REVISED ENVIRONMENTAL IMPACT ASSESSMENT-ENVIRONMENTAL MANAGEMENT PLAN REPORT

FOR

4 X 700 MWe PHWR MAHI BANSWARA RAJASTHAN ATOMIC POWER PROJECT (MBRAPP)

AT

BANSWARA, RAJASTHAN

EXECUTIVE SUMMARY

Project Proponent	Environmental Consultant

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CERTIFICATE NO: NABET/EIA/2023/RA 0195 (Rev. 02)

April, 2024

EXECUTIVE SUMMARY

1.0 INTRODUCTION

Nuclear Power Corporation of India Limited (NPCIL) is a Public Sector Enterprise under Department of Atomic Energy (DAE), Government of India. NPCIL's emphasis is to produce Nuclear Power as a safe, environmentally benign and economically viable source of electrical energy to meet the increasing needs of the country.

In pursuance of Environmental (Protection) Act, 1986 and EIA notification 2006, new projects necessitate statutory prior Environmental Clearance (EC) by conducting an Environmental Impact Assessment - Environmental Management Plan (EIA-EMP) study. NPCIL entrusted MECON Limited to conduct an EIA-EMP study for the proposed project.

Earlier based on application of NPCIL, MoEFCC granted Terms of Reference (ToR) vide letter no: J-14011/2/2014-IA.II (N) dated 05.06.2014 for green field project of establishing 4x700 MWe PHWR Mahi-Banswara Rajasthan Atomic Power Project (MBRAPP) at District Banswara, Rajasthan. The validity of ToR was extended vide MoEFCC's letter dated 25.10.2016 and 17.07.2017. Baseline data was collected for three seasons viz. Post-Monsoon (Oct. to Dec 2014), Winter (Dec. 2014 to Feb 2015) and Summer (March to May 2015). The public hearing was conducted on 24.05.2018 and after public hearing EIA-EMP Report was submitted to MoEFCC on 29.05.2018 for appraisal. The proposal was appraised by Expert Appraisal Committee (Nuclear, Defence and related projects) on 33rd EAC meeting held on 30.07.2018 and on 49th EAC meeting held on 06.05.2022.

Based on the recommendations of EAC (N&D) meeting held on 06.05.2022 w.r.t. Mahi Banswara Proposal, MoEFCC vide letter J-14011/2/2014-IA.I(N) dated 03.06.2022 informed that as the baseline data and public consultation of EIA-EMP Report are more than 3 years old and suggested to validate the earlier baseline data generated, carry out the socio-economic profile study of the area around project site and provide a comparative assessment and obtain stakeholder's comments on the proposed project by keeping the Revised EIA-EMP report along with summary of Report at various district offices through Govt. authorities and also by uploading the revised EIA-EMP Report on NPCIL's website for 30 days.

In view of above, revised EIA-EMP report has been prepared based on one-month fresh baseline data collected at site during March, 2023 of Summer Season, current socio-economic status of the area and the same have been compared with the data of earlier EIA-EMP Report.

2.0 PROJECT DESCRIPTION

2.1 Location

The site for the proposed project (project and township) spreads over the villages of Adibheet, Bari, Rel, Sajwania, Katumbi, Wank, Lalpura in Chhoti Sarwan Tehsil and Khandiadev in Ambapura Tehsil, District Banswara, Rajasthan. The proposed site and study area of 10km radius is covered in the Survey of India Topo-sheets No. F43C6, F43C7, F43C10 & F43C11. The site is about 30 km by road in ESE direction of Banswara town (District Headquarters). **RJ SH10 / NH927A** passes about 1.5 km from the site, connecting Khairwara-Dungarpur-Banswara-Ratlam. **NH113** connecting Nimbahara in Rajasthan with Dahod in Gujarat, passes through Banswara town.

The nearest Rail head is Ratlam Railway station on Kota-Ratlam section of Western Railway at about 60 km. The nearest Airports are Udaipur and Indore at road distances of about 180 km and 210 km, respectively. The project site is located on the right bank of Mahi River at the upstream of Mahi-Bajajsagar reservoir. Presently there is no major industry operating within 10 km of the project site. However, two Supercritical Thermal Power Plants (TPP) each of Capacity 2x660 MW are proposed at Phephar and Wagtalab. The Wagatalab site is at an aerial distance of 10.6 km towards east and the Phephar site is towards SE at an aerial distance of 9.0 km from project centre. There are no facilities for handling, storing or transporting inflammable/toxic material and no major railway siding or road transport depot within 10 km of the site. However a railway line is expected to pass within 10 km of the project boundary. There is no place of historical importance within 10 km of the proposed site. The Index map showing the location of the plant site is shown in **Fig. Es 1.**

The total land required for the project (Plant site & Township) is **660.15 ha**. The land requirement for plant site is 602.72 ha, which includes 14 ha of land for CISF township at plant site and 33.10 ha of land for water pipeline corridor connecting the plant site with Mahi-Bajajsagar Dam reservoir. The land requirement of township is 57.43 ha, which lies in village Khandiadev under Tehsil Ambapura. The land required for the project (660.15 ha) comprises of 434.605 ha. private land, 120.995 ha. of government land, 100.05 ha of forest land and 4.5 ha. of Mahi Bajasagar land. The tentative layout showing the plant site and the pipeline corridor is shown in **Fig. Es 2**).

Banswara District lies in **Seismic Zone II** as per Bureau of Indian Standards, IS: 1983 (Part 1) 2002. The zone is classified as the **Low Damage Risk Zone**.

