CC. The nearest villages from the project site are Bodajharia (0.2 km, E), Chhapora (0.2 km, N) and Devalsura (0.3 km, W).

The interstate boundary of Chhattisgarh and Odisha is at a distance of about 1.5 km east from the project site. The nearest national highway is NH-200 which is about 0.7 km in direction of NE. The nearest railway station is Raigarh railway station at a distance of 14.5 km in NNW direction. The nearest airport is Jharsuguda which is about 80 km at a distance of East.

The nearest reserve forests from the project site are Gajmar R.F (4.0 km, NNE), Jharghan R.F (5.5 km, NE) and Holsari Dungri R.F (9.3 km, ESE). The nearest water bodies from the project site are Nala near Chhapora village- 50 m, Mahanadi river (7.6 km, South), Kelo river (1.4 km, E), Chotte Kelo river (7.7

km, NE), Sapnai nala (7.6 km, NE), Kur nala (7.9 km, NE) and Hirakud reservoir (12.0 km, east). There is no national park, no wildlife sanctuary located within 10 km of radius of plant site. The study area showing 10 km radius are shown in **Figure-1.1.**

1.3 Brief Description of Project

1.3.1 Nature of the Project

Lara STPP, stage-II will be a coal based thermal power project based on super critical boiler parameters. The proposal involves construction and operation of two units of 800 MW each. The main components of the project include:

- Steam generator, turbine generator and auxiliary units;
- Coal handling system including dust extraction and suppression system;
- Water cooled condenser system ;
- Water & effluent treatment system;
- Fire protection system;
- Air conditioning & ventilation system;
- Electrostatic precipitators, NOx control and Flue Gas Desulphurisation (FGD) system;
- Chimney;
- Limestone and gypsum storage and disposal facilities;
- Ash handling system with dry ash extraction and wet mix system, storage and disposal facilities; and
- Electrical systems: Generator bus duct, transformers, switchgears, switch yard etc.

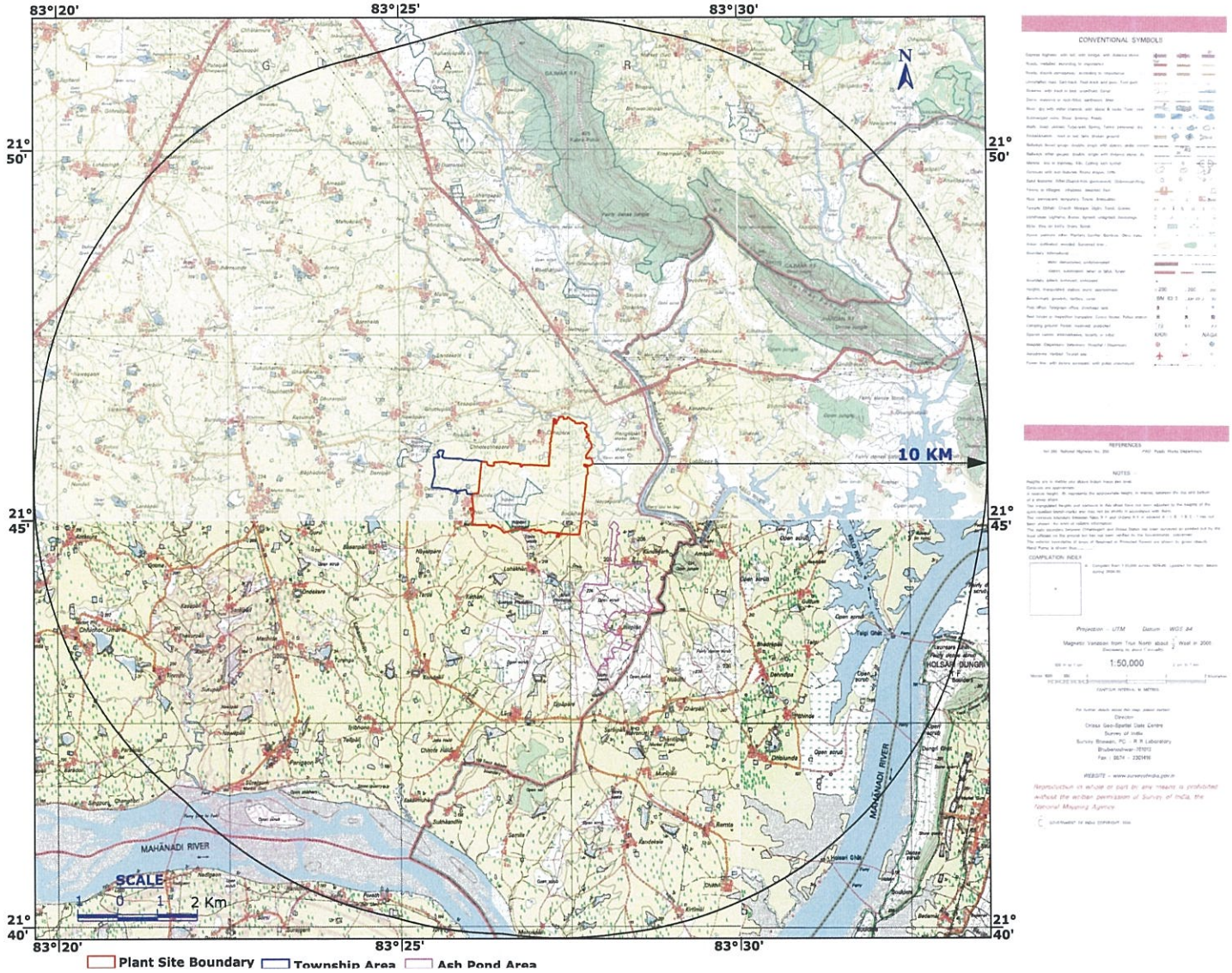

FIGURE-1.1
STUDY AREA MAP (10 KM RADIUS)

