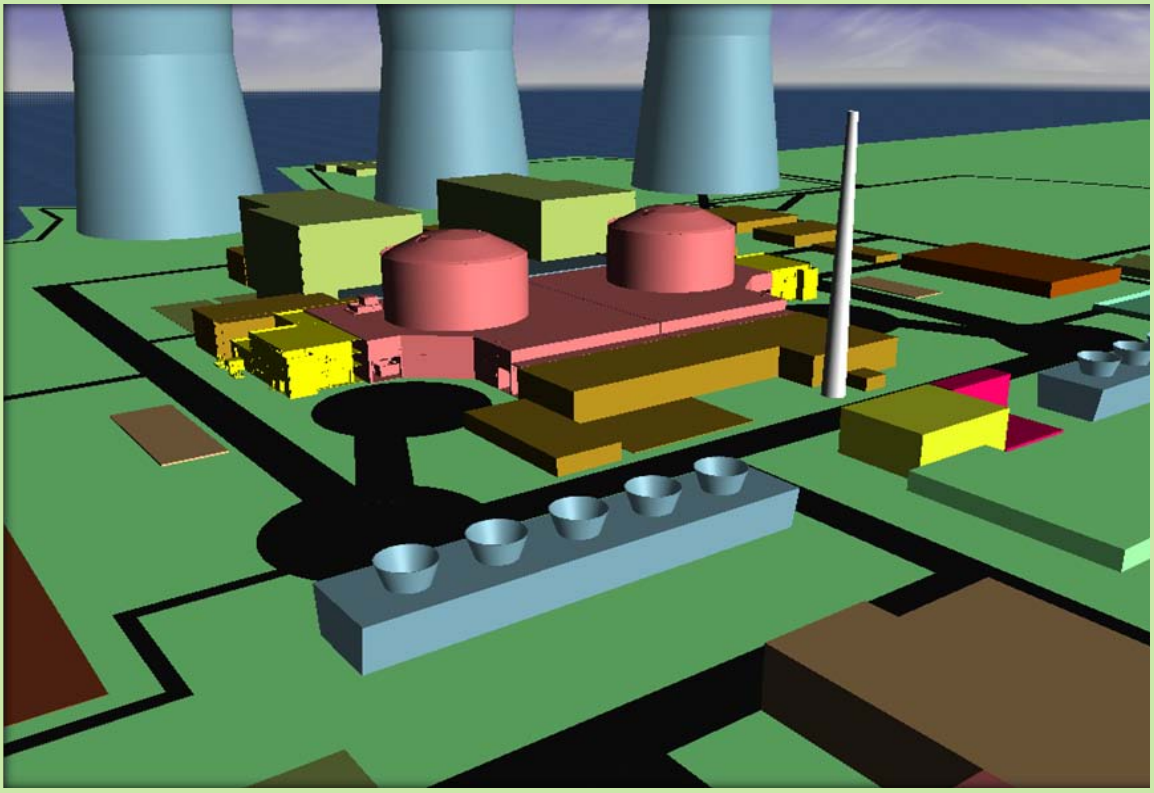
Environmental Impact Assessment Report
for
Proposed 2x700 MWe PHWR
Chutka Madhya Pradesh Atomic Power Project (CMPAPP)
at Chutka, Mandla District, Madhya Pradesh



EXECUTIVE SUMMARY

Nuclear Power Corporation of India Limited Nabhikiya Urja Bhavan, Anushaktinagar, Mumbai-400094	National Environmental Engineering Research Institute Nehru Marg, Nagpur-440 020
MARCH-2013	

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Disclaimer

This Document is the property of Nuclear Power Corporation of India Limited (NPCIL) which has been made for obtaining Environmental Clearance for the proposed 2x700 MWe PHWR Chutka Madhya Pradesh Atomic Power Project (CMPAPP) at Chutka, Mandla District, Madhya Pradesh from Ministry of Environment and Forest (MoEF) as per EIA Notification, 2006 notified by MoEF.

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Contents

List of Figures

List of Tables

Executive Summary

1.0 Introduction

After getting "In-Principle" approval from Government of India for setting up of Nuclear Power Project, 2x700 MWe Pressurised Heavy Water Reactors at Chutka Village, Tal-Narayanganj, Dist-Mandla in Madhya Pradesh, Environmental Impact Assessment Study for the proposed project was carried out in detail according to the Terms of Reference (ToR) prescribed by MoEF, New Delhi at scoping stage. The entire report is compiled into two parts i.e **Volume-I** and **Volume-II**, **Volume-I** covering the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) whereas **Volume-II** is having two parts **Volume-IIA** & **Volume-IIB** covering the additional studies carried out, etc.

Initially, the proposed project was named as Madhya Pradesh Atomic Power Project (MPAPP) and the Terms of Reference (TOR) were provided in the same name, but in future it will be known as Chutka Madhya Pradesh Atomic Power Project (CMPAPP).

For obtaining the statutory Environment Clearance (EC) to set up Chutka Madhya Pradesh Atomic Power Project (CMPAPP) at the above location from Ministry of Environment and Forests, Government of India, NPCIL entrusted the work of Environmental Impact Assessment (EIA) Study to National Environmental Engineering Research Institute (NEERI), Nagpur with a view to establish the baseline status with respect to various environmental components viz. air, noise, water, land, biological, radiological, socio-economic etc. and to assess & predict the potential impacts due to the proposed activities, including their Environmental Management Plan.

NEERI has collected environmental baseline data during winter 2010-11, summer 2011 and post-monsoon 2011 which are analyzed and presented in Volume-I of EIA report.

2.0 Need for the Project

In order to keep the pace and overall growth of development and to meet the multifold demand of electricity, Government of India has intent to achieve Energy Security in the country. Accordingly, there is need to increase the production of electricity from all available energy sources. Further, with the fast depletion of fossil fuel and associated green house gas effect, Government of India has planned to promote much more contribution of Electricity generation from nuclear sources.

In the light of the above, Government of India has given "In-Principle" approval for setting up of proposed project based on the recommendation of Site Selection Committee (SSC), constituted by Government of India. Accordingly, NPCIL proposes to establish a Atomic Power Project of 2x700 MWe PHWR type of indigenous technology at this site.

3.0 Nuclear Power Program : Present Scenario

Presently total installed capacity of Nuclear Power Plants in India is 4780 MWe (20 operating reactors) and plants of total capacity of 5300 MWe (7 reactors including PFBR under BHAVNI) are under construction. A nuclear power programme has been chalked out to increase the power generation from present level of nuclear energy to 20,000 MWe by 2020. However, Government of India, in the Integrated Energy Policy of 2006 has envisaged possibility of reaching a Nuclear Power of 63000 MWe by 2032.

Government of India has conveyed its "In-Principle" approval for setting up additional 4x1000 MWe LWRs at Kudankulam, Tamil Nadu and 6x1650 MWe LWRs at Jaitapur, Maharashtra for which Environmental Clearances (ECs) have been obtained and other pre-project activities are under progress.

"In-Principle" approval have also been received from Government of India for 11200 MWe by setting up indigenous PHWRs type of reactors at four new sites and one existing site and for 18000 MWe by setting up LWRs type of reactors on foreign co-operation at three new sites. Pre-project activities to obtain statutory ECs and regulatory clearances are under progress.

3.1 Development of Nuclear Power in the Country

In India, the development of nuclear power is taken up through a three stage nuclear power program by Department of Atomic Energy. The First Stage program involves utilization of available resource of natural Uranium in the country for generation of nuclear power by Pressurized Heavy Water Reactor (PHWR) technology. The first stage of nuclear power programme has progressed very well with the establishment of indigenous capabilities to design, manufacture, construct, commission and operates nuclear power plants & enhancing its plant capacity to 700 MWe.

The Second Stage program involves Fast Breeder Reactor (FBR) technology wherein plutonium is utilized, which is obtained by reprocessing spent fuel from PHWR units from first stage and at the same time using Thorium as blankets in these type of reactors, which will be converted into uranium.

The Third Stage involves use of uranium obtained from second stage and later on from third stage itself as fuel and thorium as blanket (which is available in abundance in India) and will be converted into uranium for long term energy generation.

4.0 The Project

Salient features of the proposed twin unit module (CMPAPP-1&2) are similar to the earlier PHWRs type of reactors in construction whereas, salient technical details of the project are shown in **Table-1**.

Steam generators supply nearly dry saturated steam to the turbine which is a tandem compound machine directly coupled to an electrical generator, which produces electricity. Generator voltage is stepped up by the generator transformer which in turn is connected to a switchyard. Generated stepped up power is transmitted to the grid from the Atomic Power Station at 400 KV.

Reactor regulating system enables automatic control of reactor power and maintains neutron flux profile and reactor protection system ensures shutdown requirements by two independent fast acting shut down systems. Natural Draft Cooling Towers (NDCTs) will be used as heat sink for condenser cooling water and make-up for recirculating water will be drawn from Rani Avanti Bai Lodhi Sagar (R.A.B.L.S) Dam reservoir.

A township for NPCIL and CISF employees and their families is also proposed to be set up at Manegaon village at a distance of 6 km from the project site in NEE direction. The proposed township of CMPAPP is not a commercial residential colony, but is an integral part of the power project for all the purposes including Environmental Clearance.

4.1 Engineering

Modifications in design and plant layout have been incorporated based on the feedback of construction & operation of latest plants i.e. TAPS-3&4, KGS-3&4 and RAPS-5&6 and also based on current regulatory requirements, technology of the state of the art globally and site specific requirements and will be identical to the design of 700 MWe units under construction at KAPP-3&4 and RAPP-7&8 except for the site specific changes that are mainly associated with plant water systems and power evacuation systems.

4.2 Inherent Safety Features

The PHWR Reactors selected for CMPAPP is safe & proven reactor design during normal as well as abnormal conditions, as it has certain inherent safety features viz. two independent shut down systems, Double containment system, interleaved feeders, containment spray system, Secondary containment Recirculation and Purge (SCRP) system, Primary Containment Controlled Discharge System (PCCD), fire protection system, Emergency Core Cooling System (ECCS), Passive Decay Heat Removal System and ultimate heat sink.

4.3 Project Cost

Base cost as per June 2011 basis is Rs 11250 Crore and expected completion cost for two units at Chutka site is Rs. 16550 crores.

4.4 Implementation Schedule

Implementation schedule is given in **Table-2**.

4.5 Salient Features of the Site

Salient features of the site are shown in **Table-3**. The proposed site is considered suitable for setting up the two PHWR Atomic Power Project Units (2x700 MWe). The project site is present on the right bank of R.A.B.L.S dam reservoir on Narmada River, about 27 Km radially upstream of the R.A.B.L.S Dam (**Fig. 1)**. The proposed site falls in Seismic Zone-II as per Seismic Zoning Map of India which is lowseismic prone zone. The township area has non-grazing grassland while the project site has scrub vegetation, forest and barren land.

4.6 Basic Requirement for the Project

4.6.1 Land

The details of land being acquired for the two units including exclusion zone is given in **Table-4**.

4.6.2 Water Requirement

About 9000 m^3/hour of water (6340 m^3/hour consumptive use and 2660 m^3/hour will be returned to the R.A.B.L.S. Dam Reservoir will be required for an NPP of 2x700 MWe PHWRs. 40 m^3/hour will be required for township. The cooling water

requirement for the twin units has been assured by the M.P. State Government.