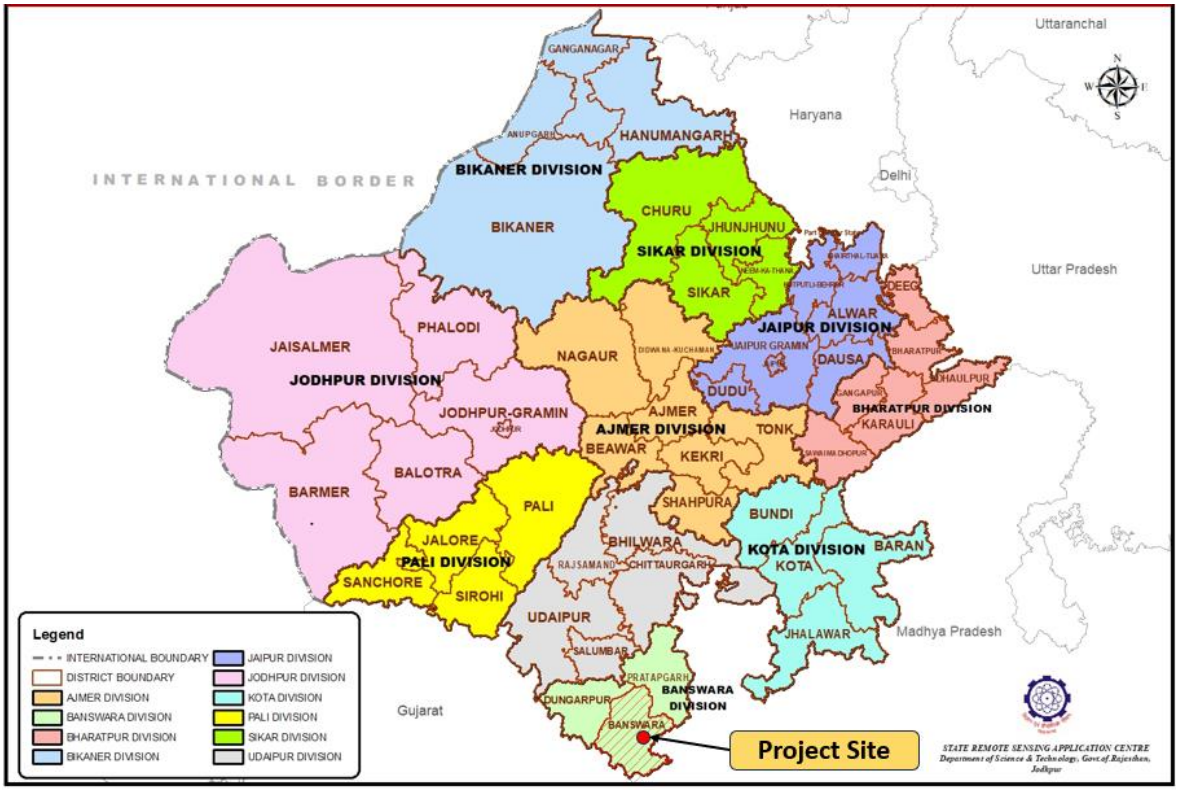

Figure Es 1: Location of Project Site at District Banswara, Rajasthan

2.2 The Proposed Project

The Mahi-Banswara Rajasthan Atomic Power Project (MBRAPP) will produce 4x700 MWe power. It falls under category of "Nuclear Power Project & Processing of Nuclear Fuel". The major equipments needed is End-Shield, Calandria, Coolant Channels, End Fittings, Primary Coolant pumps, Steam Generators, Heat Exchangers, Fuelling Machine, etc.

These equipments will be housed in nuclear buildings consisting of:

- Reactor Building (RB) and Reactor Auxiliary Building (RAB) houses the main reactor and associated process systems respectively.
- Safety related Buildings other than Nuclear Building consisting of Control Building (CB), Station Auxiliary Building (SABs), Ventilation Stack with Monitoring Room and Station Auxiliary Buildings (SABs), D_2O Upgrading Plant Building, Waste Management Facility and Exhaust Ventilation, Natural Draught Cooling tower (NDCT), Induced Draught Cooling Towers (IDCT), Safety Related Pump House (SRPH), Fire Water Pump House, Underground Tunnels and Trenches, Diesel Oil Storage Area (DOSA), Covered Passage, etc as per the design features of the plant.

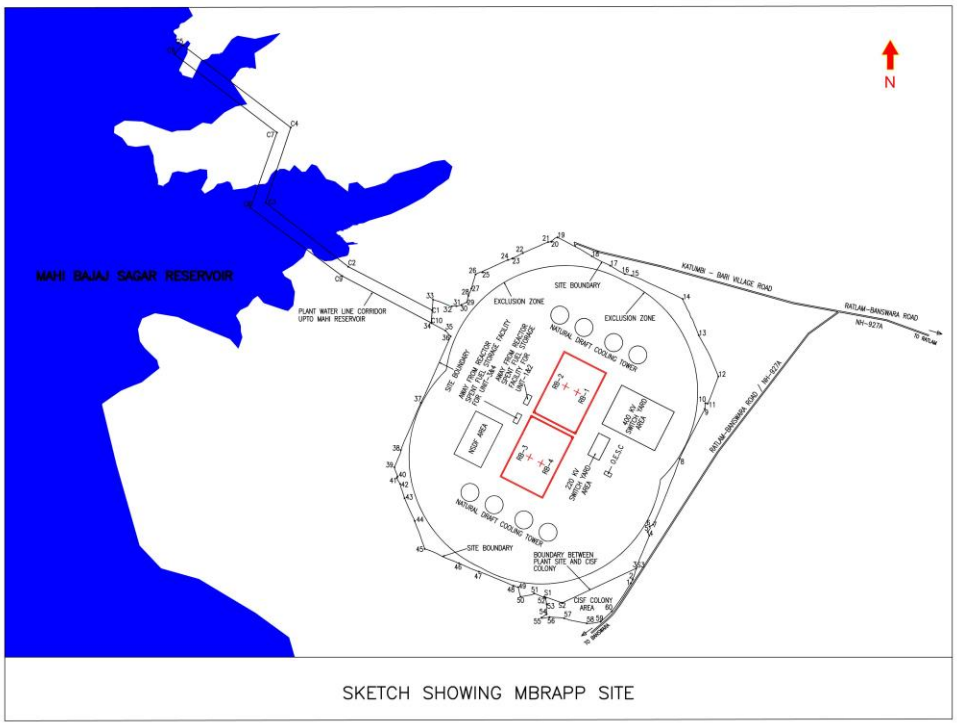

Fig. Es 2: Layout showing the plant site and the pipeline corridor

The brief technical features of the reactor unit (700 MWe PHWR) of MBRAPP are provided in **Table Es1**.

Table ES. 1: Brief technical features of the reactor unit (700 MWe PHWR) of MBRAPP

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 Sandwiched 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)

Power Evacuation "in principal" is feasible for 2800 MWe power from site. The Power generated at MBRAPP will be evacuated at a voltage level to be decided by Central Transmission Utility (CTU) / CEA based on power system studies. These studies will also indicate number of transmission outlets and their destination in line with CEA Transmission Planning Criteria. The availability of right of way, forest clearance & other statuary clearances for laying the transmission lines and the land for appropriate substations will be ensured by the concerned transmission licensee.