1.4 Salient Features

The salient features of the proposed expansion of STPP are given in **Table-1.**

TABLE-1
SALIENT FEATURES OF PROPOSED EXPANSION OF STPP

Sr. No.	Particulars	Details
1	Stage- I Stage- II	2 x 800 MW (In operation) 2 x 800 MW (Present proposal)
2	Technology	Super critical
3	Total area of the plant	A total of 2857 acres of land has been acquired to accommodate plant, township and ash dyke of Lara STPP. Approx. 1205 acres land has been utilized for Stage-I units, ancillary facilities, ash disposal area and township, remaining shall be used for Stage-II units
4	Fuel	Coal
A	Source of fuel	Talaipali Coal Block Mining Project (TLCMP) is linked to cater the coal requirement for Lara STPP. EC for TLCMP has already been accorded by MoEF&CC vide letter no. J-11015/279/2009-IA.II (M) dated 02.01.2013.
B	Fuel transportation	MGR/IR
C	Average fuel requirement (Coal)	6.6 MTPA with 85 % PLF
D	Average calorific value range	3000-3500 kcal/kg
E	Ash content	32-43 %(Max)
F	Sulphur content	0.5% (Max)
5	**Ash generation** Fly ash Bottom ash Total ash	 1.792 MTPA 0.448 MTPA 2.24 MTPA
6	Water requirement	Make up water requirement for Lara-II (2 x 800 MW) project would be 4800 m^3/hr. Water Resource Department (WRD), Government of Chhattisgarh have accorded water availability confirmation of 45 MCM (5137 m^3/hr) for stage-I (2 x 800 MW) power project and 68 MCM (7763 m^3/hr) for stage-II for Lara STPP from Sardih barrage on river Mahanadi
A	Source of water	Sardih barrage on river Mahanadi
B	Cooling system	Water cooled condenser
7	Power evacuation	LARA STPP -II shall be the extension project of LARA STPP-I (2X800 MW) and would comprise of two (2) Nos. of coal fired unit of capacity 800 MW each. Step up/power evacuation voltage of Stage-I of the project is 400KV. Under Stage-I of the project, provision of one no. 400 kV quad Double Circuit line up to Champa pooling has been kept for connectivity and evacuation of power as finalized in Western Region Standing Committee Meeting/LTA& Connectivity meeting.
8	Discharge	Zero Liquid Discharge
9	Wastewater treatment	Proposed ETP & existing STP
10	Fire fighting system	Adequate firefighting systems as per Tariff Advisory Committee (TAC) and OISD guidelines will be provided

Source: NTPC

1.5 Resource Requirement

- *Land Requirement*

  The land acquired for the project shall be mainly used for establishing main power house complex and township. Greenbelt will be developed wherever the vacant place is available. In addition, large scale afforestation and plantation activities shall be undertaken in and around main plant and township areas in all available spaces.

  A total of 2400 acres of land has been acquired to accommodate plant, township and ash dyke of Lara STPP. Approximately 1620 acres land is under utilization for construction of Stage-I units, ancillary facilities, ash disposal area, township and remaining 780 acres shall be utilized for stage-II units.

- *Water Requirement & its Source*

  Make up water requirement for this project would be about 4800 m^3/hr. The source of water for the project is from Saradih barrage on Mahanadi river at a distance of about 45 km from the plant site.

- Coal

  The coal requirement for the proposed expansion of 2 x 800 MW power plant shall be about 6.6 MTPA at 85 % PLF. The coal requirement shall be met from Talaipalli coal blocks allotted to NTPC. Mode of coal transportation from the coal mines to the power plant is by MGR/IR.

- *Manpower Requirement*

  The project will generate direct and indirect employment opportunities as well as opportunities for self-employment. Power projects have mechanised and automated plants. Therefore, the direct opportunities for employment during operation phase are limited. The no. of NTPC employees during construction and operation phases are 112 and 405 respectively. However, the no. of workforce employed during construction phase by the EPC contractors would be much higher (about 4000-5000 during peak deployment) In addition to the people directly involved in construction and operation of the power project, employment opportunities in subsidiary industries and service sectors as well as self employment opportunities shall also be generated.

- *Power Requirement & Source*

  The requirement of the construction power supply for the project would be met from the Lara Stage-I. 11 KV miscellaneous switchgear located near Stage-I 400 KV switchyard.

1.6 Process Description

In a thermal power plant, the chemical energy of the fuel (coal) is first converted into thermal energy (during combustion), which is then converted into mechanical energy (through a turbine) and finally into electrical energy (through a

generator). It has the following steps:

- The coal is transferred from the coal handling plant by conveyor belt to the coal bunkers, from where it is fed to the pulverizing mills, which grind it to fine powder. The finely powdered coal, mixed with air is then blown into the boiler by a fan where it burns like a gas;
- The process of combustion releases thermal energy from coal. The boiler walls are lined with boiler tubes containing high quality de-mineralized water (known as boiler feed water). The combustion heat is absorbed by the boiler tubes and the heat converts the boiler feed water into steam at high pressure and temperature. The steam, discharged through nozzles on the turbine blades, makes the turbine to rotate, which in turn rotates the generator coupled to the end of the turbine. Rotation of generator produces electricity, which is passed to the step-up transformer to increase its voltage so that it can be transmitted efficiently. The power is evacuated via switchyard through a transmission system;
- During combustion, the non-combustible part of coal is converted into ash. A small part of ash (about 20%) binds together to form lumps, which fall into the ash pits at the bottom of the furnace. This part of ash, known as bottom ash is water quenched, ground and then conveyed to pits for subsequent disposal to ash disposal area or sale;
- Major part of the ash (about 80%) is in fine powder form, known as fly ash, and is carried out of the boiler along with the flue gas. The flue gas, after heat recovery, is passed through the electrostatic precipitators, where the ash is trapped by electrodes charged with high voltage electricity;
- The flue gases exiting from the Electrostatic Precipitators (ESPs) shall be treated in Flue Gas De-sulphurisation (FGD) system and discharged through a tall chimney for wider dispersal of remaining ash particles and gases. The ash collected in the ESP hoppers is extracted in dry form and conveyed to dry ash storage silos from where it is supplied to user industries;
- Any unused part of fly ash is mixed with water and conveyed to ash disposal area in a slurry form; and
- The steam, after passing through the turbines, is condensed back into water in Water Cooled condensers and the same is re-used as a boiler feed water for making steam.