4.7 Radiological Safety

The operation of the proposed project involves use of natural Uranium Oxide (UO_2) as fuel and heavy water (D_2O) as coolant and moderator for the reactor. Refueling of the reactor will be carried out "on-power". The UO_2 used for fuel is a ceramic with high melting point and chemically inert to water at operating conditions. During normal operation virtually all solid fission products are permanently retained in UO_2 matrix and only a fraction of noble gases and volatile products diffuse into the inter space between fuel and cladding.

Waste management operations (liquid and solid), involves handling of radioactive wastes from all the facilities for their ultimate storage/disposal. All these operations are carried out in leak tight enclosures, under negative pressure so that the probability of the radioactive materials reaching the working environment is reduced to a minimum. Further, there are also clean up mechanisms like filters and traps to confine any radioactive materials in the exhaust streams of the ventilation systems. From the plant operations, a small fraction of these radio-nuclides are released into the environment in the form of gaseous emissions and liquid effluents which are well within the authorized limits prescribed by AERB.

4.7.1 Radioactive Waste Management Systems

4.7.1.1 Gaseous Waste Processing System

The gaseous radioactive effluents from reactor and service building ventilation exhaust systems are continuously monitored for radioactivity content and passed through pre filters and absolute filters before discharge through the stack. The dose to the public at 1 Km boundary through air route is given in **Table-5**

4.7.1.2 Liquid Waste Processing System

Low level treated liquid waste from post treatment tank will be monitored before injected into the plant water discharge (Blow down) piping. Inline mixers are provided in the pipe line to ensure thorough mixing of treated waste with plant water discharge system, before it gets discharged.

Liquid wastes having tritium and Beta-Gamma activity like Tritiated Waste (TTW) generated from Upgrading plant rejects, Moderator room sump & Clean-up system

and Active Non Chemical Waste (ANCW) generated from Equipment decontamination system of WMP, chemical laboratory & SFSB cask wash down area, of less volume will be evaporated, diluted with exhaust air and discharged through stack to air route. The dose to public at 1 Km boundary through liquid route is is given in **Table-6**.

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4.7.1.3 Solid Waste Processing System

Treatment and disposal of radioactive solid waste will be carried out as per Atomic Energy Regulatory Board (AERB) requirements. Radioactive solid waste generated at the plant is segregated at source depending upon its nature (Combustible/compactable/non-compactable) and surface dose rate. Different types of radioactive solid wastes that get generated are spent ion-exchange resins, paper-waste, cotton waste, air filter, liquid filter, shoe covers, hand gloves, mops, discarded clothing and components, sludge etc. Solid wastes are transported to in-situ Waste Management Plant in shielded containers / casks, if required, for treatment / conditioning. Conditioning system for solid waste provided in WMP include processes like spent resin management, cementation of liquid filters/ sludge and compaction of compressible wastes. The waste after treatment/conditioning shall be disposed off in engineered barriers like stone lined earth trenches, RCC vaults / trenches and tile holes / high integrity containers (HIC) located at the Near Surface Disposal Facility (NSDF), depending upon their surface dose rate. Fuel reprocessing plant is not envisaged at CMPAPP.

4.7.2 Radiation Dose Limits for NPP Workers/Public

4.7.2.1 Workers of Nuclear Power Plant (NPP)

For workers of NPP, an annual individual dose of **100 mSv** over 5 years with less than **30 mSv** in any year is imposed as effective maximum dose as per AERB requirements. The design of proposed reactor at CMPAPP is aimed at providing low dose rates work places and suitable ergonomics.

4.7.2.2 Public

For members of public the upper limit of radiation exposure is **1 mSv/y** during normal operation of all the units at the site. Based on this, the limits for radioactive releases will be designed such that the dose from all the routes is limited to **0.11 mSv/y** during normal operation of CMPAPP.

4.7.2.3 Radiation Protection

The design of the project will be such that the radiation dose to the members of public from all the routes is restricted to **0.11 mSv/y**. The AERB permitted dose to the members of public is **1.0 mSv/y** from all the routes and units at the site. For highlighting the experiences of the existing NPPs in India, the average radiation dose to the members of public from all the operating stations of NPCIL is presented in **Fig. 2**. It is clear from the figure that the radiation dose to public due to nuclear power plants is observed to be **800** to **27** times lesser than the stipulated dose limit of **1 mSv/y** and **1900** to **64** times lesser than the public domain dose due to natural background radiation. Therefore, nuclear power plants do not pose any hazard to human and other life forms.

4.7.3 Emergency Planning

The purpose of planning for on-site/off-site radiation emergency response is to ensure adequate preparedness for protection of the plant personnel and members of the public from significant radiation exposures in the unlikely event of a severe accident. The probability of a major accident resulting in the releases of large quantities of radioactivity is extremely small. The probability, however, can never be reduced to absolute zero and therefore this residual risk is sought to be mitigated by appropriate siting criteria and implementing suitable arrangements for emergency planning and preparedness.

The agencies responsible for carrying out remedial measures during the different categories of emergencies mentioned above are indicated in **Table-7**.

4.7.3.1 Exercises & Periodicity

Emergency scenarios shall be developed to test emergency plans and operational response at all levels. The periodicity of exercise is as follows

- Plant emergency Exercise – Quarterly
- Site emergency Exercise – Yearly
- Off-Site emergency Exercise – Two Yearly

As per regulatory requirement, one drill for off-site emergency is to be demonstrated before criticality of unit-1 of CMPAPP.

5.0 Description of Baseline Environment

5.1 Air Environment

5.1.1 Micrometerology

During winter, winds were recorded from SSE direction largely and also from W, WNW and NW directions and velocity found to be between 0.5 to 5.0 m/s during the 24 hours period. During summer, winds were recorded from N and NW directions and velocity found to be between 1.5 to 5.5 m/s during the 24 hours period. During post-monsoon season, winds were recorded from N and NW directions and velocity found to be between 0.5 to 3.6 m/s during the 24 hours period.

5.1.2 Particulate Matter

5.1.2.1 Suspended Particulate Matter (SPM)

The minimum and maximum values of 24 hourly SPM were ranged between 27-82 µg/m³, 90-168 µg/m³ and 60-98 µg/m³ in winter, summer and post-monsoon season respectively while the average SPM concentration varied in the range of 31-71 µg/m³, 105-120 µg/m³ and 70-82 µg/m³ for three seasons respectively. The 98th percentile of SPM ranged between 34-82 µg/m³, 119-162 µg/m³ and 76-95 µg/m³ for three seasons respectively.

5.1.2.2 Particulate Matter-10 (PM10)

The minimum and maximum values of 24 hourly PM_{10} were ranged between 22-49 µg/m³, 33-91 µg/m³ and 37-61 µg/m³ in winter, summer and post-monsoon season respectively while the average PM_{10} concentration varied in the range of 23-44 µg/m³ , 49-66 µg/m³ and 44-53 µg/m³ for three seasons respectively. The 98th percentile of PM_{10} ranged between 24-48 µg/m³, 60-90 µg/m³ and 49-60 µg/m³ for three seasons respectively. The PM_{10} concentrations were observed to be below stipulated National Ambient Air Quality Standards (NAAQS), 2009 (24 hourly PM_{10}=100 µg/m³).

5.1.2.3 Particulate Matter-2.5 ($PM_{2.5}$)

The minimum and maximum values of 24 hourly average $PM_{2.5}$ concentrations varied in the range 8-21 µg/m³, 12-48 µg/m³ and 8-28 µg/m³, while the average concentration ranged between 11-20 µg/m³, 13-33 µg/m³, 15-20 µg/m³ respectively for winter, summer and post-monsoon seasons. The 98th percentile of $PM_{2.5}$ ranged between 13-21 µg/m³, 15-47 µg/m³ and 19-26 µg/m³ respectively. The $PM_{2.5}$ concentrations were

observed within stipulated NAAQS, 2009 (24 hourly $PM_{2.5}$ =60 µg/m^3).

5.1.3 Gaseous Pollutants

5.1.3.1 Sulphur Dioxide (SO_2) and Oxides of Nitrogen (NO_X)

The minimum and maximum concentration of SO_2 and NO_x were observed in the range of 5-15 µg/m³, 5-15 µg/m³ & 3-11 µg/m³ and 9-25 µg/m³, 10-20 µg/m³ & 9-25 µg/m³ for winter, summer and post-monsoon season respectively. The average concentration of SO_2 observed ranged between 6-10 µg/m³, 7-10 µg/m³ & 6-9 µg/m³, and average concentration of NO_x observed in the ranged 12-18 µg/m³, 12-15 µg/m³ & 13-19 µg/m³ for all three winter summer and post-monsoon seasons . The 98th percentile of SO_2 and NO_x ranged between 10-15 µg/m³, 9-15 µg/m³ & 8-11 µg/m³ and 8-29 µg/m³, 14-19 µg/m³ & 16-25 µg/m³ respectively for all three seasons. The levels of gaseous pollutants were below the stipulated NAAQS, 2009 (24 hourly SO_2 is 80 µg/m^3 and for NO_x is 80 µg/m^3).

5.1.3.2 Ammonia (NH_3)

The observed minimum and maximum concentration at all locations ranged between 11-31 µg/m^3, 12-49 µg/m^3 and 12-53 µg/m^3 and average concentration ranged between 13-24 µg/m^3, 20-33 µg/m^3 and 20-34 µg/m^3 for all three seasons respectively. All these values are well within the stipulated NAAQS, 2009 (24 hourly NH_3 =400 µg/m^3).

5.1.3.3 Ozone (O_3)

The observed minimum and maximum values of Ozone at all the locations ranged between 10-34 µg/m3, 9-26 µg/m3 and 8-26 µg/m3 and average concentration ranged between 15-29 µg/m3, 11-17 µg/m3 and 12-15 µg/m3 for all the three seasons respectively which were below the stipulated standards for the designated areas (8 hourly =100 µg/m3).

5.1.3.4 Carbon Mono-oxide (CO)

The observed carbon monoxide concentration at all the locations varied between 0.12-1.48 mg/m^3, 0.52-1.00 mg/m^3 and 0.16-1.67 mg/m^3 for all the three seasons, which are within the permissible limits of NAAQS, 2009 for the respective designated areas (CO for 8 hour =02 mg/m^3).

5.1.3.5 Hydrocarbons (HC)

The concentrations of Total Hydrocarbons were 1.23-1.48 ppm, 1.24-1.47 ppm and 1.25-1.47 ppm for all three seasons.

5.1.4 Particulate Associated Toxic Pollutants

5.1.4.1 Lead (Pb)

The observed lead concentration at all the locations varied between ND-0.90 µg/m^3, 0.02-0.82 µg/m^3 and ND-0.31 µg/m^3 for all the three seasons. As seen, concentrations of Pb are within the permissible limits of NAAQS, 2009 (Pb for 24 Hour=1.0 ug/m^3).

5.1.4.2 Arsenic (As) and Nickel (Ni)

The observed arsenic concentrations at all the locations were ND for all the three seasons The observed Ni concentration at all the locations varied between ND-1.6 ng/m^3, 0.7-14.2 ng/m^3 and ND-1.8 ng/m^3 for all three seasons and were within the permissible limits of NAAQS, 2009 (annual for Ni =20 ng/m^3).

5.1.4.3 Benzo (α) Pyrene (BaP)

The observed BaP concentration at all the locations varied between ND-0.21 ng/m^3, 0.02-0.24 ng/m^3 and ND-0.24 ng/m^3 for all three seasons respectively within the permissible limits of NAAQS, 2009 (annual for BaP =01 ng/m^3).

