EXECUTIVESUMMARY
OF
ENVIRONMENTAL IMPACT ASSESSMENT REPORT

4 X 700 MW PHWR HARAYANA ATOMIC POWER PROJECT (HAPP)
AT
GORAKHPUR HARAYANA

MECON LIMITED
RANCHI – 834 002
(JHARKHAND)

NUCLEAR POWER
CORPORATION OF
INDIA LIMITED (NPCIL)
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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 objective is to develop nuclear power technology and to undertake generation of electricity under the provisions of Atomic Energy Act, 1962. 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 by conducting an Environmental Impact Assessment (EIA) study. NPCIL entrusted MECON Limited to conduct an EIA study for the proposed project.

2.0 PROJECT DESCRIPTION

2.01 Nature and Size of the Project

The **Haryana Atomic Power Project (HAPP)** will produce 4X700 MWe power. It falls under category of "Nuclear Power Project & Processing of Nuclear Fuel".

2.02 Location

The project site is located in Gorakhpur Village, Bhuna Block, Tehsil, Sub-division & District Fatehabad, Haryana, at geographical co-ordinates of longitude 75^0 37' 56" E and latitude 29^0 26' 30" N. and situated about 215 to 218m above mean sea level (MSL). The site is about 28 km in SE direction of Fatehabad town (district head-quarter) and is about 6.0 km from **NH10** (connecting Hisar to Fatehabad).

The nearest railway station is Uklana Mandi (23 km) on Northern railway. Hisar is situated about 33 km on the SSE of the project site. The nearest Airports to the plant site is at Hisar (used for Helicopter training) at a distance of about 40 km from the plant site and Indira Gandhi International Airport, Delhi is about 208 km from project site. The Bhakhara Canal (Fatehabad Branch) flows from east to west towards north close to the site. There is no major industry and no place of historical importance within 10 km off the site. 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. The site connects **NH10** by Kharakheri-Gorakhpur road. The Index map showing the location of the plant site is shown in **Fig. 1.**

The total **1503.5 acres (608.48 ha)** land required is private land, of which that required for the project is about **1318 acres (533.5 hectares)** and that for township is about **185.42 acres (75.04 hectares)**. The project site land (534 ha) comprises **1273.2 acres** or **515.24 ha** of land under agricultural category and 32 ha of land is not cultivable. The land at the township comprises mostly barren land. The locations of proposed site at Gorakgpur is shown in **Fig. 1.**

2.03 The Proposed Project

The Nuclear Power Corporation of India Ltd (NPCIL) is intended to setup Gorkhapur Atomic Power Project (HAPP) 4x700 MWe Pressurized Heavy Water Reactor (PHWR) units at Gorkhapur, Dist Fatehabd. The major equipments needed are Steam Generators, End-Shield, Calandria, Coolant Channels, End Fittings, Primary Coolant pumps, Heat Exchangers, Fuelling Machine components, etc.