1.7 Baseline Environmental Status

The baseline data monitoring studies have been carried out for one year from 1st October 2018 to 30th September 2019, covering all the seasons' Post-monsoon season, winter season, pre-monsoon season and monsoon season.

As the baseline data generation has become more than three years old, a fresh base line monitoring was undertaken by NTPC through MANTEC Consultants Pvt. Ltd. (QCI Accredited EIA Consultant at S.No.162 as per List of Accredited consultant Organizations / Rev.24 / July 05, 2022.NABET Accredited EIA Consultant, MoEF&CC and NABL approved Laboratory) during Pre-monsoon season (March to May 2022).

The project site is located in Chhattisgarh state. However, the 10 km radius study area falls in Chhattisgarh and Odisha states. Hence, the baseline monitoring locations for ambient air quality, noise, soil and ecology are covered in both states of Chhattisgarh and Odisha. The following villages considered for baseline monitoring falls in the state of Odisha are Dipapara, Karlabahal, Kanaktura, Lubabaga, Amapali, Charpalli, Semilia and Chhattisgarh are Chhapora, Rengalpali, Kandagarh, Jhilgitar, Lohakhan, Kondpali, Tarda, Nawapara, Mahadbatha, Riyapali and Lara.

1.7.1 Meteorology

The meteorological parameters were recorded on hourly basis during the study period and comprises of parameters like wind speed, wind direction (from 0 to 360 degrees), temperature, relative humidity, atmospheric pressure, rainfall and cloud cover. The meteorological parameters have been recorded and are presented in **Table-2**.

TABLE-2
SUMMARY OF THE METEOROLOGICAL DATA GENERATED AT SITE

Month	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)
	Max	Min	Max	Min	
Post Monsoon Season (1st October 2018 to 30th November 2018)					
October 2018	33	20	74	61	0
November 2018	30	18	65	54	0
Range	**18.0-33.0**		**54.0-74.0**		**0**
Winter Season (1st December 2018 to 28th February 2019)					
December 2018	29	17	62	49	0
January	31.9	10.1	63	49	1.2
February	36.9	12.5	64	40	2.2
Range	**10.1-36.9**		**40.0-64.0**		**3.4**
Pre-Monsoon Season (1st March 2019 to 31st May 2019)					
March	42.1	13.1	45	30	1.7
April	44.4	22.1	40	23	13.8
May	46.3	23.1	45	27	8.8
Range	**13.1-46.3**		**23-45**		**24.3**
Monsoon season (1st June 2019 to 30th September 2019)					
June	44.6	23.5	65	52	30.8
July	37.0	25.5	87	73	199.3
August	38.3	29.9	85	79	201.9
September	37.9	24.5	82	78	134.0
Range	**23.5-44.6**		**52-87**		**Total: 593.7**

1.7.2 Ambient Air Quality

Twelve ambient air quality locations were monitored in and around project site.

Observations of AAQ Data (1st October 2018 to 30th September 2019)

Post-Monsoon Season

The minimum and maximum concentrations for PM_{10} were recorded as 27.1 $\mu g/m^3$ and 66.2 $\mu g/m^3$ .The minimum and maximum concentrations for $PM_{2.5}$ were recorded as 14.3 $\mu g/m^3$ and 28.0 $\mu g/m^3$ respectively. The minimum and maximum

SO_2 concentrations were recorded as 8.6 µg/m³ and 17.9 µg/m³. The minimum and maximum NO_2 concentrations were recorded as 10.1 µg/m³ and 20.4 µg/m³.

The minimum and maximum CO concentrations were recorded as 142 µg/m³ and 360 µg/m³. The minimum and maximum O_3 concentrations were recorded as 3.7 µg/m³ and 11.8 µg/m³.

Winter Season

The minimum and maximum concentrations for PM_{10} were recorded as 29.3 µg/m³ and 68.1 µg/m³ .The minimum and maximum concentrations for $PM_{2.5}$ were recorded as 16.5 µg/m³ and 29.6 µg/m³.

The minimum and maximum SO_2 concentrations were recorded as 8.0 µg/m³ and 15.9 µg/m³. The minimum and maximum NO_2 concentrations were recorded as 9.2 µg/m³ and 18.6 µg/m³.

The minimum and maximum CO concentrations were recorded as 142 µg/m³ and 290 µg/m³. The minimum and maximum O_3 concentrations were recorded as 6.0 µg/m³ and 11.3 µg/m³.

Pre-Monsoon Season

The minimum and maximum concentrations for PM_{10} were recorded as 30.5 µg/m³ and 68.0 µg/m³.The minimum and maximum concentrations for $PM_{2.5}$ were recorded as 17.6 µg/m³ and 32.2 µg/m³.

The minimum and maximum SO_2 concentrations were recorded as 10.6 µg/m³ and 17.1 µg/m³. The minimum and maximum NO_2 concentrations were recorded as 10.4 µg/m³ and 19.8 µg/m³.

The minimum and maximum CO concentrations were recorded as 145 µg/m³ and 290 µg/m³. The minimum and maximum O_3 concentrations were recorded as 7.2 µg/m³ and 14.5 µg/m³.