5.2 Noise Environment

Noise levels were monitored at twenty four locations at proposed project site, surrounding villages, commercial and sensitive places such as schools, hospitals, temples etc. The noise range measured during winter 2010 was 32.6-66.4 dBA and 28.3-46.2 dBA during day and night time respectively. While in summer 2011, it was 32.5-69.4 dBA at day time and 27.1-61.2 at night. In post-monsoon 2011, the noise level measured in the range of 31.0-68.8 dBA and 26.4-53.0 dBA during day and night time. Vehicular traffic was the major noise source and contributes mainly to background noise levels in the villages.

5.3 Water Environment

In order to generate the baseline water quality (physico-chemical

bacteriological and biological) of the region, the water quality monitoring study was undertaken in core zone (1-5 km) and buffer zone (5-30 km) of the study area.

5.3.1 Surface Water

5.3.1.1 Core Zone

The overall surface water quality within the study area indicates typical of undisturbed rain fed water bodies containing low minerals and nutrients with relative insignificant organic load. The river stretch showed good water quality in terms of turbidity (2-10 NTU) and total suspended solids (<1-23 mg/l). Buffering capacity in terms of alkalinity was found to be in the range of 60-85 mg/l, whereas pH was in the range of 7.7-7.9. Inorganic parameters i.e. chloride, sulphate, sodium and potassium are 14-20 mg/l, 3-12 mg/l, 15-30 mg/l and 2-3 mg/l respectively. Dissolved Oxygen (DO), Chemical Oxygen Demand (COD) and Biochemical Oxygen Demand (BOD) were observed to be in the range of 5.2-7.2 mg/l, <5-11 mg/l and <3 mg/l respectively. The levels of oil & grease and hydrocarbons were found to be 3.4-5.6 mg/l and in non detectable levels respectively. Concentration of cadmium and chromium was found to be non detectable. Other heavy metals like copper, lead, iron, manganese and zinc was found to be within prescribed limits of drinking water quality standards IS 10500: 1991.

5.3.1.2 Buffer Zone

The results obtained for physico-chemical characteristics of surface water in Buffer zone during winter 2010, summer and post monsoon 2011 seasons showed good water quality in terms of turbidity: <1 to 9, 4 to 72 and 1 to 9 NTU and total suspended solids: <1 to 32, 3 to 177 and 2 to 10, mg/l. Buffering capacity in terms of alkalinity was in the range of 60 to 125, 65 to 132, and 50 to 110 mg/l, whereas pH was in the range of 6.9 to 7.9, 7.5 to 8.1 and 7.9 to 8.2. Nutrient load in terms of nitrate was in the range of 0.10 to 0.79, 0.31 to 0.71, and 0.32 to 1.81, mg/l and total phosphates 0.01 to 0.68, 0.18 to 0.36, and 0.61 to 1.22 mg/l in respective seasons. Levels of DO were 6.8 to 7.3, 4.6 to 5.4 and 2.6 to 6.4 mg/l and COD were observed to be in the range of <5 to 8, <5 to 21 and 7.4 to 10.8 mg/l in respective seasons. The levels of oil and grease were found to be in the range of 2.6 to 5.0, 2.6 to 14.0 and 2.0 to 8.0 mg/l respectively. Heavy metals in winter, summer and post monsoon were found in the range of non detectable levels or within permissible limits of drinking water quality standards. However, concentration of iron in lake water at village Amboda (0.66 mg.l) in winter, in river Tediya upstream of village Magrodha 1.80 mg/l in summer, while in river Narmada near village Pratapgarh

(1.00 mg/l) in post monsoon was found to exceed the prescribed limit of 0.3 mg/l for iron.

5.3.2 Ground Water

5.3.2.1 Core Zone

Groundwater samples showed wide range of variations in all physico-chemical parameters. The pH, temperature and turbidity ranged between 7.6-8.2, 23-29 ^{O}C and <1-10 NTU respectively. The total suspended solid varies from <1-96 mg/l, while the total dissolved solids from 122-375 mg/l.

Inorganic parameters, i.e. chloride, sulphate, sodium and potassium are 11-32, 7.25, 10-65 and 1-3 mg/l respectively. Levels of DO and COD were observed to be in the range of 2.8 - 7.2 mg / l and <5-16 mg/l respectively. Nutrient load in terms of nitrate and phosphates was found to be in the range of 0.18-3.00 mg/l and 0.06-0.90 mg/l respectively. Oil and grease and hydrocarbons were found to be in range of 3-8 and non-detectable limits respectively.

Concentrations of heavy metals viz. copper and nickel, cadmium, chromium, lead, were mostly observed in non-detected levels or within permissible limits, except iron which was found to exceed the permissible limit of 0.3 mg/l for drinking water, while manganese and zinc were within the limits.

5.3.2.2 Buffer Zone

The groundwater quality in buffer zone of study area for winter, summer and post monsoon seasons respectively was as follows, Turbidity: <1 to 24, <1 to 15 and <1 to 10 NTU and total suspended solids: <1 to 84, 1 to 41 and 1 to 25 mg/l. Buffering capacity in terms of alkalinity was in the range of 43 to 283, 46 to 290 and 27 to 275 mg/l. Nutrient load in terms of nitrate and phosphates was in the range of 0.16 to 1.00, 0.52 to 5.81, 0.43 to 5.12 mg/l and 0.03 to 0.77, 0.16 to 0.63 and 0.12 to 1.54 mg/l in respectively. Levels of DO were 2.7 to 7.8, 1.4 to 6.4 and 2.2 to 3.8 mg/l and COD were observed to be in the range of <5 to 8.0, <5 to 9.0 and <5 to 9.4 mg/l in respective seasons. The levels of oil and grease were found to be in the range of ND in all the three seasons. Heavy metals in winter, summer and post monsoon were found in the range of non detectable levels with a few exceptions especially of iron and manganese, exceeding the prescribed limit of drinking water quality standards.

5.3.3 Bacteriological Characteristics

5.3.3.1 Core Zone

Water samples were analyzed for total and faecal coliforms deploying membrane filtration technique showed presence of Total Coliform in winter, summer and post monsoon seasons in the range of 240 to 270, 430 to 450 and 350 to 510 CFU/100 ml respectively and Feacal Coliform in the range of 80 to 90, 140 to 210, and 115 to 248 CFU/100 ml respectively.

Ground water quality in the core zone showed Total Coliform in winter, summer and post monsoon seasons in the range of 75 to 155, 250 to 290 and ND to 145 CFU/100 ml respectively and Feacal Coliform in the range of 12 to 29, 22 to 78 and ND to 64 CFU/100 ml respectively and thus, indicates need for chlorination, before consumption for domestic proposes.

5.3.3.2 Buffer Zone

Bacteriological quality of surface water samples collected and analyzed from buffer zone showed presence of coliforms in the range of 150 to 260, 590 to 850 and 170 to 410 CFU/100 ml respectively and Feacal Coliform in the range of 30 to 75, 75 to 210 and ND to 75 CFU/100 ml respectively in winter, summer and post-monsoon seasons.

Whereas, Bacteriological quality of groundwater in the buffer zone showed presence of Total Coliform in winter, summer and post monsoon seasons in the range of 60 to 235, 105 to 670 and ND to 175 CFU/100 ml respectively and Feacal Coliform in the range of 4 to 55, 30 to 190 and ND to 70 CFU/100 ml respectively. Hence, need chlorination before consumption.

5.3.4 Biological Characteristics

5.3.4.1 Core Zone

The count as number of Phytoplankton organism per ml of surface water in core zone during the three seasons varied between 182 to 1170, 230 to 1500 and 110 to 910 respectively with the species dominated by *Chlorophyceae* and *Bacillariophyceare* followed by *Cyanophyceae* groups. Shannon Wiener Diversity Index varied between 1.66 to 1.34, 1.70 to 1.45 and 1.50 to 1.30 in respective seasons.

The count of Zooplankton per m^3 of surface water varied between 615 to 3846, 800 to 4110 and 515 to 2320 nos/mg respectively. *Rotifera* and *Copepoda* were found to be the dominant groups of zooplankton. The SWD index varies between 1.50 to 1.81, 1.65 to 1.72 and 1.0 to 1.64 in respective winter, summer and post monsoon seasons,

which indicates low impact of pollution.

5.3.4.2 Buffer Zone

The phytoplankton count in buffer zones in winter, summer and post monsoon seasons varied between 130 to 650, 48 to 610 and 312 to 648 nos/ml respectively. SWD Index was found to vary between 1.52 to 3.73, 1.00 to 2.58 and 1.84 to 3.67 in respective seasons.

The count of Zooplankton as number of organisms per m^3 of surface water varied between 461 to 2615, 920 to 3215 and 385 to 1923 nos/mg respectively with *Rotifera* and *Copepoda* as the dominant groups of zooplankton observed in buffer zone in all the three seasons**.** The SWD index varied between 0.91 to 2.15, 1.00 to 1.50 and 1.52 to 2.04 in respective winter, summer and post monsoon seasons, which indicates low impact of pollution.

5.4 Land Environment

The land around the study area is mostly undulating. For establishing soil characteristics within the study area, soil samples from 32 locations were collected and analysed for relevant parameters. Clay is the prominent textural class followed by clay loam, silty clay in the impact zone. Clay content in the soil of the study area varies from 37.60 to 49.90%. The soil being of friable consistency, the bulk density of the soil is in the range of 1.14 to 1.28 g/cm^3 whereas the porosity and water holding capacity are in the range of 40.08-46.60 % and 41.8 to 56.63% respectively. The pH of the soil in the study area is slightly acid to neutral and slightly alkaline in reaction having pH is in the range of 6.2-7.9. The (Electrical Conductivity) of the soil extract in the study area is in the range of 0.06 to 0.42 dS/m indicating normal soils with respect to mineral content i.e. EC<1dS/m.

In general, the soil samples in the study area has high to very high adsorption capacity and moderate productivity as evident from the cation exchange capacity which is found to be in the range of 28.60-44.20 Cmol (P^+) Kg^{-1} soil. Amongst the different exchangeable cations, calcium is prominent followed by magnesium. Exchangeable sodium percentage (ESP) of the soil samples in the study area was found to vary from 0.74-4.52. ESP between 4-10 can be considered as satisfactory. Soils from all the villages are normal and free from sodicity with respective to alkalinity as exchangeable sodium percentage of soil is below 15.

Organic carbon, available nitrogen, phosphorous and potassium of the soil

samples are found to be in the range of 0.36-0.58%, 126.69-451.58, 8.39-24.44 and 46.71-180.40 kg/ha respectively. Soil samples are poor to medium level in organic carbon content. Data indicates that soils in the study area are poor fertile, available potassium present in the soil also shows poor fertility level.

5.4.1 Land-use Pattern

The total geographical area of the Mandla district is 965559 hectares. Forest dominates land use of the area, occupying around 61.43%, followed by cultivated land covering 27.75% of the area. Of this cultivated land, only 23.73% is cropped more than once a year. About 14.59% of the area is not cultivable. Other land use in the district includes revenue wasteland (6.28%), cultivable wasteland (2.03%) and other fallow land (2.06%).

5.5 Biological Environment

The study area around the proposed project site comprises of terrestrial ecosystem (agricultural land, wasteland and barren land). The observations were made during winter, summer and Post-monsoon season in the month of December, May, August respectively (2010-2011).