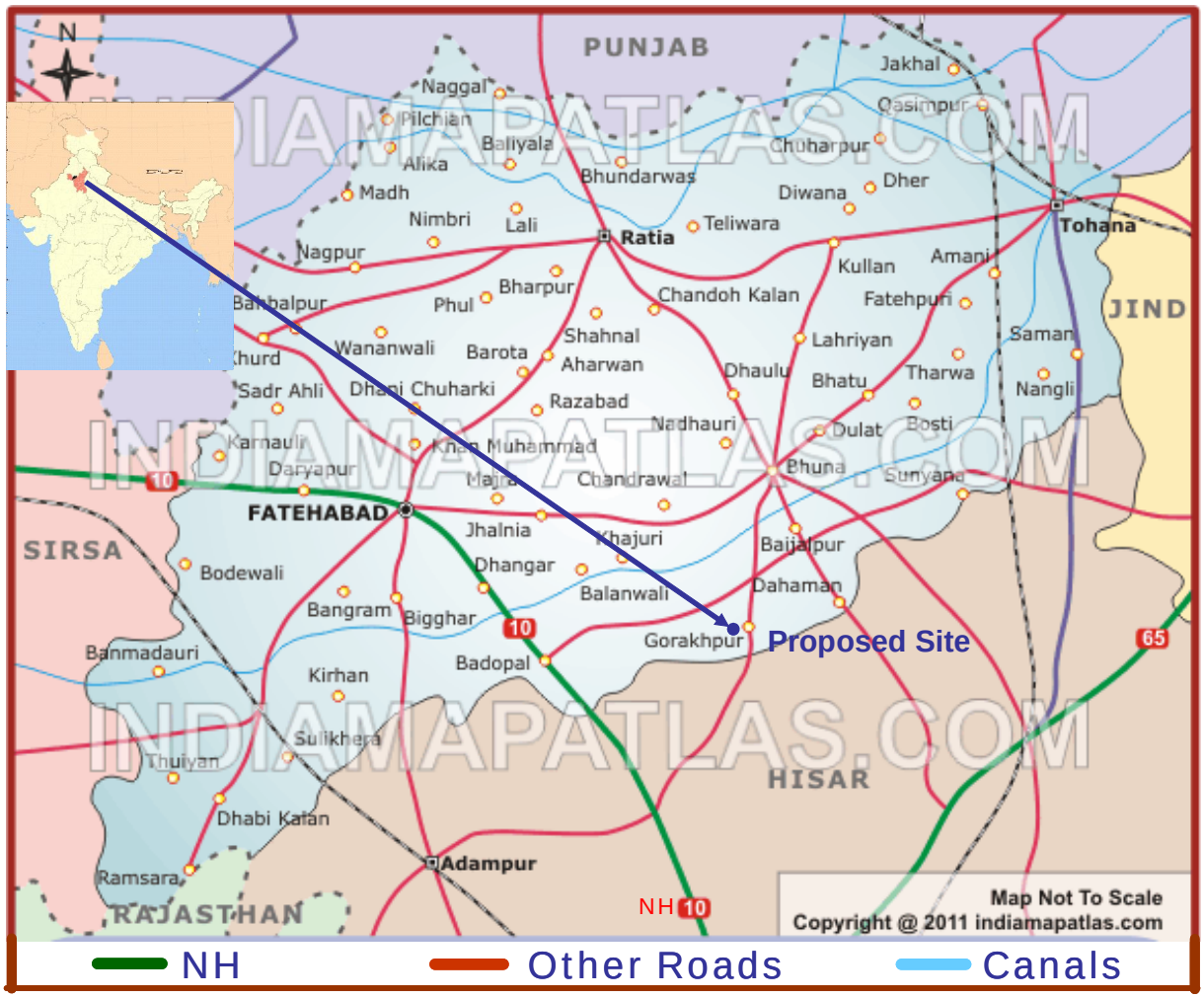

Fig.1: Proposed Project Site at Village Gorakhpur, District Fatehabad, Haryana

The above equipments will be housed in Nuclear buildings consisting of:

- Reactor Building (RB) and Reactor Auxiliary Building (RAB) house the main reactor and associated process systems,
- 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, Induced Draught Cooling Towers, Safety Related Pump House (SRPH), Fire Water Pump House, Underground Tunnels and Trenches, Diesel Oil Storage Area (DOSA), Emergency Makeup Water Pond, Covered Passage, etc as per the design features of the plant.

Power Evacuation “in principal” is feasible for 2800 MWe power from site. The Power generated at GAPP will be evacuated through 400 kv transmission system. The number of transmission outlets and their destination will be finalized taking into account share of

beneficial state in due course after a detailed power system studies are carried out by PGCIL and approved by the concerned authorities "

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 and turbine is directly coupled to an electrical generator, which produces electricity. Generator voltage is stepped up by the generator transformer. Generated power is transmitted to the grid from the nuclear power station at 400 kV.

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. as engineered safety systems 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.

Construction of the project will be taken up in two stages of 2X700 MWe each. Subsequent two units are expected to be four years later. The 1st stage project will be commissioned in **60 months** from the **"Zero-Date"** as August 2013 i.e. the start of construction activities at site.