Monsoon Season

The minimum and maximum concentrations for PM_{10} were recorded as 28.7 µg/m³ and 66.2 µg/m³ .The minimum and maximum concentrations for $PM_{2.5}$ were recorded as 15.8 µg/m³ and 31.0 µg/m³ .

The minimum and maximum SO2 concentrations were recorded as 9.4 µg/m3 and 17.1 µg/m3. The minimum and maximum NO_2 concentrations were recorded as 10.1 µg/m³ and 19.1 µg/m³.

The minimum and maximum CO concentrations were recorded as 143 µg/m³ and 289 µg/m³. The minimum and maximum O_3 concentrations were recorded as 5.4 µg/m³ and 13.3 µg/m³.

The concentrations of $PM_{2.5}$, PM_{10}, SO_2, NO_2, O_3, CO, NH_3, Pb, BaP,Hg, As, Ni and C_6H_6 are observed to be well within the NAAQ standards prescribed by Central Pollution Control Board (CPCB) for industrial and rural /residential zone.

Observations of AAQ Data (Pre-Monsoon Season-2022)

During the monitoring period (March-May 2022), it has been observed PM_{10} for all the monitoring stations is ranging from 40.0 to 58.0 µg/m^3. $PM_{2.5}$ for all the monitoring stations ranging from 24.0 to 35.0 µg/m^3. SO_2 for all the monitoring stations is ranging from 6.0 to 20.0 µg/m^3. The concentration of NO_2 is observed to be in the range from 15-28 µg/m^3.

The concentrations of $PM_{2.5}$, PM_{10}, SO_2, NO_2, O_3, CO, NH_3, Pb, BaP,Hg, As, Ni and C_6H_6 are observed to be well within the NAAQ standards prescribed by Central Pollution Control Board (CPCB) for industrial and rural /residential zone.

1.7.3 Land Use

As per satellite imagery, the built-up land is 7.7 %, forest land occupies 7.7 %, agricultural land is about 53.3 %, water body is 14.2 % and remaining land is either area available for cultivation or cultivable waste land.

1.7.4 Soil Characteristics

- ***1st October 2018 to 30th September 2019***

Post Monsoon Season

The pH of the soil in the study area ranged from 6.06 to 7.48. The electrical conductivity was observed to be in the range of 82.4 µmhos/cm to 259 µmhos/cm. The nitrogen values range between 41.3 to 128.2 kg/ha. The phosphorus values range between 35.6 to 217.9 kg/ha. The potassium values range between 127.2 to 384.1 kg/ha.The chlorides were found to be in the range of 95.7 to 271.1 mg/kg of soil.

Winter Season

The pH of the soil in the study area ranged from 6.24 to 7.82. The electrical conductivity was observed to be in the range of 78.4 µs/cm to 214.6 µs/cm. The nitrogen values range between 46.5 to 134.6 kg/ha .The phosphorus values range between 42.8 to 211.8 kg/ha. The potassium values range between 138.4 to 412.5 kg/ha.The chlorides were found to be in the range of 116.8 to 324.5 mg/kg of soil.

Pre-Monsoon Season

The pH of the soil in the study area ranged from 6.48 to 7.64. The electrical conductivity was observed to be in the range of 102.3 µs/cm to 213.4 µs/cm The nitrogen values range between 46.5 to 121.6 kg/ha. The phosphorus values range between 36.2 to 203.5 kg/ha. The potassium values range between 117.6

to 384.2 kg/ha. The chlorides were found to be in the range of 95.6 to 324.5 mg/kg of soil.

Monsoon Season

The pH of the soil in the study area ranged from 5.98 to 7.43. The electrical conductivity was observed to be in the range of 86.5 µs/cm to 245.5 µs/cm. The nitrogen values range between 53.8 to 142.8 kg/ha. The phosphorus values range between 54.8 to 241.6 kg/ha. The potassium values range between 126.9 to 406.5 kg/ha. The chlorides were found to be in the range of 122.4 to 324.5 mg/kg of soil.

The analysis of soil samples does not indicate any external industrial contamination.

- ***Pre-Monsoon Season-2022***

The textural classes of ten soil samples are sandy clay and sandy loam, (fine texture).The pH ranges between 6.92 to 7.51 indicating soils are moderately acidic to neutral. The EC ranges between 330 to 412 µs/cm. The nitrogen in the ten samples in question, as per analysis ranges between 8.18 to 12.9 mg/100gm. The phosphorus content of soil of ten samples ranges between 14.0 to 15.9 mg/100gm.The Potassium content of ten soil samples ranges between 0.71 to 0.93 mg/100gm. The CEC of the ten samples ranges between 8.38 to 9.41 meq/100gm.

1.7.5 Water Quality

The baseline water quality status in the region is established by analysing samples at 13 locations consisting of seven ground water samples and six surface water samples. The ground and surface water samples were analysed and found that ground water quality is well within the drinking water quality limits.

1st October 2018 to 30th September 2019

- ***Post-Monsoon Season***

The discussion on the analytical results of water samples is presented in the following sections:

Surface Water Quality

The discussion on the analytical results of water samples is presented in the following sections:

The results of surface water sample analysis indicate that the pH value was observed to be in the range of 6.79 to 8.5, which are well within the specified standards of 6.5 to 8.5.Electrical conductivity of surface water samples was observed to be in the range of 215 µS/cm to 1205 µS/cm. The dissolved oxygen was observed in the range of 4.8 mg/l to 5.6 mg/l.The total hardness was found

to be in the range of 48.7 mg/l to 295.1 mg/l. The chloride concentration was observed in the range of 17.8 mg/l to 177.6 mg/l and the sulphates were found to be in the range of 9.5 mg/l to 71.5mg/l. Fluoride content was found to be in the range of 0.3 mg/l to 1.0 mg/l. Cyanides and phenolic compounds found to be below detection limits. Bacteriological studies revealed that the total coliform count is measured 380-980 MPN/100ml.