5.5.1 Forest and Forest Type in Study Area

According to given working plan of forest department by Mandla and Seoni Dry Teak forest and Dry Mixed forest are observed in the study area

5.5.2 Biodiversity of Proposed Project Site

The proposed project site is situated on barren/grass land beside R.A.B.L.S. dam reservoir at Chutka village surrounded by sparse vegetation consisting of large and small trees, shrubs, under shrubs, herbs, bamboos and climbers. The dominant tree species found in the project site are Mahua *(Madhuca indica*), Palash *(Butea monosperma*), Landiya *(Lagerstroemia parviflora)*, Bel (*Aegle marmelos*), Tendu (*Diospyros melanoxylon*), etc.

5.5.3 Floristic Diversity of the Study Area

Species of 57 trees, 28 shrubs, 76 herbs, 17 climbers and 7 grass were observed during floristic survey of study area.

Dominant families recorded in the study are *Caesalpiniaceae*, *Mimosaceae, Euphorbiaceae, Fabaceae, Malvaceae, Lamiaceae, Asteraceae, Solanaceae, Orchidaceae, Cyperaceae,* and *Poaceae.*

Simpson Diversity Index of the plants in the study area shows that the study area has rich biodiversity in zone (0-1 Km) trees (0.179), shrubs (0.247) and herbs (0.081), in zone (1- 5 Km) trees (0.080), shrubs (0.162) and herbs (0.082), in zone (5-16 Km) trees (0.091), shrubs (0.166) and herbs (0.072), in zone (16- 30 Km) trees (0.096), shrubs (0.16) and herbs (0.129).

5.5.4 Medicinal Plants

According to the forest working plan of Mandla and Seoni forest division out of total 995 plant species, 155 medicinal plant species are of medicinal importance.

The common species observed having some medicinal properties are Nirgundi *(Vitex negundo*), Bel (*Aegle marmelos*), Neem (*Azadirachta indica*), Plash (*Butea monosperma), Ficus* species*,* Jamun (*Syzygium cumini*), Imli (*Tamarindus indica*), Mahua (*Madhuca indica*), Tulsi (*Ocimum* species)*,* Avovala (*Emblica* species)*,* Arjun (*Terminalia arjuna*), etc*.*

No taxa were found threatened in the study area. The reported taxa have also not been enlisted in the Red Data Book of Indian plants (Nayar and Sastry, 1988).

5.5.5 Agriculture

Main agricultural crops grown in study area are paddy, wheat, gram and pulses. Agro-climatic condition of the area provide a range of potentialities for growing cash crops like onion, chilly, brinjal, bhindi, and fruits. Most of the agricultural land in the study area is rain fed.

The common kharif crops grown in the study area are jawar, maize, arhar, moong, urad, groundnut, til, soyabean. While wheat, maize, gram, mustard are rabbi crops.

5.5.6 Faunal Biodiversity

As per record of Forest Department about 26 sp. of mammals, 39 sp. of pisces, 32 sp. of reptiles and 4 sp. of amphibians were found available in the study area.

5.5.6.1 Mammals

Species were recorded from the region by self observation and interaction with

the local people and secondary data was obtained from working plan of the Mandla and seoni district. Wild dog (*Cuon alpinus*) and fox (*Manis crassicaudata*) was sighted near R.A.B.L.S. dam area.

Wild boar (*Sus scrofa*), fox (*Manis crassicaudata*), wild dog (*Cuon alpinus*), rabbit, spotted deer (*Axis axis*), common langur (*Presbytis entellus*) and mongooses (*Herpestes spp.*) were generally observed in the study area. During Public consultation, it was found that, many other mammalian species such as Jungle cat *(Felis chaus)*; Indian fox *(Vulpos bengalensis*) were also observed by the villagers around the village.

5.5.6.2 Insect Diversity

The insects of order Lepidoptera, Odonata were abundantly seen. Different types of butterflies, which act as pollinators, of various families were located. Common leopard (*Phalanta* spp.), Common Indian crow (*Euploea* spp.), Grass yellow butterfly (*Eurema* spp.), Common Sailor (*Neptis* spp.) are seen.. Large number of dragonflies, of the order Odonata was seen.

5.5.6.3 Reptiles

Reptiles like Indian cobra (*Naja naja*), Dhaman *(Lycodon aulicus*), Water snake and Garden lizard are encountered at various places in study area. However during field survey Python spp. was also sighted.

5.5.6.4 Avifauna

The maximum diversity of birds was observed in R.A.B.L.S Dam, Project Site, Kunda, Thawar Dam, Patha, Jawa etc. Birds were found along or near the water bodies like rivers, ponds and other reservoirs

The recorded number of birds species were 48 in all seasons and census of avifauna within study area Out of that maximum bird species were native. In post-monsoon season Sarus crane (*Grus antigone)* was observed near Gorakhpur village lake, Hoopoe (*Upupa epops)* and Pond heron (*Ardeola grayii*) were observed near R.A.B.L.S Dam. Open bill stork *(Anastomus oscitans)* was observed near Tawar Dam.

Dominant birds in the study area are Red vented bulbul (*Pycronotus cafer*), Common myna (*Acridotheres tristis*), House sparrow (*Passer domesticus*), House crow (*Corvus splendens*), Black drongo (*Dicrurus macrocercus*), Small green bee eater (*Merops orientalis*), Spotted dove (*Stereptopelia chinensis*), Rose ring parakeet (*Psittacula krameri*), Blue rock pigeon (*Columba livia*), House swift (*Apus affinus*), common babbler

(*Turdoides caudatus*) and the other birds are Indian robin (*Saxicoloides fulicata*), Heart spotted woodpecker (*Hemicircus canente*), Black ibis (*Pseudibis papillosa*), Indian roller (*Coracias benghalensis*), cattle egret (*Bubulcus ibis*), white wagtail (*Motacilla alba*), etc.

5.5.6.5 Fisheries

According to the information collected from Fisheries department, Mandla, the annual fish-catch at R.A.B.L.S Dam was in the range of 406 to 582 tonne over the last four years. The fish species found in the river and village pond are catla, rohu mrugal, common carp, etc.

5.6 Socio-Economic Environment

Total surveyed villages are 47 from all direction of the study map. Total households numbers is 6655, total population is 31617. Total area in Hectare is 16890 and density of the surveyed area is 53.42 people per sq km. Sex ratio is 968 (females as per 1000 males). The overall literacy rate as per surveyed villages is 52.70%. Scheduled caste population is 1437 (4.54%) and Scheduled tribes population 18685 (59.09%). The main worker population is 10615 (33.57%), marginal worker is 5663 (17.91%) and non-worker population is 15339 (48.51%)

The statistical data of main worker, there are 4918 (46.33%) and 4369 (41.15%) are cultivators and agriculture worker. The household workers are 238 (2.24%) and other workers are 1090 (10.26%)

Anganwadi center is available in most of the surveyed villages. Educational level is very low in the area. Most of the villages have only primary and middle school facility while for further education people have to travel for about 40 km. Health status is not in good condition, villagers are not satisfied with the health centers because they are not getting proper care from Government hospitals. Some villages are having communication facility in the form of phone and post office. Roads Approach is mainly mud road and little bit government bus service and other private sources. Tap, tank water, wells and hand pumps are the main source of drinking water supply in the region. Sanitation facilities are not in good condition. Approximately 90% villagers are not using toilets. Electricity is available in almost all the villages, but frequent power cut is the main problem in this area. Wood is major fuel used for cooking purpose and kerosene is also used in some extent. Most of the respondents are engaged in agricultural and livestock activities. Farming is the main occupation and other are engaged in migration from one place to other places. Quality of houses is not in good condition and mostly people have

mud constructed house.

5.7 Baseline Radiation/Radioactivity Levels

Gamma radiation levels were measured in and around Chutka site using Bicron Micro Analyst survey meter. The gamma radiation level was in the range 3-5 µR h^{-1} (0.03-0.05 µGy h^{-1}). The gamma radiation levels around this site are normal and are comparable with that of other low background areas.

The radioactivity observed in air, water, milk, soil, aquatic organism including plant, sediment and water collected. The air particulate sample was collected using high volume air sampler and analysed for Gross Alpha and Gross Beta. The activity levels were (0.24 ± 0.09) mBq m^{-3} for Gross alpha and (0.48 ± 0.17) mBq m^{-3} for Gross beta.

The ^{137}Cs activity of well-water sample collected from Dehra village located near the site was below detection limit (BDL) of 0.79 mBq L^{-1}.

The ^{137}Cs and ^{40}K activity in fish sample were 'Below the limit of detection' of 0.06 Bq kg^{-1} and 60.3 Bq kg^{-1} wet weight in edible portion respectively. The ^{137}Cs and ^{40}K activity in the aquatic plant sample were 2.8 Bq kg^{-1} dry weight and 417.9 Bq kg^{-1} dry weight respectively. Sediment samples were collected from various locations of R.A.B.L.S. dam reservoir and analysed for natural and fallout activity. The samples were counted by gamma spectrometry using HPGe detector for the estimation of ^{226}Ra, ^{228}Ra, ^{40}K and ^{137}Cs.

^{137}Cs activity varied in the range of 1.6 to 4.2 + 0.2 while **^{40}K** varied in the range of 117.0 ± 2.9 to 306.8 ± 4.2 Bq kg^{-1}. **^{226}Ra** and **^{228}Ra** varied in the range of 7.9 ± 2.0 to 19.1 ± 1.9 Bq kg^{-1} and 17.5 ± 1.5 to 34.7 ± 2.0 Bq kg^{-1} respectively.

The concentration of uranium in the drinking water samples collected from hand pumps varied from < 0.2 µg L^{-1} - 24.6 µg L^{-1}

Soil samples were collected from various locations around the site and analysed with HPGe detector for the estimation of ^{238}U, ^{232}Th, ^{40}K and ^{137}Cs. The activity for ^{238}U, ^{232}Th, ^{40}K and ^{137}Cs were in the range of 10.6 ± 1.6 to 14.1 ± 1.9 , 20.6 ± 1.5 to 24.7 ± 1.9, 52.7 ± 2.1 to 113.9 ± 3.0 & 1.1 ± 0.2 to 3.5 ± 0.2 Bq Kg^{-1} respectvely.

Vegetables samples collected from Tatighat village were analyzed for ^{137}Cs and ^{40}K. The ^{137}Cs activity was below detection limit i.e. < 0.047 Bq Kg^{-1} while ^{40}K content was 187.0 Bq kg^{-1}. Samples of cereals and pulses grown around Chutka site were collected and analysed for ^{137}Cs and ^{40}K. The concentration of ^{137}Cs was not detectable (<0.05 Bq kg^{-1} fresh weight) in any of the samples while ^{40}K ranged from 32.7 - 103.6 Bq kg^{-1}. ^{137}Cs activity in grass samples collected from Tatighat and Baliwada showed <0.28

Bq $kg^{-1}$of activity while ^{40}K activity was in the range of 213.7 ± 7.1 to 621.5 ± 16.6 Bq kg^{-1}. The activity levels in Milk samples were below the detection limits i.e. <0.07 Bq L^{-1}.

6.0 Impact and Mitigation Measures

6.1 Impacts on Air Environment

Impact on air due to engine exhausts and emission of dust as a result of temporary increase in number of transport vehicles and operation of heavy vehicles for transport of construction material and machinery and loading / unloading operations is envisaged. Fugitive Dust Model (FDM) has been used to predict the Ground Level Concentrations (GLCs) during construction activities.