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 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 Fatehabad Branch of Bhakra Canal. Assurance has been given to supply **783 Million Liters per Day (MLD)** or **32625 m3/hr** and that for the township about **0.65 MLD** or **27 m3/hr** of water from Haryana Government. About **18000m3/hr** of water will be required for unit 1 to 4 for cooling tower makeup and other plant requirements. Out of which **12680 m3/hr** will be towards consumptive use and the rest of the **5320 m3/hr** will be returned to canal.

Township

A residential colony for about **1700** employees has been envisaged, with main features as follows:

a. Land area is : 75 Ha
b. Ground Coverage area : 28.4 Ha (37.8%)
c. Built up area = 26.00 Ha [Floor Space Index (FSI[1]) : 0.34].
d. The township will have a maximum height of Ground + two stories limited to maximum height of 11.45 m.
e. Water Consumption = **1.250 Million Litres Per Day (MLD) or 1250 m^3/d**
f. Power requirement = 2000 KVA for stage one and 2000 KVA for stage two. A 500 KVA Standby DG set will be provided.
g. Connectivity: Via local roads near Badopal village on National High way number (NH-10) connecting Hisar and Fatehabad.

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

h. Parking requirements: Adequate parking space of about 1500 cars, light commercial vehicles, buses etc. - available 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 proposed township.
j. All the civic amenities.
k. Measures to minimize energy consumption
   - Use of CFL[2]
   - Use of Low-pressure sodium lamps for outdoor lighting along the road and security lighting with Solar Street Lights mix.
   - Use of solar water heater for hospital, guest house.
   - Automatic timing control mechanism will be incorporated in the street lighting to save energy. Mechanism will involve staggering of on-off sequence of street lights.
l. Sewage treatment plant of 1MLD envisaged for treatment of sewage water. The treated sewage shall be disinfected / filtered and used for gardening purpose.
m. Green belt will be developed in and around the township.
n. A fire extinguishing system as per the requirements of national Building Code will be provided.

The estimated cost of 4 X 700MWe PHWR Atomic Power Project is about **Rs 23502 Crores** (base cost 2011-12).

3.0 DESCRIPTION OF THE ENVIRONMENT

3.01 General

Study area has been taken as 10km radius around the project site for conventional pollutant and other baseline study for which the baseline environmental data monitoring was conducted during March 2011 to May 2011 (summer season). Whereas for baseline radiological monitoring the study area taken was 30km radius around the project site and the study was conducted during January to March 2011.

3.02 Meteorology

In summer season overall, the predominant wind directions for March 2011 – May 2011 were NW, W, NE, SE, SW, and N (prevailing for 16.03%, 10.06, 6.33, 4.75 and 4.34 of the time). Calm conditions prevailed for 29.39% of the time. The wind velocity was mostly between 1.6 to 18.0 km/hr (70.59% of the time).

3.03 Ambient Air Quality (AAQ)

Eight AAQ monitoring stations were monitored. The maximum values of Particulate Matter (PM_{10} & $PM_{2.5}$), SO_2 , NO_x and Ozone (O_3) at all the monitoring stations the values of different pollutants were below the National AAQ Standards for Industrial, Residential, Rural & Other Areas as well as for ecologically sensitive areas (**Table ES.2**).

Table ES 2: Summarised Results of AAQ Monitoring

Parameters		Gorakhpur A1	Nehla A2	Siwani A3	Kirmara A4	Chaubara A5	Sabarwas A6	Kajalheri A7	Khaujri A8
SO_2 ($\mu g/m^3$)	Max	15.00	14.00	20.00	18.00	12.00	13.00	14.00	11.00
	Min.	5.00	4.00	4.00	4.00	5.00	4.00	5.00	5.00
	Avg	8.92	6.54	10.21	9.00	7.92	7.54	9.00	7.42
	C 98	14.54	12.16	18.62	16.86	11.78	12.54	14.00	10.78