Ground Water Quality

The analysis results of ground water samples showed the pH in range of 5.86 -7.63 which are with the specified standard limits of 6.5 to 8.5. Color and turbidity of the samples ranged from 1-7 Hazens and 1-5 NTU respectively. Electrical conductivity of the samples ranged from 270-857 µS/cm. The total hardness of the samples ranged from 58.3-332.5 mg/l.

Calcium and magnesium concentrations ranged from 15.4-84.6 mg/l and 4.8 -32.7 mg/l respectively. The total dissolved solids of the samples ranged from 173 -545 mg/l. Range of chlorides and sulphates concentrations at all the locations 27.8-78.2 mg/l and 6.2-92.5 mg/l.

Fluoride concentration ranged from 0.3-1.0 mg/l and is found to be within the permissible limits. Similarly, nitrates are also found to be ranging in between 1.9–10.2 mg/l. Iron concentrations in ground water varied from 0.01-0.61 mg/l. Zinc levels varied from 0.01 mg/l to 0.61 mg/l respectively. Aluminium concentration in ground water is 0.13-1.84 mg/l which are within the limits stipulated. All other metal concentrations are observed to be below detectable limits. The total coliform counts are <2 in all the samples against the standard limit of 10 MPN/100 ml.

- **Winter Season**

The discussion on the analytical results of water samples is presented in the following sections:

Surface Water Quality

The results of surface water sample analysis indicate that the pH value was observed to be in the range of 6.77 to 7.79, which are well within the specified standards of 6.5 to 8.5.Electrical conductivity of surface water samples was observed to be in the range of 217 µS/cm to 1252 µS/cm. The dissolved oxygen was observed in the range of 4.9 mg/l to 6.1 mg/l. The total hardness was found to be in the range of 80 mg/l to 337.3 mg/l. The chloride concentration was observed in the range of 12.5 -165.8 mg/l and the sulphates were found to be in the range of 0.3 mg/l to 44.8 mg/l. Fluoride content was found to be in the range of 0.12 mg/l to 1.3 mg/l. Cyanides and phenolic compounds found to be below detection limits. Bacteriological studies revealed that the total coliform count is measured 760-2260 MPN/100ml.

The surface water quality in the study area does not indicate any industrial contamination.

Ground Water Quality

The analysis results of ground water samples showed the pH in range of 6.76-7.6 which are with the specified standard limits of 6.5 to 8.5. Color and turbidity of the samples ranged from 1-4 Hazens and <1-5 NTU. Electrical conductivity of the samples ranged from 385-724 µS/cm. The total hardness of the samples ranged from 126.4 -308.2 mg/l.

Calcium and magnesium concentrations ranged from 26.7-82.8 mg/l and 14.5-27.1 mg/l .The total dissolved solids of the samples ranged from 253 -488.1 mg/l. The TDS values are within the stipulated 2000 mg/l. Range of chlorides and sulphates concentrations at all the locations 24.2-105.6 mg/l and 13.1-38.2 mg/l. Fluoride concentration ranged from 0.4-1.1 mg/l and is found to be within the permissible limits. Similarly, nitrates are also found to be ranging in between 1.6– 8.6 mg/l. Iron concentrations in ground water varied from 0.04-0.19 mg/l. Zinc levels varied from 0.04 mg/l to 0.19 mg/l respectively.

Aluminium concentration in ground water is 0.04-1.84 mg/l which are within the limits stipulated. All other metal concentrations are observed to be below detectable limits. The total coliform counts are absent in all the samples against the standard limit of 10 MPN/100 ml.

- **Pre-Monsoon Season**

The discussion on the analytical results of water samples is presented in the following sections:

Surface Water Quality

The results of surface water sample analysis indicate that the pH value was observed to be in the range of 6.82 to 7.42, which are well within the specified standards of 6.5 to 8.5.Electrical conductivity of surface water samples was observed to be in the range of 237 µS/cm to 1080 µS/cm. The dissolved oxygen was observed in the range of 5.3 mg/l to 6.1 mg/l. The total hardness was found to be in the range of 85.0 mg/l to 330.3 mg/l. The chloride concentration was observed in the range of 13.5-149.8 mg/l and the sulphates were found to be in the range of 10.4 mg/l to 58.8 mg/l. Fluoride content was found to be in the range of 0.4 mg/l to 0.8 mg/l. Cyanides and phenolic compounds found to be below detection limits. Bacteriological studies revealed that the total coliform count is measured 1430-2690 MPN/100ml.

Ground Water Quality

The analysis results of ground water samples showed the pH in range of 6.89 -7.52 which are with the specified standard limits of 6.5 to 8.5. Color and turbidity of the samples ranged from 1-4 Hazens and <1 NTU respectively. Electrical conductivity of the samples ranged from 131.2-716 µS/cm. The total hardness of the samples ranged from 168.2 -306.4 mg/l. Calcium and magnesium concentrations ranged from 36.5-78.5 mg/l and 16.9-28.1 mg/l respectively. The total dissolved solids of the samples ranged from 276 -491.48 mg/l. The TDS values are within the

stipulated 2000 mg/l. Range of chlorides and sulphates concentrations at all the locations 22.2-116.5 mg/l and 22.5-40.4 mg/l respectively. Fluoride concentration ranged from 0.4-0.9 mg/l and is found to be within the permissible limits. Similarly, nitrates are also found to be ranging in between 1.7 – 9.4 mg/l. Iron concentrations in ground water varied from 0.04-0.17 mg/l. Zinc levels varied from 0.06 mg/l to 0.27 mg/l respectively. Aluminium concentration in ground water is 0.04-0.18 mg/l which are within the limits stipulated. All other metal concentrations are observed to be below detectable limits. The total coliform counts are absent in all the samples against the standard limit of 10 MPN/100 ml.