Various operations viz drilling, blasting, dozing, loading trucks, unloading trucks, loading and unloading of quarry waste, dumps, haul road dust etc. were considered during construction: Maximum incremental GLC of PM_{10} due to construction activities at project site is predicted to be 43.5 $\mu g/m^3$ which is within NAAQS for residential/industrial areas. Reduced level emissions were predicted considering water sprinkling and wind breaking by green belts as a mitigation measure of environmental management plan. With proper EMP, maximum incremental GLC of PM_{10} due to construction activities at project site will be about 20.76 $\mu g/m^3$. As the particulate matter/dust is envisaged more during summer season due to moderate to strong winds and hot environment, the predictions are made only for summer season.

Diesel is the main fuel used for vehicles deployed during construction. Prediction of impacts for CO and NO_x was made on 8 hourly basis up to a distance of 500 m on either side of the roads of project site. The GLCs of CO and NO_x are found to be less than 44.5 $\mu g/m^3$ and 26.8 $\mu g/m^3$ respectively. As such there is no significant impact due to vehicular emissions within the study area against stipulated standards of 2000 $\mu g/m^3$ and 80 $\mu g/m^3$.

The impact on conventional air pollutants during operation will be from operation of emergency DG sets during operation phase in power disruption situation and from increase of vehicular traffic and urbanization.

The predicted impact of running eight emergency DG sets altogether in winter season, GLCs of SO_2, NO_x and PM_{10} are found to be 71.6 $\mu g/m^3$, 86.2 $\mu g/m^3$ and 28.2 $\mu g/m^3$ occurring at a distance of about 2.7 Km in WNW direction. While in summer season GLCs of SO_2, NO_x and PM_{10} are found to be 55.3 $\mu g/m^3$, 66.6 $\mu g/m^3$ and 21.7 $\mu g/m^3$ occurring at a distance of about 7.0 Km in S direction. In the case post monsoon

GLCs of SO_2, NO_x and PM_{10} were found to be 58.3 µg/m^3, 70.2 µg/m^3 and 23.0 µg/m^3 occurring at a distance of about 7.0 Km in S direction.

The cumulative GLCs are obtained after adding the baseline concentrations to the predicted incremental concentrations at the locations where maximum incremental GLCs are observed. It is found that the cumulative GLCs of SO_2 are slightly less than the NAAQS in summer and post-monsoon seasons, whereas the cumulative GLCs of SO_2 are exceeding the NAAQS in winter season. The cumulative NO_x GLCs are found to be exceeding the NAAQS in all seasons. The cumulative GLCs of PM_{10} are found be exceeding in summer season and less than NAAQS in winter and post monsoon seasons.

The above values are with all EDGs will be operated at their full capacity at a time under power disruption situations, however, one EDG set is able to take full in-house load of one unit in case of power disruption situation. Therefore in case of power disruption situation in both the units at a time, two EDGs (one from each unit) will able to take the full in-house load of both the units. In any unit, if two EDGs will operate at a time, in that case they will be operated at 50% of their full capacity. Similarly in case of three EDGs and four EDGs operation, the operating capacity will be at 33% and 25% of their full capacity respectively. Accordingly pollutants emission rate from EDG stacks will also vary with respect to their operating capacity.

Also the proposed township will not have regular sources of air emissions. Small quantities of conventional pollutants will be emitted during the intermittent operation of emergency DG sets during power disruption situations. However these emissions will be occasional in nature and will be for only short duration.

The predicted impact of running emergency DG at township in winter season, GLCs of SO_2, NOx and PM10 are found to be 5.2 µg/m^3, 6.3 µg/m^3 and 2.1 µg/m^3 occurring at a distance of about 0.6 Km in WNW direction. While in summer season GLCs of SO_2, NOx and PM10 are found to be 4.3 µg/m^3, 5.2 µg/m^3 and 1.6 µg/m^3 occurring at a distance of about 2.8 Km in S direction. In the case post monsoon GLCs of SO2, NOx and PM10 were found to be 4.5 µg/m^3, 5.4 µg/m^3 and 1.7 µg/m^3 occurring at a distance of about 3.3 Km in S direction.

It is found that the cumulative GLCs of SO_2, NO_x and PM_{10} are less than the NAAQS in all the three seasons. Hence no significant impact has been envisaged on the air environment of the proposed township.

Mitigation Measures

- The oversized consignment vehicle will be directed to ply only during night between 10.00 PM to 05.00 AM.
- Material transport vehicles during construction phase will be maintained in good working condition, properly tuned and maintained to keep emission within the permissible limits and engines turned off when not in use to reduce pollution.
- It will be ensured that all staff buses during operation phase are in good working condition, properly tuned and maintained to keep emission within the permissible limits and engines turned off when not in use to reduce pollution.
- Vehicles would be regularly maintained so that emissions confirm to standards of Central Pollution Control Board (CPCB).

6.2 Impact Due to Noise Sources

The main sources of noise in the nuclear power plant are turbines, air compressors, ventilation inlets, diesel generators (occasionally operated), pump house equipments, chillers, vents, exhaust fans and heavy & medium automobiles moving around the plant

It is predicted that the noise levels in the surrounding environment due to above said equipments of the proposed units at a distance of 500 m will be 58 dB(A) and at 1000 m will be 51 dB(A). It is also predicted that the noise levels from these sources at 2000 m distance will be <50 dB(A). The maximum noise levels will occur at receptors located near all the proposed units which are predicted to be less than 60 dB(A) without any barriers viz. buildings. These noise levels would be significantly reduced when the barrier of building is considered at the time of operation of plant.

Considering the attenuation due to specially designed building within which noise generating machineries will be housed, the increase in noise levels will be around 1-2 dB(A) just outside the building of power plant. Thus, there will not be any change in the ambient noise levels due to operation of nuclear power plant in the nearest villages at or beyond 2 km distance. Therefore the community will not be affected by the operation of the proposed NPP.

Occupational health of the workers will also not be affected as the noise levels in the building are predicted to be 90 dB(A).and which will be reduced considerably because of deployment of protective equipments like ear muffs.

However, these concentrations shall be within the prescribed limits of CPCB / MPPCB as the proposed nuclear power project is not the source of conventional air pollution and present levels of conventional air pollutants are very low.

Mitigation Measures

- Vehicular movement during construction will be controlled to keep the noise level low.
- Employees as well as the construction workers will be provided with suitable noise protective devices like earmuffs, whenever necessary to reduce the exposure to noise levels.
- All the noise generating machines/ equipment will be within confined places and would be maintained with an effective maintenance plan on regular basis.
- The operator's cabins of machines particularly prone to noise would be acoustically insulated with special door and observation windows.
- The operators & other staff working in high-noise area would be provided with ear-muffs/ear-plugs and they would be properly trained to use the same.
- The duties of employees working in high noise area will be rotated systematically to avoid occupational health hazards.
- Green belt in the exclusion zone of 1.0 km around the plant boundary to completely attenuate noise to background levels.
- Controlled blasting activity should be followed strictly or restricted during nighttime.

6.3 Impact on Water Environment

The outflow from the plant will be through NDCT and IDCT blow down (2160 + 320 = 2480 m^3/hr) and through plant drains 180 m^3/hr. A total of 2660 m^3/hr will be returned back to R.A.B.L.S dam Reservoir. The temperature difference between discharged water to R.A.B.L.S dam reservoir, through cooling towers, and inlet water from R.A.B.L.S dam reservoir will not be above 5°C which meets the MoEF requirement..

Mitigation Measures

- Sanitation facilities to the nearby villages around the plant site to reduce faecal contamination in water.

- The vehicle maintenance / washing area will be selected in such a way that it does not contaminate surface or ground water.
- Proper piling of waste material generated during excavation.
- In-plant control measures to minimize the quantities of wastewater generation.
- Poorly maintained machinery will not be allowed to operate on site. All routine maintenance of construction machinery and vehicles shall be carried out in a designated workshop / maintenance area(s) with concrete hard standing surface and drainage to an oil interceptor.
- The concrete batching plant / mixing area will be surrounded by a retention bund and all excess wash water will be retained in a sedimentation reservoir from where it will be pumped back for reuse in the concrete manufacturing process.
- Sediment control and attenuation facilities such as sand traps, temporary attenuation ponds and soak always will be used as necessary during construction to protect the site, adjacent areas and the downstream drainage system.
- Construction of the diversion tunnel / coffer dams will be carried out in the dry season when the river level is lowest
- An effective liquid waste management plan based on segregation of the waste, treatment, on line monitoring and regular review will be implemented.
- Performance evaluation of wastewater treatment plant to take corrective actions well in time.
- Trained personnel would be engaged for operating the effluent treatment plant.
- Wherever possible, treated effluent would be recycled and reused for watering plantations in order to conserve fresh water.
- The treated sewage will be reused for gardening and green belt areas in the township.
- Provision for rain water harvesting.

6.4 Impact on Land Environment

With the introduction of the project, the land use pattern of the area will improve

with neat and clean project buildings, lawns and gardens. The area in the exclusion zone around the project will be developed into a green belt as per the requirements of AERB and Madhya Pradesh Pollution Control Board (MPPCB). This will further improve the aesthetic and land use environment at the proposed project site.

Land for proposed township would be changed to institutional and residential. Requisite approval for the same will be obtained from the competent authorities. All the possible facilities in the proposed township will be developed & designed with minimum disturbance to the existing ecology to address the issue of green buildings. Proposed township will be built on slopping ground without disturbing the contours of the area.

Mitigation Measures

- To minimise risks of erosion, the execution of major earthworks will be restricted as far as possible to the dry season
- The solid wastes generated during construction phase will be collected and segregated and will not be disposed off on land. Combustible waste will be burnt in controlled manner, whereas bio-degradable waste will be sent for composting and non bio degradable would be disposed in secured land fills
- During operation phase, the domestic solid waste would be suitably treated and disposed off as per Municipal Solid (Management and Handling) Rules, 2000. Putrescible solid waste will be treated by vermiculture composting.
- The non-compostable material will be segregated from the solid waste generated from residential complex for which composting cannot be carried out, and it will be disposed of by using sanitary landfilling
- Tree planting programme to compensate for the loss of trees.

6.5 Impact on Biological Environment

The development of NPP would not affect the green cover of the area however on the contrary, extensive developmental plan for green belt and plantation in plant and residential complex area will result in increase in green cover and biodiversity of plants and birds in the area apart from creation of beautiful landscape.

The reserved forest land will be maintained as such with no plant structures located in this area. There is no sensitive ecosystem like National Park, Sanctuary or Biosphere Reserve within 10 km radial area around the NPP as such there will be no

significant impact on biological environment.

Mitigation Measures

- The reserved forest land will be maintained as such with no plant structures located in this area.
- Increase in green cover with the development of additional greenbelt.

6.6 Impact on Socio-Economic Environment

The policy of NPCIL towards social welfare & community development aims at strengthening the bond between the project/station authorities and the local population in the vicinity of nuclear power plants. As such as a result of the project there will be multifold development in the community residing in the vicinity of the plant viz .

- Assistance in Educational Welfare Measures.
- Assistance in Health-Care Welfare Measures.
- Assistance in Community Welfare Measures.
- Assistance in Development of Fisherman's Welfare Measures.
- Welfare Programme for the Employees and Their Families.

The proposed township area is presently uninhabited and does not involve any rehabilitation. The proposed township will have a design population of about 6000. The proposed township will not cause noticeable adverse effects on local communities. It will only cause positive impacts in terms of infrastructure, sanitation facilities, development and quality of life of the surrounding population.