2 Compact fluorescent lamp **(**CFL) or Compact Fluorescent Light

Parameters		Gorakhpur A1	Nehla A2	Siwani A3	Kirmara A4	Chaubara A5	Sabarwas A6	Kajalheri A7	Khaujri A8
NO_x ($\mu g/m^3$)	Max	31.00	23.00	36.00	46.00	19.00	30.00	24.00	17.00
	Min.	9.00	7.00	10.00	6.00	8.00	9.00	8.00	8.00
	Avg	16.79	12.54	21.04	17.04	12.33	14.38	14.33	12.67
	C 98	29.16	20.24	35.54	39.56	18.78	26.78	23.34	16.78
PM_{10} ($\mu g/m^3$)	Max	98.00	98.00	97.00	96.00	72.00	92.00	83.00	65.00
	Min.	53.00	55.00	52.00	62.00	52.00	66.00	50.00	45.00
	Avg	85.25	77.25	76.29	78.33	61.92	76.42	64.33	58.75
	C 98	97.54	97.54	95.62	96.00	71.78	91.08	81.46	65.00
$PM_{2.5}$ ($\mu g/m^3$)	Max	49.00	47.00	45.00	58.00	46.00	44.00	45.00	50.00
	Min.	39.00	29.00	32.00	33.00	37.00	29.00	34.00	37.00
	Avg	44.67	40.33	40.00	45.33	40.67	37.67	40.33	44.33
	C 98	48.88	46.92	44.92	57.48	45.72	43.84	44.88	49.84
O_3 ($\mu g/m^3$)	Max	17.30	13.60	14.40	15.20	16.10	12.60	15.20	15.40
	Min.	15.50	12.30	13.80	13.50	15.50	11.90	14.30	11.80
	Avg	16.40	12.95	14.10	14.35	15.83	12.20	14.78	13.63
	C 98	17.28	13.56	14.38	15.18	16.10	12.58	15.17	15.34

3.04 Ambient Noise

Noise mmonitoring was conducted at ten locations in and around the project site. The values at all stations were below the respective statutory norms as applicable.

3.05 Water Environment

Four surface and four ground water samples were analysed for the study. All the parameters in surface waters were within the CPCB norms for Classes B, C, D, and E for surface water. Ground water analysis reveals that in village Sabarwas (GW2), total hardness, Chloride, TDS, Ca, Mg and Alkalinity is exceeding the respective desirable / permissible norms of IS:10500. Whereas in village Samani (GW3) TDS is higher than desirable limits. Other parameters of all the samples are within the limits with the drinking water quality standards (IS :10500).

3.06 Soil

Soil samples were analysed for ten locations in and around the project site and were found good for plant growth.

3.07 Ecological Features

There is no wildlife or bird sanctuary within the study area. The study area falls under agro-climatic zone "**Trans-Gangetic Plains Region**" and under climatic region **arid to semi arid** - characterised by dryness and extremes of temperature and scanty rainfall. The vegetation is characterized by "**tropical desert thorn"** and comprises predominantly of xerophytes.

3.08 Traffic Density

The traffic density on NH 10 is highest for LMV (5167/d), followed by HMV (1841/d) and two wheelers (1940/d), whereas that on road leading to project site from NH 10 is highest for two wheelers (452/d), followed by LMV (341/d) and HMV (11/d).

3.09 Hydrogeology

Normal annual rainfall of Fatehabad district is 373 mm falling in 22 rainy days. The groundwater is in water table condition at a depth of 3 to 20m below ground level and in semi confined.

3.10 Socio-economic Status

The 10 km study area consists of 83044 persons. Basic socio-economic conditions are:

- The population density up to 5 km is minimum followed by that in 10 km radius.
- The study area consists of mostly rural population.
- Predominance of individual land holdings in small to marginal category. Wheat is mostly grown followed by cotton, paddy, gwar, etc.
- The employment rate is moderate: 43% are engaged as main workers, 17% as marginal workers and 40% as non-workers. Agriculture and small commercial activities plays an important role in rural economy.

3.11 Baseline Study for Radiological Environment

The 30 km study area for radiological monitoring was divided into four zones 1, 2, 3 and 4 (1.0 - 5 km, 5 - 10 km, 10 - 15 km, and 15 - 30 km, respectively) and further divided in to 16 circle-segments / sectors from A to P, taking the project site as centre.

The Ambient Radiation Levels (Gamma radiation level) was measured using Gamma dose rate tracer. The gamma radiation levels ranged between 0.07-0.22 µGy/h, which is normal and comparable with Kakrapar and Kaiga sites.