- **Monsoon season**

The discussion on the analytical results of water samples is presented in the following sections:

Surface Water Quality

The discussion on the analytical results of water samples is presented in the following sections:

The results of surface water sample analysis indicate that the pH value was observed to be in the range of 7.36 to 7.68, which are well within the specified standards of 6.5 to 8.5.Electrical conductivity of surface water samples was observed to be in the range of 258 µS/cm to 956 µS/cm. The dissolved oxygen was observed in the range of 5.4 mg/l to 6.1 mg/l. The total hardness was found to be in the range of 79.8 mg/l to 274.9 mg/l. The chloride concentration was observed in the range of 24.6 to 142.6 mg/l and the sulphates were found to be in the range of 10.2 mg/l to 46.2 mg/l. Fluoride content was found to be in the range of 0.4 mg/l to 1.0 mg/l. Cyanides and phenolic compounds found to be below detection limits. Bacteriological studies revealed that the total coliform count is measured 1520-2410 MPN/100ml.

The surface water quality in the study area does not indicate any industrial contamination.

Ground Water Quality

The analysis results of ground water samples showed the pH in range of 6.74 -7.42 which are with the specified standard limits of 6.5 to 8.5. Color and turbidity of the samples ranged from 1-6 Hazens and <1 NTU respectively. Electrical conductivity of the samples ranged from 521.0 -902.0 µS/cm. The total hardness of the samples ranged from 167.79 -301.24 mg/l. Calcium and magnesium concentrations ranged from 36.5-66.5 mg/l and 17.5-34.20 mg/l respectively. The total dissolved solids of the samples ranged from 340.80 -581.20 mg/l. The TDS values are within the stipulated 2000 mg/l.Range of chlorides and sulphates concentrations at all the locations 36.80 -114.6 mg/l and 27.8-39.6 mg/l respectively. Fluoride concentration ranged from 0.1-1.10 mg/l and is found to be within the permissible limits. Similarly, nitrates are also found to be ranging in between 2.8 –8.6 mg/l. Iron concentrations in ground water varied from 0.04-0.14 mg/l. Zinc levels varied from 0.08 mg/l to 0.24 mg/l respectively. Aluminium concentration in ground water is 0.02-0.12 mg/l which are within the limits

stipulated. All other metal concentrations are observed to be below detectable limits. The total coliform counts are absent in all the samples against the standard limit of 10 MPN/100 ml.

Based on the above results, it is evident that all of the parameters in ground water fairly meet the desirable standard limits of IS: 10500. The ground water quality in the study area does not indicate any industrial contamination

➢ **Pre-Monsoon Season 2022**

Ground Water Quality

The analysis results of ground water samples showed the pH in range of 6.89 to 7.41. The maximum value was observed at plant site (GW1) and the minimum value observed at semilia (GW4). Colour of the samples ranged from <5 Hazen.Electrical conductivity of the samples ranged from 437 - 556 µS/cm. The Total Dissolved Solids of the samples ranged from 281 to 363 mg/l. The maximum value was observed at Semilia (GW4) and the minimum value observed at kandagarh (GW3).Calcium concentrations ranged from 48.8 to 71.2 mg/l.Magnesium concentrations ranged from 19.4 – 28.1 mg/l. The Total Hardness of the samples ranged from 202 - 292 mg/l. The maximum total Hardness was observed at Kandagarh (GW3) and where as the minimum value observed at semilia (GW4).

Surface Water Quality

The analysis results of surface water samples indicate that the pH value was observed to be 7.24 to 7.43.Electrical conductivity of surface water samples was observed to be 302 to 412 µS/cm.

The total dissolved solids were observed about 208 to 268 mg/l.Total hardness was observed in the range of 118 to 188 mg/l.Sulphates were found to be in the range of 38 to 48 mg/l and Nitrates were found to be in the range of 6.4 to 7.8 mg/l which are within the prescribed limits only.Fluoride concentration was found to be 0.64 to 0.81 mg/l at all the locations.

1.7.6 Noise Levels

1st October 2018 to 30th September 2019

Post Monsoon Season

Day time Noise Levels (L_{day})

The day time noise levels at all the locations were ranged in between 43.3 dB(A) 51.2 dB(A). The minimum value (43.3 dB (A)) was recorded near Rengalpali (N5) and the maximum value (51.2 dB (A)) was recorded at Lohakhan (N10).

Night time Noise Levels (L_{night})

The night time noise levels were ranged in between 39.4 to 47.6 dB (A). The minimum value (39.4 dB (A)) was recorded near Rengalpali (N5) and the maximum value (47.6 dB (A)) was recorded at Lohakhan (N10).

Winter Season

Day time Noise Levels (L_{day})

The day time noise levels at all the locations were ranged in between 39.9 dB(A) 52.2 dB(A). The minimum value (39.9 dB (A)) was recorded near Lara (N11) and the maximum value (52.2 dB (A)) was recorded at Riyapalli (N14).

Night time Noise Levels (L_{night})

The night time noise levels were ranged in between 36.9 to 48.6 dB (A). The minimum value (36.9 dB (A)) was recorded near Lara (N11) and the maximum value (47.6 dB (A)) was recorded at Riyapalli (N14).

Pre-Monsoon Season

Day time Noise Levels (L_{day})

The day time noise levels at all the locations were ranged in between 39.2 dB(A) 52.8 dB(A). The minimum value (39.2 dB (A)) was recorded near Kandargh (N8) and the maximum value (52.8 dB (A)) was recorded at plant site (N1).

Night time Noise Levels (L_{night})

The night time noise levels were ranged in between 36.0 to 49.6 dB (A). The minimum value (36.0 dB (A)) was recorded near Kandargh (N8) and the maximum value (49.6 dB (A)) was recorded at plant site (N1).