Mitigation Measures

- R&R plan for project affected people and compensation as per MP Govt. Policy.
- To compensate for physical displacement and loss of fixed family assets, the directly affected households as well as the indirectly affected households in the project area should be relocated as per R&R plan.
- The NPCIL R&R policy for the proposed project envisages a special focus on the creation and up-gradation of skill sets of landless persons and other project affected persons (PAPs), who are dependent upon agricultural operations over the acquired land, and for the rural artisans e.g. blacksmiths, carpenters, the potters, the masons etc., who contribute to

the society together, to improve their employability.

- NPCIL is committed to establish requisite system for organizing vocational and formal training and education for all such identified persons and extend full assistance to them to become eligible for seeking employment with the project proponent or any other organized sector.
- NPCIL is committed to implement the State Government approved R&R package at the earliest possible.

7.0 Environmental Monitoring Programme

The environmental aspects to be monitored and also to ensure proper implementation and effectiveness of various mitigative measures envisaged / adopted during the design and commissioning stage of the CMPAPP for the followings.

- Air Quality Monitoring
- Water Quality Monitoring
- Land Environment Monitoring
- Noise Environment Monitoring
- Biological Environment Monitoring

7.1 Construction Stage

During construction stage monitoring of conventional pollutants will be looked upon by Planning Section which will be set up at the site, well before the operation of the plant units. The monitoring of conventional pollutants will be taken up by hiring agencies/consultants who will be registered with State Pollution Control Board (SPCB), whereas, the sampling and analysis for radiological parameters will be undertaken by ESL, BARC.

7.2 Operation Stage

During operation, plant level Technical Services Unit (TSU) will look after the environmental matters and environmental monitoring programme. An Environmental Management Apex Review Committee (EMARC) will be formed, which will review the effectiveness of environmental management plan of the station during operation phase in line with ISO-14001 & ISO-18001. Radiological & non-Radiological parameters within exclusion zone will be monitored by Health Physics Unit (HPU), Chemical Laboratory and Waste Management Unit (WMU) formed at project level by NPCIL. Radiological

parameters outside exclusion zone will be monitored by Environmental Survey Laboratory (ESL) of Health Physics Division (HPD), Bhabha Atomic Research Centre (BARC).

Monitoring of radiation exposures to occupational workers and the releases to the environment are controlled by the station and monitored by Health Physics Unit (HPU) within exclusion zone and the radioactivity levels in the public domain will be monitored by the Environmental Survey Laboratory (ESL), Health Physics Division (HPD), BARC to ensure compliance with the regulatory requirements. The radiological monitoring program to be followed at CMPAPP is described under three separate categories.

- Monitoring at the work place
  - Ambient Radiation and Contamination monitoring withn plant area , Effluent monitoring (Gaseous & Liquid) , monitoring of waste storage integrity & Personnel Monitoring.
- Monitoring on site
  - Weekly vehicular survey of the site at predefined point & Monitoring of gamma radiation by a network of continuous radiation monitoring instrument.
- Monitoring program in public domain
  - Radiological survey in the area up to a radial distance of 30 Km. covering terrestrial as well as aquatic environs and gamma radiation level using TLD.

7.3 Other Monitoring Requirements: Occupational Health and Safety

As per AERB norms and in accordance with the revised Radiation Protection Rules-2004, all the plant personnel would be subjected to periodic medical examination. Accordingly,

(i) Every employer shall provide the services of a physician with appropriate qualifications to undertake occupational health surveillance of classified workers.

(ii) Every worker, initially on employment, and classified worker, thereafter at least once in three years as long as the individual is employed, shall be subjected to (a) general medical examination as specified by order by the competent authority and (b) health surveillance to decide on the fitness of each worker for the intended task.

The health surveillance shall include (a) special tests or medical examinations as specified by order by the competent authority, for workers who have received dose in excess of regulatory constraints and (b) counseling of pregnant workers.

7.4 Socio-Economic Development

Plant management under Corporate Social Responsibility (CSR) plan will have structured interactions with the community to disseminate the measures planned / taken by the CMPAPP and also to elicit suggestions from stake-holders for overall improvement for the development of the area.

8.0 Additional Studies

Following additional studies have been carried out:

- Feasibility study for transportation of heavy and over dimensional consignments.
- Extreme value analysis of meteorological parameters for Nuclear Power Project at Chutka, Mandla District, M.P.
- Seismotectonic studies and earthquake ground motion for Nuclear Power Project at Chutka, Mandla District, M.P.
- Preliminary pre-operational environmental survey report for radiological parameters for Chutka Atomic Power Project.
- Provisional Public Dose Calculations for a twin unit 700 MWe project at Chutka, Madhya Pradesh.

In addition to the above, studies for flooding and dam break of dams on the upstream side are being carried out by National Institute of Hydrology, Roorkee.

9.0 Benefits of CMPAPP

The foregoing analysis and discussion indicates that the proposed project at Chutka village for establishment of 2x700 MWe atomic power plant is environmentally benign and techno economically viable & sustainable.

9.1 Economics of Nuclear Power

Nuclear power in India has been established to be safe, reliable, clean & environmental friendly and economically compatible with other sources of power generation and is an economical option particularly at locations away from coal mines.

The escalation impact on tariff is also lower as the fuel cost relative to coal is lower in case of nuclear power; the fuel transportation cost is insignificant when compared to that of coal.

The average tariff of NPCIL for the year 2011-12 was about Rs. 2.70 per KWh for all the operating plants. However, tariff of TAPS-1&2 (operating since the year 1969) is lower than Re 1.00 per kWh.

9.2 Environmental Sustainability of the Project

NPCIL's Nuclear Power Plants in India are amongst the safest plants from environmental and safety assessment point of view. With insignificant emission of conventional pollutants, CMPAPP will not at all affect the surrounding ecosystem. Consequently, the environmental concerns such global warming, acid rain, green house effect, depletion of the ozone layer of the earth atmosphere are not associated with the CMPAPP.. However, with regards to minimization and mitigation of radiological risk, there are five distinct barriers between the radioactive material in the NPP and the environment to protect the public, flora and fauna and the environment, from radioactive releases. The fool-proof advanced technological systems would be adopted for segregating treating, processing and secured disposal of radioactive waste through air, liquid and solid waste routes as per AERB requirements.

9.3 Development of the Region around CMPAPP

The establishment of CMPAPP for Power generation would provide electricity at a fairly competitive price and result in electrification of villages, development of irrigation facilities / drinking water supply, development of industries, overall development of area and consequent indirect and direct job opportunities which would finally result in improvement in the quality of life of people in the region and especially in the area around the CMPAPP's site.

9.4 Green Belt Development

The Green belt will be developed around the CMPAPP site and residential complex. In this green belt development, the guidelines of State as well as National regulating agencies i.e. MoEF will be integrated, besides incorporating the local social forestry and suitability of the plant species. CMPAPP is committed to develop green belt in approximately one third of total area of nuclear power plant besides developing

plantations around water and wastewater treatment facilities and over open spaces in proposed residential complex.

9.5 Employment Potential

9.5.1 Skilled and Semi-Skilled

Skilled and Semi-skilled employment potential in terms of indirect employment of the proposed project will be non-marginal and will usually remain widespread across a long region. The proposed project will cause generation of income and employment opportunities the ancillaries and service units which will came in the vicinity of the plant, specifically, in transport and manufacturing sectors. The project is expected to generate substantial indirect employment in other sectors. Overall assessment of the employment and income effects indicates that the project has strong positive direct as well as indirect impact on employment and income generation of the area.

9.5.2 Un-Skilled

Unemployment for un-skilled workers is quite common in the study area. The present project has employment generation potential by way of recruiting local people directly for different activities of the project, specifically at the construction phase. It is expected that substantial portion of the investment in this project will trickle down to the local people in the form of employment and income.

9.5.3 Direct Employment Opportunities with NPCIL

Preference will be given by NPCIL to PAFs in providing employment in the project subject to the availability of vacancies and the suitability of person for the employment.

9.5.4 Employment Opportunities with Contractors

A large Number of Contract labours would be required during, construction. This includes skilled, semi skilled and unskilled workers. Suitable provisions are proposed to be made in all contracts to the effect that the PAFs shall be given, preference in jobs as per their suitability and skill under the respective contract.

9.5.5 Assistance in Training and Skill Development

NPCIL proposes to provide assistance, sponsoring, training for skill development to the wards of PAFs as well as to other meritorious students in the area

around the site for availing various job opportunities. In brief, the following are proposed:

9.5.5.1 Opportunities for Self Employment

NPCIL, as a policy, provides opportunities to PAFs for self employment during construction, operation and maintenance phase of the Plant. This also meets the provisions of National and State R&R Policy. The brief details are given below:

9.5.5.1.1 Award of Small Value Contracts to "Registered Local Societies"

NPCIL promotes formulation of Registered Societies consisting of members from local including Project affected families. These Societies are proposed to be given small value contracts for auxiliary services such as Housekeeping, Gardening, Transport service etc. with the provisions to deploy as much Project affected persons in the project as possible.

9.5.5.1.2 Allotment of Shops in Residential Complex

NPCIL also propose to provide allotment of shops in Shopping Centre of Residential Complex at CMPAPP like Milk Vending, Barbershop, Washer man shop, Vegetable shops, Communication centre, Chemist shop etc. through Registered Societies.

9.6 Other Indirect Business Opportunities

During the construction phase of APP, various contractors will be executing works at the site. They will be required to deploy contract labour in different categories depending on the requirement of skill etc. The strength of the percentage of contract labours will gradually increase from the beginning and at peak the number may increase upto 4000. All these labourers will be staying in the labour camp to be established inside the property boundary of CMPAPP site.

9.7 Other Tangible Benefits

- The proposed project would generate indirect employment opportunities as daily wage labors during construction, transportation activities, supply of raw materials, auxiliary and ancillary works etc.
- The project has favorable ranking by the people and is looked upon as a step for further development of the area
- Due to the project, there would be an overall development of the area and

job opportunities, which may improve the quality of life in the region.

- Proposed project would help to fulfill the gap between demand and supply of electricity within the country and particularly in the region.
- The electricity generated in plant will result in electrification of villages, development of irrigation facilities, drinking water supply, development of industries etc.
- Development in housing, education, medical, health, sanitation, power supply, electrification and transport in the study area.

9.7.1 Improvements in Physical Infrastructure

The proposed project will bring about improvement in physical Infrastructure in the area. The basic features like, roads, electricity availability, drinking water availability, etc are also expected to improve. It is expected that a similar trend will follow with the proposed project at Chutka, Mandla.

9.7.2 Industrialisation Around the Proposed Project

The atomic power plant will serve as the nuclei for development of small-scale industries in the area. These small-scale units usually have input-output linkages with the plant and township. The demand for spares, assemblies and sub-assemblies by the plant and township generally met through the supply (of these items) from small-scale units located nearby.

9.8 Corporate Social Responsibility

- Under Corporate Social Responsibility, the NPCIL is committed to work towards improvement in the living conditions of local population near the project, particularly in the areas of health & hygiene, civic amenities, infrastructure, education & training, water supply etc. For this purpose, NPCIL shall incur expenditure equivalent to 1% of the net profit being generated by the project. The allocated fund shall be cumulative in nature regardless of expenditure made.
- In case, the project does not generate any profit due to unforeseen reasons, NPCIL HQ at Mumbai shall allocate maximum 40 Lakhs per annum to the project for sustaining activities being carried out under Corporate Social Responsibility.
- A Nigarani Samiti, involving representatives of the villages, shall be

constituted by the District Administration to plan and monitor the activities under CSR. The Samiti shall be empowered to stop the regular activities of the project if the Project Authorities breach the commitments made by NPCIL.