The pre-operational Base Line Levels of Natural and Fallout Radio-nuclides were measured in terms of radio-nuclides of natural (^{238}U, ^{232}Th, ^{40}K) and fallout (^{137}Cs and ^{90}Sr) origin by taking environmental samples from terrestrial and aquatic environs. Canal water, soil, cereals, pulses and vegetation samples were collected from the study area.

Air samples

Five air samples were analysed for gross alpha and beta activities. The gross beta activity ranged between BDL (<0.007 $Bq.m^{-3}$) to 0.017 $Bq.m^{-3}$ and gross alpha ranged from 0.0002 to 0.003 $Bq.m^{-3}$.

Radioactivity levels in water samples

Fifteen (15) water samples were analysed for gross alpha and beta activities. The Gross alpha activity ranged from 6.7 **$mBq.l^{-1}$** to 281.3 **$mBq.l^{-1}$** and the gross beta activity ranged from MDL (<225 **$mBq.l^{-1}$**) to **332.6 $mBq.l^{-1}$**. Higher gross alpha activities as compared to other power station sites may be attributable to comparatively higher concentrations of Uranium in ground water.

Radioactivity levels in soil

Fourteen samples were analysed for baseline radio-activity level in soil. The ^{226}Ra activity ranged from 9.6 to 70.9 $Bq.kg^{-1}$dry wt, ^{238}U activity varied from 11.5 to 70.8 $Bq.kg^{-1}$dry dry wt, the ^{232}Th activity varied from 20.2 to 118.7 $Bq.kg^{-1}$dry dry wt. The ^{226}Ra and ^{238}U concentrations are found to be higher than those observed in other power station sites of India. ^{40}K concentrations in soil varied from 249.6 to 1353 $Bq.kg^{-1}$dry wt. The observed values are comparable with those observed in other power station sites. The ^{137}Cs and ^{90}Sr concentrations in soil samples from the study area are comparable to the levels reported elsewhere[3].

Radioactivity levels (^{137}Cs, ^{90}Sr and ^{40}K) in biological samples

3 UNSCEAR 2000, Sources and effects of ionizing radiation, Report to General Assembly, with Scientific Annexes, United Nation, 2000.

Radioactivity levels in food and related matrices are monitored in terms of ^{137}Cs and ^{90}Sr in ten (10) biota (biological) samples, covering grass, cereals, leaves, fruits, etc. The activity levels of ^{137}Cs and ^{90}Sr are comparable to the levels reported elsewhere[4].

4.0 ANTICIPATED ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

4.01 Impact and Mitigation : Construction Phase

The main Plants units of the project will be establish in **608.5 ha** of area which included exclusion zone of 1 km around the reactor building of the main plant of the project. For land acquisition, R&R policy 2010 of Government of Haryana agreed with local bodies / PAPs will be implemented in phases. Only land Oustees and no homestead population involved. A total of **979 PAP's** due to land acquisition. For acquisition of the private land, R&R policy 2010 of Haryana - shall be followed. No forest land is involved in the project.

4.02 Impacts and Mitigation : Project Design

The HAPP is being envisaged based on the state of art technology as presently available in the country. A number of environment friendly / safety features have been envisaged which ensures that the anticipated adverse environmental impacts are either avoided or minimized.

The basic design of the Atomic Power Plant allows for

a. Normal Releases of radioactive or chemical pollutants to the environment within statutory limits.
b. There could be accidents, off normal situations with potential for large uncontrolled releases are minimized with probability of occurrence within statutory limit.

The first approach aims to avert such situations to the best extent possible. 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.

Apart from the steps taken to avert / contain unplanned releases, the design provides for the reduction of pollution burden by minimizing the quantum of wastes generated in normal operation also.

The concept of defense-in-depth is adopted in design of safety systems, various state of the art safety systems mechanisms are engineered to ensure safe operation of the reactor, viz

- **Barriers to radioactive release**:
  Multiple series of fission product barriers designed to prevent radioactivity release, viz.
  i) Fuel matrix
  ii) Fuel sheath
  iii) Primary Heat Transport System
  iv) Containment

4 UNSCEAR 2000, Sources and effects of ionizing radiation, Report to General Assembly, with Scientific Annexes, United Nation, 2000.