Monsoon Season

Day time Noise Levels (L_{day})

The day time noise levels at all the locations were ranged in between 38.2 dB(A) 49.0 dB(A). The minimum value (38.2 dB (A)) was recorded near Kandargh (N8) and the maximum value (49.0 dB (A)) was recorded at Tarda (N12).

Night time Noise Levels (L_{night})

The night time noise levels were ranged in between 35.0 to 46.0 dB (A). The minimum value (35.0 dB (A)) was recorded near Kandargh (N8) and the maximum value (46.0 dB (A)) was recorded at Tarda (N12).

Noise monitoring results reveal ambient noise levels in all the locations are well within the limits as per CPCB ambient noise standards. The higher range can be attributed to local industrial and commercial activities.

- **Pre-Monsoon Season 2022**

  The day time noise levels are ranged from 18.2- 59.4 dB (A). The night time noise levels are ranged from 36.8- 41.6 dB (A).

1.7.7 Flora and Fauna

The fauna in the buffer zone is confined in the respective schedules of the Wildlife (Protection) Act, 1972 such as Schedule –II, III, IV and V. Due to anthropogenic interventions and mining interests in the district, green cover and conservation areas are fragmented.

There are no endangered aquatic fauna found in the Kelo river and in the Mahanandi river in the 10 km radius of the buffer zone, especially fishes of the 10 km radius study area. Apparently also there is no presence of endangered & threatened flora as per the list of "Botanical Survey of India".

1.8 Anticipated Environmental Impacts and Mitigation Measures

1.8.1 Impact on Land Use

The land selected for proposed expansion of power plant project is within the premises of STPP, which is categorized as industrial area. There will not be any change in land use. There will not be any additional land acquisition for the expansion project. Hence, there is no impact on land use due to the proposed expansion.

There is no additional ash pond for Stage-II expansion project. The ash pond for stage-I will be used for Stage-II also. The present land use of the area falls under industrial category. The project site will not be having any adverse impact on the surrounding land use during the operation period.

1.8.2 Impact on Soil

The impact on soil during operation of the project could result due to deposition of residual particulate matter and gaseous emissions on the soil. The soil within the deposition zone of pollutants may undergo physico-chemical changes due to deposition of PM (ash particles) and washout of gases (SO_2 and NO_2) during the rains. The impacts on soil due to operation of the power plant and gaseous emission are likely to be negligible as the incremental concentration of particulate matter (PM), SO_2 & NO_2 levels are observed within limit.

1.8.3 Impact on Air Quality

The major air pollutants from a power project are Particulate Matter (PM), SO_2, NO_2 and CO which are emitted continuously from the stacks (point sources), attached with coal combustion boilers. The fugitive emissions of coal dust are also

contributed by coal handling activities at storage yard, wind erosion, spillages from conveyor system, pulverization etc.

Prediction of impacts on air environment has been carried out employing mathematical model based on a steady state Gaussian plume dispersion model. The incremental concentrations of the proposed project are super imposed on the maximum baseline data to arrive at resultant concentrations during operational phase of the proposed project.

The incremental concentrations when superimposed over the existing maximum baseline concentrations, the resultant concentrations are observed to be within the permissible levels for residential/rural conditions.

The mitigative measures recommended for control of air pollution in the plant are:

- Installation of ESP of efficiency more than 99.90% to limit the particulate matter (PM) concentrations below 30 mg/Nm^3;
- Installation of flue gas de-sulfurization (FGD) system;
- Combustion control for NO_x (Low NO_x burner);
- Provision of twin/single flue stack of 220/150 m height for wider dispersion of gaseous emissions;
- Online flue gas monitors as well as flue gas flow rates and temperature measurement shall be provided for all stacks;
- Dust suppression and extraction system in coal handling plant;
- Provision of water sprinkling system at raw material storage yard; and
- Asphalting of the roads within the plant area.

1.8.4 Impact on Water Resources

➢ *Water Resources*

Make up water requirement for this project would be about 1680 m^3/hr. Lara STPP will abstract its entire water requirement from the Saradih Barrage being created on river Mahanadi by Government of Chhattisgarh.

DM plant discharge shall be treated in neutralization pit to adjust pH prior to using in ash handling unit. Since there will be no effluent discharge from proposed project, the impact on water quality of surrounding water bodies will be insignificant.

➢ *Impact on Ground Water*

As no ground water is proposed to be used for plant during operation phase, there will be no impact on availability of ground water during operation of plant.

➢ *Impact on Hydrology*

The storage at Saradih barrage is confined within banks and therefore it shall not cause any submergence of land beyond the banks. The river carries sufficient flow during monsoon season.

Therefore drawl of water for Lara STPP during monsoon season shall have no adverse impact on downstream water users. Lean season flow in the river shall not be obstructed. Surplus water in monsoon season shall be ponded at Saradih barrage to meet lean season water requirement for Lara STPP. Thus, in lean season also there shall be no adverse impact on downstream water users.

It may be concluded that the withdrawal of water for Lara STPP Stage-II, shall not cause any major adverse impact on the availability of water to downstream users.