10.0 Environmental Management Plan (EMP)

Summary of Impacts, Mitigation Measures & Environmental Management Plan for CMPAPP during construction phase and operational phase are presented in **Table 8 and 9** respectively. The budgetary provisions for Environmental Management Plan for the proposed project will be kept separately and maintained.

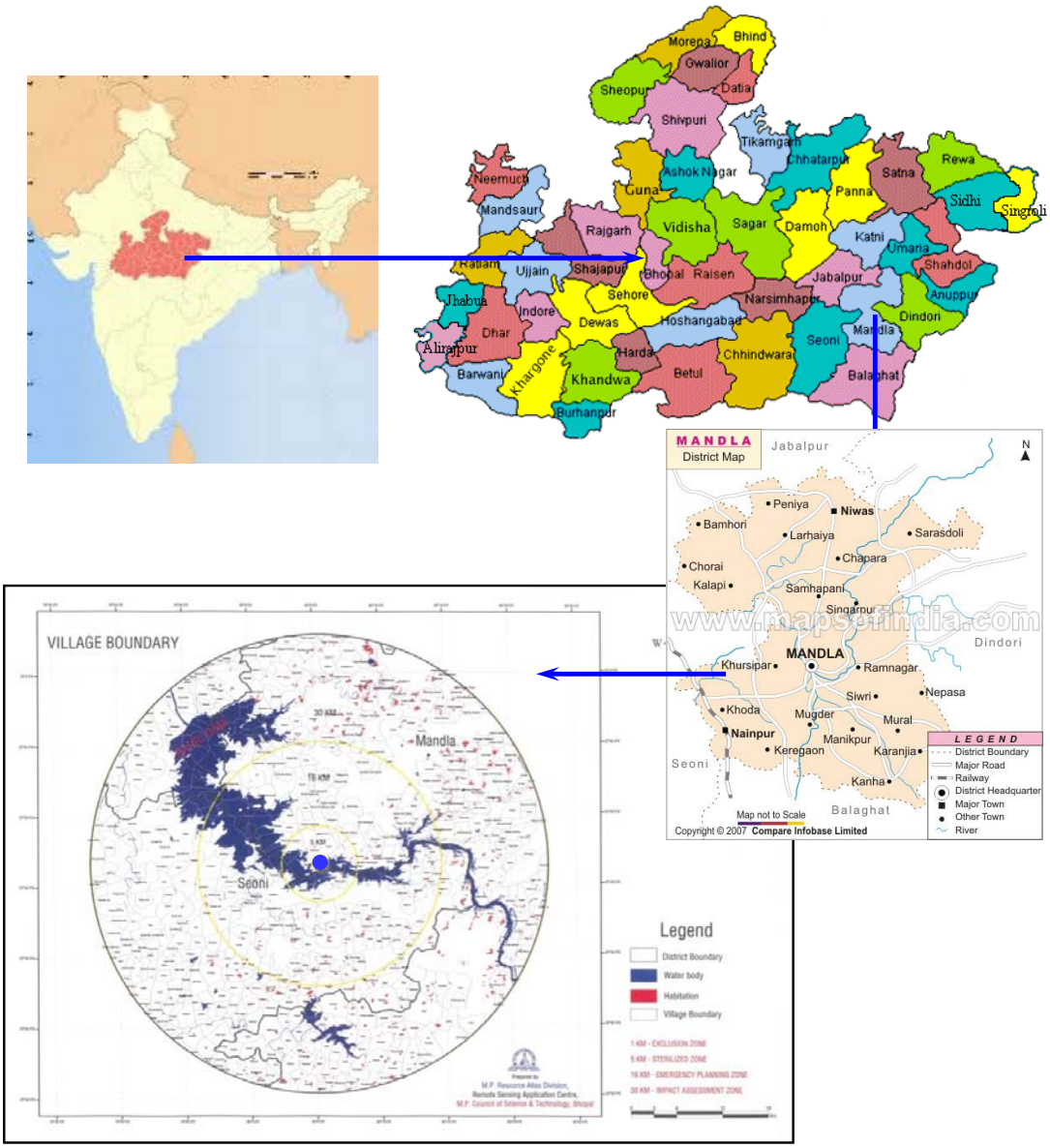

Fig. 1 : Location of CMPAPP in Madhya Pradesh

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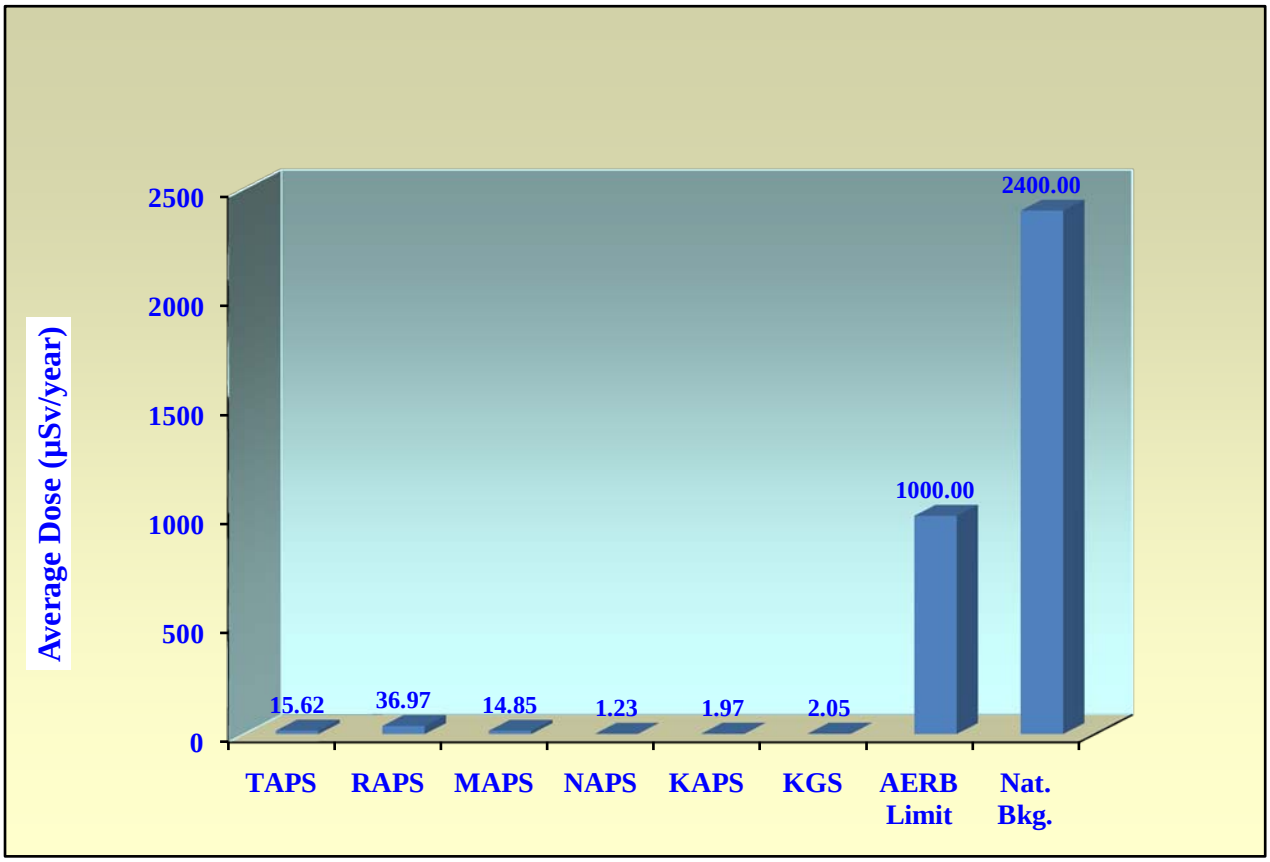

Fig. 2 : Average Environmental Radiation Dose (micro Sievert / year) at Exclusion Zone Boundary Due to Operation of NPPs in India (2000-2011)

- Source – ESL Reports, HPD, BARC
- AERB/ICRP Dose Limit to Public is 1000 micro Sievert/year (1 mSv/y), (Excluding natural background and medical exposures)
- Average natural background is 2400 micro Sievert/year

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Table-1

Technical Details of the Project

S. No.	Item	Details
1.	RATED OUTPUT ELECTRICAL	700 MWe
2.	RATED OUTPUT THERMAL	2166 MWt
3.	FUEL	NATURAL UO_2 , 37 ELEMENT BUNDLE
4.	MODERATOR AND REFLECTOR	HEAVY WATER
5	COOLANT	HEAVY WATER
6	TYPE	HORIZONTAL PRESSURE TUBE
7	PRESSURE TUBE	392 , 103.4 MM ID , ZIRCONIUM 2.5 % NIOBIUM ALLOY
8	PRIMARY COOLANT TOTAL FLOW	8019 kg/s
9	PRESSURE (OUTLET HEADER)	100 kg/cm^2
10	CHANNEL INLET TEMPERATURE	266^0 C
11	CHANNEL OUTLET TEMPERATURE	310^0C
12	SHUT DOWN SYSTEM-1	28 MECHANICAL RODS , CADMIUM SANDWITCHED IN STAINLESS STEEL (SS)
13	SHUT DOWN SYSTEM-II	LIQUID POISON –GADOLINIUM NITRATE ($GDNO_3$) INJECTION IN MODERATOR
14	STEAM GENERATORS	4 STEAM GENERATORS WITH INVERTED U-TUBES AND INTEGRAL STEAM DRUM (MUSHROOM SHAPED)

Table-2

Project Implementation Schedule

Salient Milestones of Unit 1&2		
Activity	**Unit 1**	**Unit 2**
Land Acquisition and statutory clearances (Revised)	2013-14	
Start of construction activity (Revised)	June-2015	Dec-2015
Completion (Revised)	Dec-2020	June-2021

Table-3

Salient Features of the Site

<table>
<tr><th>S. No</th><th>Particulars</th><th>Details</th></tr>
<tr><td>1</td><td>Latitude and Longitude</td><td>Latitude: 22°46’34”N
Longitude :80°5’21.7”E</td></tr>
<tr><td>2</td><td>Elevation above MSL</td><td>RL+425 to RL+455</td></tr>
<tr><td>3</td><td>Climatic conditions</td><td>Mandla District extends over the highest plateaus of the Satpura ranging from 500 meters to 800 meters above mean sea level. Thus in comparison with the low-lying plains of Jabalpur and Raipur on the north and south it is cool and exhilarating. The climate of this district is characterized by hot summer season and general dryness except in the southwest monsoon season