- **Special safety zones** :
  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 within limits.
- Exclusion zone
- 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.
- 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.

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

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, a small fraction of these radio-nuclides are released into the environment in the form of gaseous emissions and liquid effluents are released into the environment within statutory limit.

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 HAPP has been done as **0.40 mSv** for the twin-unit 700-MWe HAPP.

Radioactive Air Emissions
Impacts:
The radioactivity through air route will be discharged within AERB limit which will not cause any adverse impact to surrounding life systems.

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.

Radioactive Liquid Effluent Discharges

Impacts

- Effluent waste containing radioactivity levels above AERB norms if discharged to receiving water bodies may cause radiation exposure to canal biota and downstream users of the canal water.
- The cooling water if discharged at high temperature may cause concern to the flora and fauna in the receiving water bodies.

Mitigation Measures

- Design of the plant is based on minimizing the radioactive leakages from the plant system in to plant buildings to minimized generation of radio-active effluents.
- Designed radioactive waste management facilities will treat different levels of radioactive effluents to meet the authorized release limits stipulated by AERB.
- Total Dilution water to be discharged will be **5320 m^3/hr,** which will be continuously monitored for radioactivity levels. .
- Periodical monitoring of receiving water body water quality at up-gradient and down gradient of the effluent discharge point.

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

Solid waste generated from different units to the tune of **514m^3/yr** 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 is 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

No direct use of fossil fuel in the plant process. However, for each unit of 700MWe there are 4 DG sets (1w + 3 stand by), for use during power failure. Each DG set is of capacity 4.2 MW (sufficient for supplying power to one 700MWe reactor unit) with fuel (HSD) consumption of 979kg/hr. Thus 4 DG set will run for 24 hours during emergency power failure situation.

The resultant ambient air concentrations if the DG sets are run for 24 hrs continuously has been presented in **Table 3** for PM, SO_2 & NO_x. The values of different parameters are well within the National Ambient Air Quality norms. Thus there will not be any adverse changes in AAQ in the study area due to the project.

Table 3: Expected Ambient Air Quality after Proposed Plant

Pollutants	Monitored (Max. C98) (µg/m3)	Anticipated Maximum contribution of pollutants in µg/m3 due to proposed plant (maximum GLC occurrence co-ordinate)	AAQ after proposed plant (µg/m3)
Four DG sets of 4.2 MW capacity each during emergency running continuously for 24 hrs			
RPM	97.54	1.5 (18, 2.5km)	99.04
SO2	18.62	1.29 (17, 2.5km)	19.91
NOx	39.56	1.3 (17, 2.5km)	40.86
**Concentrations are in µg/m3 and of 24 hours averaging time. Values in the parenthesis indicate the coordinates of the grid points in Km (10, 10 km) is the centre of the plant.*			

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 MOE&F / 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.
- Monitoring of ambient air quality (AAQ).

4.3.3 Water Environment: Impacts

The plant water requirement will be **4.5 m^3/hr** per MWe, with cycle of concentration (COC) as 3, to be met from Fatehabad Branch of Bhakra Canal. Necessary permission has been accorded from Government of Haryana. About **18000m3/hr** water will be required for unit 1 to 4, out of which **12680 m3/hr** will be towards consumptive use and the rest of the **5320 m3/hr** will be returned to canal. Total sewage generated from township will be about **34 m^3/hr** and from plant will be **3.5m^3/hr**. No impact on ground water is envisaged as ground water will not be drawn. Plant operation does not have any impact on drainage pattern and expected to remain as it is.

Mitigation Measures

- Effluent quality monitoring at inlet and outlets of STP in plant 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, rain water harvesting and monitoring of ground water levels in and around the area of the proposed project will be done.

4.3.4 Solid Waste Disposal: Impacts and Mitigation Measures

The Hazardous wastes like active Organic Liquid waste 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 passed through two stage water scrubber. The ash and scrubbing water after solidification / embedment in cement will disposed in RCC trenches. Continuous monitoring system is provided to monitor the gas emitted from the chimney. The Lead Acid Battery generated will be sold to registered recyclers.