The project will use Natural uranium oxide as fuel and heavy water (D_2O) as coolant and moderator for the reactor with on-power refueling of reactor. Steam generators supply nearly dry saturated steam to the turbine which is directly coupled to an electrical generator, which produces electricity. Generator voltage is stepped up by the generator transformer. The concept of defense-in-depth is adopted in design of safety systems. Provision of multiple barriers, double containment structures with liner on inner containment wall of Reactor Building, containment spray cooling system, emergency core cooling system, reactor shut down systems etc. ensure safe operation of reactor. Reactor protection system ensures shutdown requirements through two independent fast acting shut down systems. Reactor regulating system enables automatic control of reactor power and maintains neutron flux profile.

During operation of the reactors, spent fuel is removed from the reactor core and transferred to Spent Fuel Storage Bay (SFSB), where it is stored till it cools down to dry storage level (about 5 years). SFSB can accommodate 10 years of spent fuel discharge and one core load. Subsequently, the spent fuel will be stored in an Away From Reactor Facility (AFR) at the site. AFR facility at the site is planned to have total capacity adequate to store the spent fuel bundles discharged during operation of all the 700 MWe PHWRs units (MBRAPP 1 to 4) at the site. Further action on the spent fuel is dictated by the policy of the Department of Atomic Energy / Government of India.

The first pour of concrete at site is scheduled by January 2025. The start of commercial operation for both the units is expected in May 2030. During construction stage maximum of 8000 persons (when construction of stage-I will be nearing completion and construction of stage-II will be started) will be temporarily deployed and up to the final stage of the project about maximum of 1700 manpower will be required (covering technical and general administration). During construction & commissioning maximum **10 MW** power will be required which will be sourced from State Grid. The water requirement for the project will be met from Mahi-Bajajsagar Reservoir, Rajasthan Government has assured supply **180 cusec**. Out of 180cusec, **126 cusec** (plant site) + **1 cusecs** (township) = **127 cusecs** water will be towards consumptive use and rest of the **53 cusec** water flow will be returned to reservoir.

Township

The Township for population size of about **8500** persons has been envisaged, with main features as follows:

a. Land area is : 71.43 ha (including 14 ha for CISF township near plant site).
b. Ground Coverage area : 16.74 ha (23.43%).
c. Built up area : 22.59 ha [Floor Space Index (FSI[1]) : 0.32].
d. Water Consumption : 1.287 Million Liters Per Day (MLD) or 1287 m^3/d.
e. Power requirement : 2000 KVA for stage one and 2000 KVA for stage two.
f. Power back-up : A 500 KVA Standby DG set will be provided and later on installation of feeders between plant and township.
g. Connectivity : Via local roads near Khandiadev before Gammon Bridge on State High way number (SH 10/NH927A) connecting Ratlam and Banswara.
h. Parking requirements: Adequate parking space of about 1500 cars, light commercial vehicles, buses etc. will be provided in the township.
i. Community facilities: Hospital, Community centre, School and shopping centre recreation club, sports complex, play ground, bank, post office, petrol pump etc. will be provided in the township.
j. All the civic amenities.
k. A sewage treatment plant is envisaged for treatment of sewage water. The treated sewage shall be disinfected / filtered and used for gardening purpose.
l. Green belt will be developed in and around the township.
m. A fire extinguishing system as per the requirements of national Building Code will be provided.

The estimated cost of 4 x 700 MWe PHWR Atomic Power Project is about **Rs 42,000 Crores**.

3.0 DESCRIPTION OF THE ENVIRONMENT

3.1 General

Study area has been taken as 10 km radius around the project site for conventional pollutant and other baseline study. The previous EIA-EMP Report in 2018 for MBRAPP was prepared based on three seasons baseline data collected during 2014-15 covering post-monsoon (Oct. to Dec. 2014), winter (Dec., 2014 to Feb., 2015) and summer season (March to May, 2015). MoEFCC vide letter J-14011/2/2014-IA.I(N) dated 03.06.2022 recommended to validate the baseline data of EIA-EMP Report by one month data of a monitoring season (pre-monsoon or post-monsoon). Accordingly, one month baseline monitoring work was undertaken during March, 2023 (one of the month of Summer Season) in the study zone of 10 km of MBRAPP. The baseline environment data of the EIA-EMP report - 2018 are validated with findings of one month baseline monitoring work presented in the revised EIA-EMP Report. For baseline radiological monitoring, the study area taken was 30km radius around the project site.

1 Floor Space Index (FSI) = Total floor area including walls of all floors / Plot Area / Building Unit

3.2 Meteorology

A meteorological station was set up at Chhoti Sarvan (Latitude 23°31'32.3"N, Longitude 74°38'31.9"E), which lies within the study area was monitored for one month i.e. March 2023 during summer season. At the meteorological station, Wind Speed & Direction, Temperature, Relative Humidity and Solar radiation were recorded at hourly intervals throughout the monitoring period. The meteorological data collected for one year during 2014-15 and March 2023 were compared. The meteorological data for March 2015 is compared with the present March 2023 data, showing that temperatures were recorded higher in March 2015, accompanied by corresponding solar radiation. The rainfall observed in March 2015 was less in comparison to March 2023. It is observed that there is no significant variation in the meteorological conditions in the study zone.

3.3 Ambient Air Quality (AAQ)

As per the CPCB guidelines on methods of monitoring & analysis, 8 (eight) AAQ monitoring stations were selected and monitored. The present one-month range of AAQ results monitored during March 2023 are compared with the parameters monitored for EIA-EMP study conducted during 2014-15 for three seasons and summer season 2015. The maximum concentrations of most of the parameters in the AAQ locations are almost in the same range or slightly higher. The current minimum values for PM_{10} and $PM_{2.5}$ at all AAQ locations have increased slightly in comparison to the previous eight years of AAQ data for an example at village Dungra A2, the range of concentration of PM_{10} in March 2015 was 62 – 84 µg/m^3 and in March 2023 it is 72 – 87 µg/m^3, indicating an increase in various activities in this area that contribute to PM levels, such as vehicular movement, domestic waste burning and construction activities.

The concentrations of all the parameters monitored during 2015 and 2023 are well within the NAAQS, 2009 norms. It is observed that there is no significant variation in the AAQ data in the study zone.

3.4 Ambient Noise

Noise monitoring was conducted at ten locations in and around the project site. Minimum and maximum noise levels during daytime and nighttime monitored during March 2023 are compared with all the three seasons of EIA-EMP study conducted during 2014-15. At all the locations the noise levels are well within the respective norms as prescribed. The noise levels at most of the locations are almost in the same range with previous data but during the present study in March 2023 the noise levels at locations N4 (Chhoti Sarvan SH10/NH927A), N7 (Kundlu Khurd) and N9 (Bortalav village) have increased slightly. The slight elevated noise levels may be attributed at these locations to their close proximity to highway road and there has been increase in vehicle movement on this road. It is observed that the noise levels at the project site in Barri village have marginally dropped, which may be attributable to locals' resettlement from the project site area.