Maximum temperature : 42.1 ^{0}C
Minimum temperature : 6.2 ^{0}C
Average Annual Rainfall : 1400-1600 mm</td></tr>
<tr><td>4</td><td>Present land use at the site</td><td>
<table>
<tr><th colspan="8">Land Use Details (Ha)</th></tr>
<tr><th></th><th>Name of Village</th><th>Waste Land</th><th>Habited Land</th><th>Revenue Forest</th><th>Reserved Forest</th><th>Agriculture Land</th><th>Total</th></tr>
<tr><td rowspan="3">For Plant Site</td><td>Chutka (Full)</td><td>112.16</td><td>12.62</td><td>35.49</td><td>65.00</td><td>46.00*</td><td>271.27</td></tr>
<tr><td>Tatighat (Part)</td><td>42.54</td><td>-</td><td>-</td><td>-</td><td>-</td><td>42.54</td></tr>
<tr><td>Kunda (Part)</td><td>95.22</td><td>-</td><td>18.93</td><td>-</td><td>2.07</td><td>116.22</td></tr>
<tr><td>For Colony</td><td>Manegaon (Part)</td><td>67.66</td><td>-</td><td>0.04</td><td>-</td><td>-</td><td>67.70</td></tr>
<tr><td colspan="2">Total</td><td>317.58</td><td>12.62</td><td>54.46</td><td>65.00</td><td>48.07</td><td>497.73</td></tr>
<tr><td colspan="8">* Seasonal patches of Rabi & Kharif crops are seen in the submerged portion (48.07 ha) of land belonging to NVDA (Narmada Valley Development Authority) being taken on lease basis for security reasons</td></tr>
</table>
</td></tr>
<tr><td>5</td><td>Nearest Highway National Highway</td><td>NH-12A at a distance of 23 Km</td></tr>
<tr><td>6</td><td>Nearest Railway Station</td><td>Railway Station : Mandla (80 Km) by road
Jabalpur (83 km from the site)</td></tr>
<tr><td>7</td><td>Nearest Airport</td><td>Airport : Dumna, Jabalpur (100km by road from the site)</td></tr>
<tr><td>8</td><td>Nearest town / city</td><td>Takariya / Narayanganj at 27km by road
District HQ: Mandla (80 Km by road)</td></tr>
<tr><td>9</td><td>Nearest Sea</td><td>NIL</td></tr>
<tr><td>10</td><td>Defence Installations</td><td>NIL</td></tr>
<tr><td>11</td><td>Nearest State Boundary</td><td>Chatisgarh</td></tr>
</table>

Table-4

Details of Land

Land Details (Ha)							
	Name of Village	**Private Land**	**Government Land**	**Forest Land with Revenue Department**	**Reserved Forest with Forest Department**	**Irrigation Department (NVDA) (on Lease)**	**Total**
For Plant Site	Chutka (Full)	112.16	12.62	35.49	65.00	46.00	271.27
	Tatighat (Part)	26.40	16.14	-	-	-	42.54
	Kunda (Part)	85.41	9.81	18.93	-	2.07	116.22
For Colony	Manegaon (Part)	65.22	2.44	0.04	-	-	67.70
Total		**289.19**	**41.01**	**54.46**	**65.00**	**48.07**	**497.73**

Table-5

Estimated Exposure from Gaseous Emissions for 2x700 MWe

Adult	**Infant**
Dose (mSv/y)	**Dose (mSv/y)**
3.52E-02	**5.72E-02**

Table-6

Estimated Exposure from Liquid Effluents for 2x700 MWe

Adult	**Infant**
Dose (mSv/y)	**Dose (mSv/y)**
45.4E-03	**45.1E-03**

Table-7

Agencies Responsible for Carrying Out Remedial Measures during Emergency

Type of Emergency	Responsible Agency
Emergency Standby	Plant / Site Management
Personnel Emergency	
Plant Emergency	
Site Emergency	
Off-site Emergency	District authorities of the State Government having jurisdiction over the public domain affected by the accident, normally the District Collector.

Table-8

Summary of Impacts, Mitigation Measures & Environmental Management Plan for CMPAPP during Construction Phase

Sr. No.	Environmental Component	Impacts	Mitigation Measures	Element of Environmental Management Plan
1.1	Occupational health and safety	Hazards to workers	Occupational Safety and health measures	Provision of proper occupational safety and health conditions Provision of safety equipment to labour force & casual workers apart from Project workers Regular medical check-up and treatment
1.2	Air Environment	Only few conventional pollutants, which will not cross the specified limits because of low background levels.	Maintenance of machinery, heavy vehicles and trucks	- Regular maintenance of the vehicles and equipment. - Regular monitoring of the levels of conventional pollutants as per MPPCB requirements - Proper control on movement of heavy vehicles - Spraying of water on roads & dust emitting areas - Use of PUC certified vehicles - Protection of reserve forest & development of green belt & plantations
1.3	Noise Environment	Higher Noise levels due to increased activities in a construction zone during construction activities	Isolation of project site noise protection gadgets to workers	- Project fence, green belt in exclusion zone will attenuate the noise levels considerably to reach to the public domain. - Employees and workers will be provided with ear muffs etc. for noise protection. - Rules & Regulations of Factories Act will be implemented. - Proper maintenance of vehicles

Sr. No.	Environmental Component	Impacts	Mitigation Measures	Element of Environmental Management Plan
1.4	Water Environment	Impact on aquatic system / ground water of small magnitude due to soil erosion & leaching. Impact on aquatic system / ground water of small magnitude from construction workers colonies.	Proper sanitation and disposal of excavated soil and waste	- Stabilization of the excavated soil. - Provision of trenches around the stock pilings. - Provision of appropriate sanitary facilities for the construction workers. - Construction of oil and water separation facility. - Storage & building material & operation building at designated places to avoid water pollution - Construction activity during non- monsoon season - Stock piling of waste in designated areas
1.5	Land Environment	Land pollution of small magnitude due to solid waste generation. Overburden and construction waste debris etc. will also be produced	Management of solid waste and excavated soil & construction waste	- Effective housekeeping. - Effective collection & segregation of solid waste. - Composting of bio-degradable waste. - Disposal of non bio-degradable waste in secured landfills. - Overburden will consists of rocky material and will be utilized for construction of project building and will be used also for land filling purpose as the project site is undulating - Proper management of overburden & building material

Sr. No.	Environmental Component	Impacts	Mitigation Measures	Element of Environmental Management Plan
1.6	Socio-economic Environment	Beneficial effects out-weigh adverse effects on socio-economic environment.	Job and employment to local people; construction site to be fenced; Social, cultural and infrastructural development Development of sanitary facilities	- Preference to local peoples in the job opportunities as per the norms. - Promotion of social and cultural activities - Regular fumigation of the construction workers colonies. - Fencing of the construction site to check unauthorized entry. - Adequate sanitary measures in labour colonies - Provision of infrastructural facilities such as sanitation, fuel, restroom, medical facilities in labour colonies as well as to casual labours & employees.

Table-9

Summary of Impacts, Mitigation Measures & Environmental Management Plan for CMPAPP during Operation Phase

Sr. No.	Environmental Component	Impacts	Mitigation Measures	Element of Environmental Management Plan
2.1	Safety of Individual, society & Environment	Health Effects of Radiation	Safety in plant design; Monitoring & compliance to radiological standards; Occupational safety,	- Proper maintenance of exclusion zone and sterilized zone as per AERB requirements - Minimize the radiation doses as per specified limits of AERB - Safety in design as per AERB requirements. - Adequate Engineered safety system with sufficient redundancy, diversity to deal with off-normal situations as per AERB requirements. - Hazard analysis and safety measures in place to reduce the undue risk to employees, members of public & environment as per AERB requirements - Regular monitoring of the radiological levels in different components in surrounding environment - Regular monitoring of personal radiation dose and regular health check-up of the workers - Rotation of places of duties - Occupational and safety training - EMP implementation and environmental monitoring programme to evaluate the effectiveness of environmental management system - Provision of Safety Gadgets to employees & casual labours - Regular refresher training courses for employees
2.2	Radiological Pollution			- Radiological Risk Assessment and Emergency

Sr. No.	Environmental Component	Impacts	Mitigation Measures	Element of Environmental Management Plan
				Response System will be in operation as and when required
2.3	Air Environment	- Radioactive gaseous emissions of small magnitude. - No impact due to conventional pollutants.	Active gaseous waste processing; Compliance to standards; Monitoring-feedback-rectification system	- Effective program to control air emission at source. - Effective treatment to reduce the emission levels. - Provision of on line monitoring for taking appropriate measures. - Emissions much below the discharge limits of AERB - Regular maintenance of the vehicles - Regular monitoring of the levels of conventional pollutants as per MPPCB requirements - Fencing around exclusion zone - Development of green belt in exclusion zone - Adoption of proper landuse in sterlised zone - Proper emergency preparedness plan for any emergency
2.4	Noise Environment	Noise levels due to plant activities.	Development of barriers to control noise in public domain; occupational safety measures	- Confinement of noise generating equipments. - Project fence, green belt & exclusion zone will attenuate the noise levels considerably to reach to the public domain. - Employees and workers will be provided with ear muffs etc. for noise protection. - Rules & Regulations of Factories Act will be implemented.
2.5	Water Environment	- Impact on aquatic system / ground water of small magnitude due to liquid effluent discharges. - Impact on aquatic system	Proper management of active and domestic wastewater; proper design of Condenser Cooling system and discharge channels for	- Effective program to control liquid waste at source. - Effective collection & treatment of active liquid effluents. - Provision of on line monitoring of active effluent for taking appropriate measures.

Sr. No.	Environmental Component	Impacts	Mitigation Measures	Element of Environmental Management Plan
		due to discharges of cooling tower blow-down	compliance to thermal discharge standards; Conservation of water	- Liquid effluent discharges much below the discharge limits of AERB. - Treatment of domestic waste and reuse of effluent for irrigation of plantation/green belt - Regular monitoring of the levels of conventional pollutants in liquid discharges as per MPPCB requirements - Construction of oil and water separation facility. - Implementation of rain water harvesting and other water conservation measures. - Temperature difference between discharged water to R.A.B.L.S dam reservoir, through cooling towers, and inlet water from R.A.B.L.S dam reservoir will not be above 5°C.
2.6	Land Environment	-Land pollution of small magnitude due to solid waste. Generation. -Positive impact on land use - Promotion of aesthetic environment	Management of active and domestic solid waste; development of green belt	- Effective house keeping. - Effective collection & segregation of active solid waste & domestic solid waste. - Treatment & disposal of active solid waste as per AERB requirements - Composting of degradable solid waste. - Disposal of non-degradable solid waste in secured land fills. - Development of green belt around the plant and exclusion zone
2.7	Biological Environment	Impact on terrestrial and aquatic flora and fauna	Discharges through air and water below stipulated levels; Conservation of forest and plant species	- Compliance to radiological standards for air and water - Treatment and disposal of active waste as per AERB requirements - Development of Green belt of diverse local trees and shrubs - Control of eutrophication due to sewage discharge by treatment and reuse of

Sr. No.	Environmental Component	Impacts	Mitigation Measures	Element of Environmental Management Plan
				wastewater - Regular monitoring of diversity and density of flora in green belt - Regular monitoring of radioactivity in biological samples collected from surrounding area
2.8	Socio-economic Environment	Beneficial effects out-weigh adverse effects on socio-economic environment.	Awareness camps, health care; R&R plan; job and employment generation; Social, cultural and infrastructural development	- Regular fumigation of the plant & residential complex. - Implementation of social welfare measures for the local people including fishermen. - Enhancement of awareness about the project by plant visits, interactive Seminars, etc. - Fencing of the project site to check unauthorized entry in exclusion zone - Preference to local peoples in the job opportunities as per the norms. - Implementation of proper Resettlement and Rehabilitation plan for the benefit of project affected people - Ensure participation of local people in cultural events to create social harmony and goodwill
2.9	Aesthetic environment	Quality of aesthetic environment will be improved	Improvement of vegetation cover and good roads	- The project area would be aesthetically adorable due to green belt, plantation, beautiful buildings, good roads etc.