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. Thus, there will not be any change in the ambient noise levels due to operation of nuclear power plant. Noise in the work place generated from operation of equipment is the only concern.

Mitigation Measures:

- All the equipment in different units designed/operated that the noise level will not exceed 85 dB (A) at a distance of 1m.
- The noise generating equipments are housed in acoustic enclosures / buildings. The presence of exclusion zone (1 km) with greenbelt will serve to insulate generated noise.
- Periodical monitoring of work zone noise and outside 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 and if detected, they will be provided with alternative duty.

4.3.6 Impact of Transportation

During construction stage there will be only marginal increase in traffic load on the road leading to the project site, thus no impact is anticipated due to the same. However, the over sized consignment maximum one vehicle per day will be plying on the road. For catering to oversized consignment, 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 (4 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 project site is envisaged.

4.3.7 Ecological Features: Impact

- After the plant operation, the maximum predicted SO_2 levels is 20 ug/m^3 and NO_x level is 41ug/m^3, which is well below the permissible SO_2 and NO_x levels for sensitive areas. Thus it is expected that the flora and fauna in the study area will not get affected.
- Noise generated due to the project may cause disturbance to the faunal species.
- Strong light in the project premises during night may cause disturbance to the fauna in the near by areas.

Mitigation Measures

- All technological measures to limit air emissions, waste water discharge and noise generation are envisaged in the proposed plant design.

- An elaborate green belt / cover has been planned within and around the plant covering about 33% of the project area to ameliorate the fugitive emissions and noise from the project operation.
- The STP waste water after treatment will be used for gardening, plant road dust suppression, etc.and only excess water will be discharged out side 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 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 down wards to reduce light spread out side the plant boundary.

4.3.8 Occupational Safety and Health: Impacts

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

Mitigation Measures

- Proper control of fugitive dust from sources inside plant including open stockyards. The dust in work zone will be regularly monitored and reported for necessary control action.
- 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.
- Spot cooling facilities for workers exposed to high heat generating shops and will be checked periodically.

4.3.9 Socio-economic Impacts

Advantages

i. Project may generate more employment, directly and indirectly, and major portion of it may be provided to the local people.
ii. Development of business opportunity in the area.
iii. Development of infrastructure facilities including roads may help in improving the whole area.
iv. Improvement in living standard.

Disadvantages

ii. The releases from the plant during normal as well as off normal situations will be maintained within the AERB approved limits and hence will not cause any advense impact in the public domain.
iii. People perceive that the increase in pollution may cause damage to agriculture and damage to health of people due to pollution.
iv. 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.

4.3.10 Impacts During Decommissioning Phase

At the end of the operating life of 60 years of different units, a detail decommissioning plan will be worked out as per AERB to bring the land to its original use, which will ensure that no radioactive releases exists in the public domain / environment.

4.3.11 Impacts and Mitigation Measures Because of Accidents

A detailed risk assessment, on-site emergency plans & Disaster Management Plan has 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 35% 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 mitigative 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, and tackle the bottlenecks of the implementation of mitigation measures.

6.0 RISK ASSESSMENT

The major chemicals 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 is around **Rs 23502 Crores** (base cost 2011-12).and the item wise estimated cost towards environmental protection and enhancement measures are given in **Table Es. 4.**

Table Es 4: Cost of Environmental Protection Measures (Rs. Crores):

SN	Environmental Protection Measures	Capital Cost	Recurring Cost / Annum
1.	Pollution Control – Radiological Aspects	2350	40.0
2.	Pollution Control - Conventional Aspects	15.0	0.3
3.	Environmental Pollution Monitoring	30.0	1.2
4.	Green Belt for 200 ha. 1.5 lakhs / ha.	3.0	0.3
5.	Social Welfare Measures	1.5	0.3

SN	Environmental Protection Measures	Capital Cost	Recurring Cost / Annum
	Total	**2399.5**	**42.1**

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, waste water and noise levels. Further, maximum re-use wastewater has been envisaged.

The EIA 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 AERB stipulation 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.