The noise level data at all the locations monitored in summer season 2015 and March 2023 are well within the respective type of area of MoEFCC norms, as outlined in the Noise (Regulation & Control) Rules, 2000. It is observed that there is no significant noise level variation in the study zone.

3.5 Water Environment

During the study period of 2014-15, four surface water and four groundwater samples were analyzed. In the current monitoring period (March 2023), samples were collected from the same sites.

The surface water quality results monitored in March 2023 are compared with the data from the summer season of 2015, as part of the EIA-EMP study conducted in 2014-15. The data indicates minor variations in the current observed data, with slight increases in pH levels, SAR, and aluminum concentrations. The remaining values either remained similar or were somewhat lower than those in the previous study. Total coliform concentrations in all surface water samples analyzed during the summer season of 2015 and in March 2023 are less than 500 MPN/100 ml, falling under Class B and considered suitable for outdoor bathing (organized) according to CPCB surface water criteria. Overall, there is no significant variation in water quality parameters in the study zone, and the water quality meets the criteria set by the Central Pollution Control Board (CPCB).

The results of groundwater parameters were compared with the drinking water quality standards specified in IS: 10500 (2012) Amendment No. 1, 2015 in absence of any specific norms for Ground Water Quality. In comparison to previous groundwater data (2014-15), the current data shows a slight rise in Al, B, Ca, fluoride, Mn and nitrate concentrations. The remaining parameter values were matching the previous data. The current data is validated by comparing with the scientific management of the country's groundwater resources with CGWB, for Banswara district in the year 2019 as given in Ground Water Yearbook 2020-2021 Rajasthan. The present results shows that the groundwater concentration for nitrate and fluoride are in well agreement with the CGWB study conducted in Banswara district.

3.6 Soil

Soil samples from ten locations in and around the project site were analyzed during both the periods of 2014-15 and March 2023. In the soil samples tested during the current study, there has been an increase in the availability of Nitrogen and organic carbon % content. Available Phosphorus and Potassium have shown slight variations in the present study. The rainfall and temperature patterns can influence nutrient availability in the soil. The study area features a hilly terrain, and the variations in rainfall levels over the years could contribute to the leaching of specific nutrients. It is important to consider that the present soil monitoring is based on samples collected in the month of March, whereas the previous study relied on samples collected during the month of October.

This temporal difference could also contribute to variations observed in soil nutrient levels between the two study periods.

3.7 Ecological Features

There is no National Park or Wildlife or bird sanctuary within the study area. The study area falls under agro-climatic zone "**Central Plateau & Hill Region-8**" and under climatic region "**Tropical Savanna (Aw)".** This zone is characterized by annual rainfall ranging from 511 - 1043 mm and temperature ranges between 7.2^{0}C to 39^{0}C. The forests in the study area as per Champion Seth, falls under Teak Mixed Dry Deciduous Forests.

The Site specific Wildlife conservation Plan has been prepared for the conservation of Schedule I animal species in the study area.

3.8 Traffic Density

The existing traffic density for different types of vehicles was counted on weekend and weekdays at all the three locations (T1, T2 & T3) out of which two locations (T1 & T2) were same as previous locations studied in 2014-15 and the third one (T3) was carried out on the highway (SH10/NH927A) near to proposed Township Site of NPCIL instead of approach road leading to Township Site from SH10/NH927A for 24 hours. T3 location was relocated to better understand the existing traffic load on the highway (SH10/NH927A) as the approach roads from the settlements and from the proposed township road are all linked to the highway. The highway's maximum Passenger Car Units (PCUs) can be calculated as the project site is in between T3 and T1.

Compared to the previous data, traffic at T1 and T2 location has increased by two to three times as a result of improved infrastructure, greater road connectivity, places of attraction in Banswara (such as Mahi Banswara Dam, Kagdi Pick up Lake, temples, lakes, etc.) and employment opportunities in the region. PCUs at the previous T3 location (Road leading to Township Site from SH10/ NH927A) is very small, but the current T3 location (On Highway (SH10/ NH927A) near to proposed Township Site of NPCIL), better represents the data because the township is close to the highway and all of the approach roads from the villages and township road are connected to the highway. In comparison to weekends, weekdays have the highest PCU counts on highway.

3.9 Hydrogeology

Normal annual rainfall of Banswara district is 919.2 mm. The groundwater is at a depth of 2 to 10m below ground level and in un-confined aquifer.

3.10 Socio-economic Status

The 10 km study area consists of 83091 persons (2023 estimated). Basic socio-economic features are:

- The population density up to 5 km radius is 264 person/sq km and up to 10 km radius is 225 person/sq km (based on 2011 census data).

- The study area consists of almost rural population.
- Predominance of individual land holdings in small to marginal category. Maize, are mostly grown followed by Wheat, Kapas, Gram, etc.
- The employment rate is moderate: 27.26% are engaged as main workers, 27.01% as marginal workers and 44.71% as non-workers. Agriculture and small commercial activities plays an important role in rural economy of the study area.

3.11 Baseline Study for Radiological Environment

The first phase pre-operational survey was carried out around MBRAPP in July, 2016 while the second phase pre-operational survey was carried out in October, 2022.

The background radiation level in villages around Mahi Banswara site ranged between 40 to 200 nSv/h during July, 2016 and between 50 to 160 $nGyh^{-1}$. background radiation levels are comparable to the levels observed in normal background areas.

Tritium, ^{137}Cs and ^{90}Sr activities were below detection limits in water samples during July, 2016 as well as during Oct. 2022.

Uranium concentration in water samples were in the range <0.1 µg/l – 8.91 µg/l during July, 2016 and were in the range < 0.1 ppb – 16.1 ppb during Oct. 2022.

^{137}Cs in soil were in the range of 0.82-2.17Bq/kg dry wt. during July, 2016 and were in the range of $\leq$ 0.1-3.0 Bq/kg dry wt. during Oct. 2022.

The ^{40}K in the soil ranged from 208.52-362.00 Bq/kg of dry wt. during July, 2016 and were in the range of 63.5-711.2 Bq/kg of dry wt. during Oct. 2022.

^{137}Cs activities were below detection limit for biota samples during July, 2016 analysis as well as during Oct. 2022.

The natural Uranium and Thorium activity levels in soil samples were comparable with that for a normal background area during both the analysis period.