Water Pollution Mitigation Measures

An effluent management scheme, consisting of collection, treatment, recirculation and disposal of effluents shall be implemented in order to optimize the makeup water requirement as well as liquid effluent generation. The detail of water system for the project is described as follows:

- The filter backwash water of PT plant shall be collected and recycled back to the DM clarifier;
- The sludge from clarifiers of water PT plant shall be collected in a sump/ pit and shall be pumped to bottom ash slurry sump for disposal to bottom ash dyke;
- The waste effluents from neutralization pits of DM plant and condensate polishing plant shall be collected in the respective neutralization pits and neutralized before pumping to the ash slurry sump before final disposal;
- A coal settling pond shall be provided to remove coal particles from coal handling plant waste. Decanted water shall be pumped back to the coal dust suppression system;
- Service water effluent collected from plant drains shall be led to a sump. From the sump the service water shall be pumped upto tube settler/ clarifier for treatment of suspended solids. Treated service water shall be sent back to service water tank to the extent possible for re-use;
- All the plant liquid effluents shall be mixed in Central Monitoring Basin (CMB) and finally to ETP/Recycling point;
- The plant shall have two different systems for ash disposal - conventional wet ash slurry disposal system with Ash Water Recirculation System (AWRS) for Bottom Ash and High Concentration Slurry Disposal System (HCSD) for fly ash. HSCD system will require less quantity of water and there will be no effluent from the fly ash disposal site;
- Efficient operation of various treatment schemes shall be ensured so that the quality of treated effluent from CMB conforms to relevant standards, prescribed by regulatory agencies. The treated effluents shall be recycled/reused to the existing plant water system; and
- The sewage from plant and township shall be treated in a sewage treatment plant. The treated effluent conforming to prescribed standards shall be utilized for plantation to the extent possible.

1.8.5 Impact of Solid Waste

Ash generated due to combustion of coal will be the main industrial/ solid waste generated from the project. About 80% of the ash shall be generated as fly ash while 20 % of the ash shall be generated as bottom ash. With average annual coal requirement of 6.6 MTPA and average 43 % ash in coal, it is estimated that about 2.24 MTPA of ash shall be generated annually.

In addition, gypsum shall be generated as solid waste from FGD system, which shall be utilized/ disposed off in an environmentally suitable manner. The details of the solid waste generated in the plant are given in **Table-3.**

TABLE-3
EXPECTED SOLID WASTE FROM THE PROPOSED EXPANSION PROJECT

Sr. No.	Plant	Quantity	Mode of Disposal
1	**Ash generation** Fly ash Bottom ash Total ash	 1.792 MTPA 0.448 MTPA 2.24 MTPA	Ash will be supplied to cement industries. In case the ash could not be lifted, the same will be disposed in ash pond using HCSD disposal method.
2	Gypsum Generation	912 tonnes /day	Byproduct used by cement industries

1.8.6 Impact on Noise Levels

The main sources of noise and vibration during operations will be:

- Delivery of equipment and raw materials by trucks;
- Transfer of coal through railway line;
- Operation of generators and turbine inside the power house; and
- Operation of various pumps, fans and motors.

Scheduling deliveries to daytime as much as possible would minimize noise generation by truck movement. Turbines, transformers, compressors, pumps, vehicles and miscellaneous equipment during plant operation, will generate noise. However, proper acoustic enclosures would be provided to control the noise level within 80dB, as per the requirement of Occupational Safety and Health Administration Standard (OSHA).

Noise Pollution Mitigation Measures

In the process, various equipment's like pumps, compressors and boilers etc will generate the noise. Greenbelt, landscaping with horticulture at power block areas to reduce noise impacts is already being implemented. The recommendations to mitigate higher noise levels are:

Equipments should be designed to conform to noise levels prescribed by regulatory authorities:

- Provision of acoustic barriers or shelters in noisy work places;
- Provision of hoods to noise generating equipments like pumps;
- Provision of thick greenbelt to attenuate the noise levels; and
- Provision of personal protective equipment (PPE) such as earplugs, earmuffs to the workers working in high noise level area.

1.8.7 Impacts on Socio-Economics

The requirement of unskilled manpower will be met from nearby villages during construction phase. The project will also help in generation of the indirect employment apart from direct employment. This will be a positive socio-economic development for the region. There will be a general upliftment of standard of living in the region.

1.9 Environmental Monitoring Program

Post project environmental monitoring is important in terms of evaluating the performance of pollution control equipment installed in the project. The sampling and analysis of the environmental attributes will be as per the guidelines of CPCB/ Chhattisgarh Environment Conversation Board (CECB). The frequency of air, noise, surface water and ground water sampling and location of sampling being as per the directives of CECB.

1.10 Risk Assessment and Disaster Management Plan

Risk assessment has been carried out to quantify the extent of damage and suggest recommendations for safety improvement for the proposed expansion project. Risk mitigation measures based on consequence analysis and engineering judgments are incorporated in order to improve overall system safety and mitigate the effects of major accidents.

An effective Disaster Management Plan (DMP) to mitigate the risks involved is in place for proposed expansion of power plant. This plan defines the responsibilities and resources available to respond to the different types of emergencies envisaged. Training exercises will be held to ensure that all personnel are familiar with their responsibilities and that communication links are functioning effectively.

1.11 Project Benefits

The beneficial impact of proposed expansion project on the civic amenities will be substantial after the commencement of project activities. As corporate social responsibility various activities will be started like welfare for poor/widows/physically challenged persons. Capacity building programs, sports events, assistance to government schools, scholarships will be done. For community development trainings will be provided for woman for self employment, community toilets, drinking water facilities etc. A separate budget will be made for these activities during operation of plant. Medical camps/health awareness camp will be organized in nearby villages for both the states of Chattisgarh and Odisha.

1.12 Environmental Cost

An Environmental cost provision of Rs. 2147.77 crores has been kept towards the environmental control measures.

1.13 Conclusions

The proposed expansion project would add significant value to Indian economy. The project will not only help ensure our country by becoming self-sufficient in terms of power generation, but will also drive macro-economic growth.

The proposed expansion project would have minimal impacts on the environment. However, with proper and judicious implementation of the mitigation and environment management measures, the impacts can be further minimized and can be maintained well within the permissible limits specified by the regulatory authorities.

Thus, it can be concluded that with the strict implementation of the pollution control and mitigation measures, with proper environment management system in place the proposed expansion project will be beneficial to the society and will contribute to the economic development of the state in particular and the country in general.