Thus, the comparative analysis of the two pre-operational radiological survey gathered from 30 km of the Mahi Banswara sites revealed that the ambient radiation and activity levels at Mahi Banswara site are equivalent to those of a typical background area.

4.0 ANTICIPATED ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

4.1 Impact and Mitigation: Construction Phase

The land requirement for the project is **660.15 ha.** The project displaced families as per the re-revised R&R award dated 18.2.2016 is 1618. R&R issues are being settled as per Schedules I & II of "Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 (LARR)". Construction phase may cause land disturbance, land use, deterioration in water quality, air quality, noise etc. Moreover, problems associated with influx of labour force, sourcing of construction / filling material are also expected. However, adequate mitigation measures will be adopted to bring these temporary impacts to minimum.

Deterioration of air quality during construction stage is given in **Table Es 3**. It can be seen that the ambient air quality during construction stage will be below the National Ambient Air Quality Norm near the receptor villages. However, mitigation measures like,

- Wet suppression and wind speed reduction (wind barriers) to control open dust sources,
- Stringent construction material handling / overhauling procedures,
- Low emission construction equipment, vehicles and generator sets, etc will be used to further reduce deterioration in air quality.

Table Es 3. : Air Quality during Construction Stage at the Receptor Location

SN	Location	Predicted value	Background AAQ (March, 2023)	Total During Construction Phase, with 2023 baseline	Background AAQ (Overall three seasons, 2014-15)	Total During Construction Phase, with 2014-15 baseline
1	Katumbi (A1)	6.0	91	97.0	87	93.0
2	Dungra (A2)	5.9	87	92.9	91	96.9
3	Choti Sarwan (A3)	5.9	94	99.9	93	98.9
4	Phephar (A4)	3.3	91	94.3	94	97.3
5	Deri (A5)	9.5	87	96.5	88	97.5
6	Keshavpura (A6)	0.0	91	91.0	89	890
7	Bortalav (A7)	0.0	93	93.0	91	91.0
8	Chip village near Mahi Dam (A8)	2.3	90	92.3	95	97.3

4.2 Impacts and Mitigation : Project Design

The MBRAPP is being envisaged based on the state of art reactor technology. A number of environment friendly / safety features have been envisaged which ensure that the anticipated adverse environmental impacts are either avoided or minimized.

The basic design of the Atomic Power Plant allows for

a. The releases of radioactive or chemical pollutants during normal operations to the environment within statutory limits.
b. Uncontrolled releases during off-normal situations with probability of occurrence within statutory limits. The Engineered safety features of the plant will keep the radiological released during operational and accidental condition to the minimum.

An appropriate monitoring system is also designed to ensure that the design objectives are met. This is done by monitoring and rigorously controlling the plant operating conditions.

The second approach aims at designing the facility with multilayer of safety system in such a way that even if the event were to occur, the resulting unplanned releases are

contained as far as practical. Provisions are made for directing the releases along planned flow paths, thereby permitting their collection and treatment before discharge to the environment. This is facilitated by handling / processing radioactive material in confined space, the confinement being assured by providing multiple barriers between the environment and the radiation sources. The multiple barrier approach is applied not only in processing, but also in storage of hazardous materials / wastes.

The concept of defense-in-depth is adopted in the design of safety systems using state of the art technology, viz

- **Barriers to radioactive release**:
  Multiple series of fission product barriers are designed to prevent radioactivity release in public domain, viz.
  i) Fuel matrix
  ii) Fuel Cladding
  iii) Primary Heat Transport System
  iv) Containment
  v) Exclusion Zone

- **Special safety features**:
  The safety features are:
  - Reactor regulating system enables automatic control of reactor power and maintains neutron flux profile.
  - Reactor protection system ensures shutdown requirements through two independent fast acting shut down systems.
  - Emergency core cooling system,
  - Containment spray cooling system,
  - Double containment structures with liner on inner containment wall of Reactor Building,
  - Abundant Water storage.
  - Special zoning of the plant to minimize the contamination potential within the plant.
  - Exclusion zone.

The entire operating island is designed to be divided into 3 distinct zones based on the contamination potential. These zones have been designated as Zone-1, Zone-2 and Zone-3 in the ascending order of contamination potential. These zones are equipped with required safety features to limit the potential radiation exposure.

4.3 Operational Phase Impact

4.3.1 Radio-active Releases

The uranium dioxide (UO_2) is used as fuel. At normal operating conditions 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.
All the processes / 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 However, under normal operation the radioactivity discharges are such that the nuclear radiation dose at exclusion zone boundary (also called fence post, 1.0 km radius around the plant) is only a small fraction of the radiation dose permitted by AERB for general population and thus under normal operation of the plant impacts due to radio-activity releases do not have any adverse impact on the surrounding environment.

Waste management operations (liquid and solid), involves handling of radioactive waste from all the facilities for their ultimate storage/disposal.

The radiation dose limit specified by AERB for the general pubic at the fence post (exclusion zone) due to operation of all facilities within the site through all pathways is **1 mSv/yr (100 mrem/y)**. Compliance to this regulatory requirement is ensured by dose apportionment estimation for different types of radio-nuclides of all the facilities. The dose apportionment estimation implicitly specifies discharge limits for each kind of anticipated radionuclide. A conservative estimate of dose apportionment of radioactivity released from MBARPP has been done as **0.384 mSv/y** for the 4x700 MWe power station at MBRAPP, Banswara, Rajasthan.

Radioactive Air Emissions
Impacts and Mitigation Measures

- Design of the plant is based on minimizing the leakages from the plant system in to plant buildings so that generation of radioactive effluents is minimized.
- Gaseous radioactive effluents from reactor and service building ventilation exhaust systems are passed through pre filters and absolute filters (to confine any radioactive materials in the exhaust streams) before discharge through the **100m** ventilation stack.
- Gaseous effluents are continuously monitored for radioactivity content before discharging through ventilation stack.

With the integration of the above mitigation measures the dose to the members of public due to air emission will be small fraction of AERB approved dose limit.

Radioactive Liquid Effluent Discharges

Impacts

- Effluent waste containing radioactivity levels above AERB norms if discharged to receiving water bodies may cause radiation exposure to reservoir biota and downstream users of the reservoir water.

Mitigation Measures

- Design of the plant is based on minimizing the radioactive leakages from the plant system in to plant buildings to minimize generation of radio-active effluents.
- Radioactive waste management facilities will be designed to treat different levels of radioactive effluents to meet the authorized release limits stipulated by AERB.
- Total Dilution water to be discharged will be **5308 m^3/hr,** which will be continuously monitored for radioactivity levels.
- Periodical monitoring of receiving water body quality at up-stream and downstream of the effluent discharge point.

With the integration of the above mitigation measures the dose to the members of public due to liquid discharges will be small fraction of AERB approved dose limit.

Radio-active Solid Waste Disposal

Radioactive solid waste will be segregated at source depending upon its nature (compactable / non-compactable) and surface dose rate.

Impacts

At NPP only low level radioactive solid waste is generated (after due processing) which would be disposed off in specially design Near Surface Disposal Facility (NSDF). It will not cause radiation dose to the member of public beyond AERB approved Dose limit as it will be segregated, handled and disposed off with the application of advanced technology.

Mitigation Measures

- Treatment and disposal of radioactive solid waste at the plant will be carried out as per AERB / SG / D-13.
- Solid wastes will be transported to Waste Management Plant (WMP) in shielded containers / casks, for treatment / conditioning (if needed) and then will be disposed off in engineered barriers (trenches, vaults and holes) at the Near Surface Disposal Facility (NSDF).
- Packages having higher activity will be disposed off at the bottom of trenches / vaults and will be suitably sealed permanently as per established practices.
- The NSDF area will be fenced and necessary access control procedures will be established.
- The dose rate on the top of the sealed earth trenches and RCC trenches / vaults will not exceed 0.01 mGy/h.

4.3.2 Conventional Pollutants

Air Environment: Impacts

There is no direct use of fossil fuel in the plant process. However, four (4) DG set will run for 24 hours during emergency power failure situation, wherein in the fuel (HSD) requirement will 979 kg/hr. The impact on air environment for the MBRAPP has been predicted considering two scenarios as following:

- **Scenario 1** : Impact on ambient air due to air emissions from testing / operation of emergency diesel generator sets of MBRAPP only.
- **Scenario 2** : Impact on ambient air due to cumulative air emissions from testing / operation of emergency diesel generator sets of MBRAPP and the air emissions from the two proposed super-critical thermal power plant at a distance of 9 to 10 km from MBRAPP .

The resultant AAQ if the 4 DG sets run for 24 hrs continuously under **scenario 1**, is presented in **Table Es. 4.1a, 4.1b** and **4.1c** for PM_{10}, SO_2 & NO_x and the resultant AAQ from MBRAPP and the two proposed supercritical TPP under **scenario 2**, is presented in **Table Es. 4.2a, 4.2b and 4.2c** for PM_{10}, SO_2 and NO_x. The predicated values of air pollutants are well within the National Ambient Air Quality norms for the above mentioned two scenarios. Thus, there will not be any adverse impact on AAQ in the study area due to the project.

Mitigation Measures

During the design phase all efforts have been made to adopt latest state of art technology and to install adequate pollution control measures for point and fugitive emission sources so as to meet the MoEFCC / CPCB air emission norms. The following mitigation measures will be employed to reduce the pollution level to acceptable limits:

- Stack monitoring to ensure proper functioning of pollution control systems.
- Air monitoring in the Work-zone.
- Adequate plantation in and around different units and around the plant.
- Regular Monitoring of ambient air quality (AAQ).

Table Es. 4.1a : Scenario 1 - Expected Ambient Air Quality after MBRAPP Proposed Plant (PM_{10})

SN.	Location	Predicted PM_{10} concentration during Emergency Run (µg/m³)				
		Predicted value	Monitored Max. Conc. During Summer season, 2023	Max. AAQ conc. after proposed plant, with 2023 baseline	Monitored Max. Conc. Overall three seasons (2014-15)	Max. AAQ conc. after proposed plant, with 2014-15 baseline
1	Katumbi (A1)	2.18	91	93.18	87	89.18
2	Dungra (A2)	2.02	87	89.02	91	93.02
3	Choti Sarwan (A3)	1.85	94	95.85	93	94.85

SN.	Location	Predicted PM_{10} concentration during Emergency Run (µg/m³)				
		Predicted value	Monitored Max. Conc. During Summer season, 2023	Max. AAQ conc. after proposed plant, with 2023 baseline	Monitored Max. Conc. Overall three seasons (2014-15)	Max. AAQ conc. after proposed plant, with 2014-15 baseline
4	Phephar (A4)	2.42	91	93.42	94	96.42
5	Deri (A5)	0.83	87	87.83	88	88.83
6	Keshavpura (A6)	0.05	91	91.05	89	89.05
7	Bortalav (A7)	0.19	93	93.19	91	91.19
8	Chip village near Mahi Dam (A8)	1.02	90	91.02	95	96.02

Table Es. 4.1b : Scenario 1 - Expected Ambient Air Quality after MBRAPP Proposed Plant (SO_2)

SN.	Location	Predicted SO_2 concentration during Emergency Run(µg/m³)				
		Predicted value	Monitored Max. Conc. During Summer season, 2023	Max. AAQ conc. after proposed plant, with 2023 baseline	Monitored Max. Conc. Overall three seasons (2014-15)	Max. AAQ conc. after proposed plant, with 2014-15 baseline
1	Katumbi (A1)	1.87	8.6	10.47	8	9.87
2	Dungra (A2)	1.73	4.4	6.13	8	9.73
3	Choti Sarwan (A3)	1.58	9.8	11.38	9	10.58
4	Phephar (A4)	2.07	6.2	8.27	10	12.07
5	Deri (A5)	0.71	6.4	7.11	8	8.71
6	Keshavpura (A6)	0.05	8.7	8.75	8	8.05
7	Bortalav (A7)	0.16	10.7	10.86	8	8.16
8	Chip village near Mahi Dam (A8)	0.87	5.1	5.97	9	9.87

Table Es. 4.1c: Scenario 1 - Expected Ambient Air Quality after MBRAPP Proposed Plant (NOx)

SN.	Location	Predicted NO_X concentration during Emergency Run (µg/m³)				
		Predicted value	Monitored Max. Conc. During Summer season, 2023	Max. AAQ conc. after proposed plant, with 2023 baseline	Monitored Max. Conc. Overall three seasons (2014-15)	Max. AAQ conc. after proposed plant, with 2014-15 baseline
1	Katumbi (A1)	1.89	21.7	23.59	19	20.89
2	Dungra (A2)	1.76	12.6	14.36	18	19.76
3	Choti Sarwan (A3)	1.61	22.9	24.51	20	21.61
4	Phephar (A4)	2.10	17.0	19.10	19	21.1
5	Deri (A5)	0.72	17.6	18.32	19	19.72
6	Keshavpura (A6)	0.05	22.8	22.85	20	20.05
7	Bortalav (A7)	0.16	24.0	24.16	19	19.16
8	Chip village near Mahi Dam (A8)	0.89	15.9	16.79	17	17.89

Table Es. 4.2a : Scenario 2 - Expected Ambient Air Quality after MBRAPP & Two Proposed TPP Plant (PM_{10})

SN	Location	Predicted PM_{10} concentration during Emergency Run (µg/m³)				
		Predicted value	Max. Conc. During Summer season, 2023	Max. AAQ conc. after MBRAPP along with Proposed TPP also	Max. Conc. Overall 3-seasons (2014-15)	Max. AAQ conc. after MBRAPP along with Proposed TPP
1	Katumbi (A1)	2.30	91	93.3	87	89.3
2	Dungra (A2)	2.03	87	89.0	91	93.0
3	Choti Sarwan (A3)	1.88	94	95.9	93	94.9
4	Phephar (A4)	2.38	91	93.4	94	96.4
5	Deri (A5)	0.84	87	87.8	88	88.8
6	Keshavpura (A6)	0.20	91	91.2	89	89.2
7	Bortalav (A7)	0.40	93	93.4	91	91.4
8	Chip village near Mahi Dam (A8)	1.02	90	91.0	95	96.0

Table Es. 4.2b : Scenario 2 - Expected Ambient Air Quality after MBRAPP & Two Proposed TPP Plant (SO_2)

S N.	Location	Predicted SO_2 concentration during Emergency Run(µg/m³)				
		Predicted value	Monitored Max. Conc. During Summer season, 2023	Max. AAQ conc. after MBRAPP along with Proposed TPP also	Monitored Max. Conc. Overall 3-seasons (2014-15)	Max. AAQ conc. after MBRAPP along with Proposed TPP
1	Katumbi (A1)	3.45	8.6	12.05	8	11.5
2	Dungra (A2)	1.90	4.4	6.30	8	9.90
3	Choti Sarwan (A3)	1.74	9.8	11.54	9	10.7
4	Phephar (A4)	2.03	6.2	8.23	10	12.0
5	Deri (A5)	0.85	6.4	7.25	8	8.90
6	Keshavpura (A6)	0.63	8.7	9.33	8	8.60
7	Bortalav (A7)	0.84	10.7	11.54	8	8.80
8	Chip village near Mahi Dam (A8)	1.29	5.1	6.39	9	10.3

Table Es. 4.2c : Scenario 2 - Expected Ambient Air Quality after MBRAPP & Two Proposed TPP Plant (NOx)

N.	Location	Predicted NOx concentration during Emergency Run (µg/m³)				
		Predicted value	Monitored Max. Conc. During Summer season, 2023	Max. AAQ conc. after MBRAPP along with Proposed TPP also	Monitored Max. Conc. Overall 3-seasons (2014-15)	Max. AAQ conc. after MBRAPP along with Proposed TPP
1	Katumbi (A1)	3.48	21.7	25.18	19	22.5
2	Dungra (A2)	1.93	12.6	14.53	18	19.9
3	Choti Sarwan (A3)	1.77	22.9	24.67	20	21.8
4	Phephar (A4)	2.06	17.0	19.06	19	21.1
5	Deri (A5)	0.85	17.6	18.45	19	19.9
6	Keshavpura (A6)	0.63	22.8	23.43	20	20.6
7	Bortalav (A7)	0.85	24.0	24.85	19	19.9
8	Chip village near Mahi Dam (A8)	1.32	15.9	17.22	17	18.3

4.3.3 Water Environment: Impacts

The plant water requirement will be **4.5 m³/hr** per MWe, with cycle of concentration (COC) as 3. Water requirement will be met from Mahi-Bajaj Reservoir, for which necessary sanction has been accorded by Government of Rajasthan. About **18000 m³/hr** water will be required for unit 1 to 4, out of which **12692 m³/hr** will be towards consumptive use and the rest of the **5308 m³/hr** will be returned to reservoir. Total

sewage generated from township will be about **1030 KL/day** and from plant will be **100 m^3/day or KLD**. A STP of **1.03 MLD** will be made to treat the sewage water. As ground water will not be used for the project & there will be no discharges to ground water. It is predicted that there will be no impact on ground water due to the proposed project. The project site elevation will be designed in such a way so as it will not have any impact on the local area drainage pattern.

Mitigation Measures

- To treat domestic wastewater at plant & township site Sewage Treatment Plant (STP) are integrated with the project design.
- Effluent quality monitoring will be carried out at inlet and outlets of STP at site and in township. The STP treated water will be used for green belt development in the respective areas and only the excess will be discharged.
- In addition, rainwater harvesting and monitoring of surface water & ground water in and around the area of the proposed project will be carried out regularly.

4.3.4 Solid Waste Disposal: Impacts and Mitigation Measures

Hazardous wastes like Oil, lubricants, scintillation liquid etc are burnt along with low radioactive level solid waste in incinerator, with burning capacity 20 kg/hr consuming 50 liter/hr furnace oil. The incinerator will be operated for 2 to 3 days per month. The flue gas will be passed through two stage water scrubber. A continuous monitoring system is provided to monitor the gas emitted from the chimney. Ash collected from the incinerator is solidified with cementation process and disposed off in RCC trenches. The used oil, electronic waste & used lead acid batteries generated will be sold to authorised agencies.

4.3.5 Noise Levels: Impacts

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, which will be further attenuated to ambient noise level at the exclusion zone boundary at a distance of 1 Km. Thus, there will not be any change in the ambient noise levels due to operation of nuclear power plant units.

Mitigation Measures:

- All the equipment in different units are designed/operated such that the noise level will not exceed 85 dB (A) at a distance of 1m.
- The noise generating equipment is housed in acoustic enclosures / buildings. The presence of exclusion zone (1 km) with greenbelt will serve to insulate generated noise.
- Regular monitoring will be carried out for noise levels in the work zone and outside the plant premises.
- Workers exposed to noise level will be provided with protection devices like earmuffs and will be deployed with rotational duties.
- All workers will be regularly checked medically for any noise related health problem.

4.3.6 Impact of Transportation

During construction stage there will be only a marginal increase in traffic load on the road leading to the project site. The transportation of over dimensional consignment (ODC) will be maximum to the tune of one vehicle per day will be plying on the road. For catering to ODC, the road leading to project site will be adequately widened and strengthened.

During operation phase, the increase in vehicular movement for manpower transportation from township to the plant (9 km), there will be some increase in traffic load only for short duration during the opening and closing time of main shift office hours. Thus, no congestion of traffic on the road leading to the project site is envisaged.

4.3.7 Ecological Features: Impact

- The level of air pollutants (SO_2 and NOx) due to occasional running of DG sets will be much below the National Ambient Air Quality Standards. Thus, it is expected that the natural vegetation and agricultural crops will not be affected.
- Forests are in close vicinity to the project site.
- Noise generated due to the project may cause disturbance to faunal species.
- Strong light in project premises during night may cause disturbance to fauna.
- Wastewater from plant and domestic use may cause surface water pollution.
- There are few Schedule -I animals in the study area, after the project these animals may get increased human interference and may get disturbed.

Mitigation Measures

- All technological measures to limit air emissions, wastewater discharge and noise generation are envisaged in the proposed plant design.
- An elaborate green belt / cover has been planned within and around the plant to ameliorate the fugitive emissions and noise from the project operation.
- The STP wastewater after treatment will be used for gardening, plant road dust suppression, etc. and only excess water will be discharged outside the plant premises.

Mitigation Measures for Reducing Impacts on Faunal Species

- **Direct Disturbance:** Ten feet high fencing erected all around the project site and the green belt erected along the fencing will reduce the impact of direct disturbance.
- **Noise disturbance to faunal species:** All technological measures to reduce noise generation are envisaged in plant design, moreover the green belt along the project boundary will reduce the noise level.
- **Strong Light during Night:** All the light posts erected along the boundary will face inwards and downwards to reduce light spread out side the plant boundary.
- A wildlife conservation plan has been prepared and budget has been kept for the same. The same will be implemented through State Forest Department for conservation of wildlife in the study area.

4.3.8 Occupational Safety and Health: Impacts

Negligence in plant operations may cause risk to safety and health problems.

Mitigation Measures

- Based on the environmental monitoring for dust, gases, radioactivity levels, noise & vibration, the workers exposed to these will be regularly checked in medical unit and results will be intimated to management for necessary management interventions / measures.

4.3.9 Socio-economic Impacts

Advantages

- Project will generate more employment, directly and indirectly, and major portion of it will be provided to the local people as for as possible.
- Development of business opportunities in the area.
- Development of infrastructure facilities including roads will help in improving the whole area.
- Improvement in living standard.

Disadvantages

- People perceive that the increase in pollution may cause damage to agriculture and damage to the health of people due to pollution.
- Loss of agricultural land.

Mitigation Measures

- The community development efforts of the project for its stakeholders will fulfill their aspirations.
- The project will have structured interactions with the community to disseminate the measures taken by the plant and also to elicit suggestions for overall improvement for the development of the area.
- Proper compensation to the Project Affected Persons (PAP).
- More Higher secondary schools
- Dispensaries / Health Centers and availability of doctors and other para-medical staff
- Drinking water supply schemes
- Loan facility for self employment to open petty shops, purchase of cycle rickshaws, agricultural tools and implements, bullock carts, fertilizers, improved seeds and digging of well for irrigation.
- All measures have been taken to keep the radiation levels due to plant operation under AERB limits, thus any adverse effect on human health due to radiation is not envisaged. As regards conventional pollutants as shown above that conventional pollutant will be generated only during emergency situation of power failure due to running of DG sets., it has been predicted that even after operation of two proposed super critical TPP, the level of pollutants will be within the national AAQ norms. Thus, the impact due the same is not envisaged.

4.3.10 Impacts During Decommissioning Phase

At the end of the operating life of 60 years, a detailed decommissioning plan will be worked out as per AERB guidelines, which will ensure that no radiation exposure occurs in public domain / environment.

4.3.11 Impacts and Mitigation Measures under Accidental Conditions.

A detailed risk assessment, on-site emergency plans & Disaster Management Plan have been made to take care of any on-site emergency. In addition, regular mock drills will be conducted to check the effectiveness of the system. An offsite Disaster Management Plan will be prepared in consultation with District Authorities before the plant operation.

4.4 Green Belt Development

A total of about 33% of total project area will be developed as green belt or green areas in project area.

5.0 ENVIRONMENTAL MONITORING PROGRAMME

All the environmental aspects will be regularly monitored by Technical Services Unit and Environmental Survey laboratory (ESL), HPD, BARC. The two will ensure the implementation and effectiveness / monitoring of various mitigating measures envisaged / adopted. An Environmental Management Apex Review Committee (EMARC), comprising of senior management level officers will periodically assess and monitor the implementation of mitigation measures and environmental monitoring programme.

6.0 RISK ASSESSMENT

The major chemical which will be stored by the project is only High Speed Diesel Oil (HSD). However, the handled quantity is well below the lower threshold limit. Accordingly, only rule 17 (of "Manufacture, Storage and Import of Hazardous Chemical (Amendment) Rules, 1989 and its Amendment Rules 2000") applies, i.e. preparation and maintenance of material safety data sheets are required and has been taken care off.

7.0 BUDGETARY PROVISIONS FOR ENVIRONMENTAL PROTECTION MEASURES

The estimated capital cost of the proposed project (4x700 MWe) is around **Rs 42,000 Crores** and the item wise estimated cost towards environmental protection and enhancement measures are given in **Table ES 5.** The environmental protection and enhancement measures include engineered safety features, "Equipment, Components, Systems & Structures (ECSS)" which are an integral part of nuclear power station.

Table ES 5: Cost of Environmental Protection Measures (Rs. Crores):

SN	Environmental Protection Measures	Capital Cost
1.	Reactor Safety & Radiological protection Aspects	**4200**
2.	Pollution Control - Conventional Aspects	**20.0**
3.	Environmental Studies and monitoring	**38.4**
4.	Green Belt	**10.0**
5.	Social Welfare Measures	**1.5**
		4269.9 (say 4270)

8.0 SUMMARY AND CONCLUSION

The plant is designed with latest state of art technology so as to achieve minimum radioactive releases (within AERB norm) from air and water route and minimal release of conventional pollutants emitted from plant operation in form of air emissions, wastewater and noise levels. Further, maximum re-use of wastewater has been envisaged.

The Revised EIA-EMP report has thoroughly assessed all the potential environmental impacts associated with the project. The environmental impacts identified by the study are manageable. Site specific and practically suitable mitigation measures are recommended to mitigate the impacts and to comply with MoEFCC/ RSPCB/ AERB stipulations/ norms with considerable margin. Further, a suitably designed monitoring plan has been provided to monitor and control the effectiveness of envisaged mitigation measures during the operation phase. These measures will ensure that any possible impacts is avoided and controlled before its occurrence.