adani
Power

Ref: APL/Kawai/ENV/RSPCB/EC/PH/45/25
Date: 11.05.2025

To,
The Regional Officer,
Rajasthan State Pollution Control Board,
Room no, 345 to 347, Mini Secretariate,
Jhalawar, Rajasthan

Sub: Request to conduct Public Hearing for proposed expansion of Kawai Thermal Power Plant by 3200 (4x800) MW Coal based Ultra Super Critical Technology to existing 1320 (2x660) MW at Village Kawai, Tehsil Atru, District Baran, Rajasthan **by Adani Power Limited, Kawai.**

Ref.: MoEFCC granted Terms of Reference (ToR) vide File No. J-13012/154/2008-IA.II(T) dated: 29.07.2024.

Dear Sir,

With reference to the above subject APL, Kawai has proposed expansion with capacity of 3200 (4x800) MW Coal based Ultra Super Critical Thermal Power Project to existing 1320 (2x660) MW at Village Kawai, Tehsil Atru, District Baran, Rajasthan.

The Ministry of Environment, Forest and Climate Change, New Delhi has issued the Terms of Reference (ToR) vide file no. **J-13012/154/2008-IA.II(T) dated: 29.07.2024** and advises to submit the Draft EIA-EMP Report to the Rajasthan State Pollution Board for conducting Public Hearing.

In compliance to ToR condition, we have completed EIA study and submitting herewith the Draft EIA-EMP Report, along with Executive Summary in English & Hindi and soft copy (Pen drive/DVD) to conduct the Public Hearing.

We request the Board, kindly conduct the Public Hearing process as per EIA Notification 2006 & subsequent amendments for the proposed Thermal Power Project at the earliest.

Thanking you
Yours faithfully,
for **Adani Power Limited, Kawai**

(R N Shukla)
Head Environment & Forest

Encl: 1. Copy of Granted ToR
2. Executive Summary in English & Hindi (Hard & Soft copies)
3. Draft EIA-EMP reports (Hard & Soft copies)

CC: The Member Secretary,
Rajasthan State Pollution Control Board,
4, Institutional Area, Jhalana Doongri
Jaipur-302004, Rajasthan

DRAFT ENVIRONMENTAL IMPACT ASSESSMENT & ENVIRONMENTAL MANAGEMENT PLAN

FOR

Proposed Expansion of Kawai Thermal Power Plant under Phase–II by adding 3200 (4x800) MW Ultra Super Critical Thermal Power Plant to Existing 1320 (2x660) MW at Village Kawai, Tehsil Atru, District Baran, Rajasthan

{Under item 1(d) Schedule of EIA Notification dated 14th September'2006, & amendments}
Cat. 'A', *1(d) - Thermal Power Plants*

DRAFT REPORT

PROJECT PROPONENT
Adani Power Limited
Adani Corporate House, Shantigram,
S.G Highway, Near Vaishnodevi Circle,
Ahmedabad – 382421, Gujarat.

ENVIRONMENTAL CONSULTANT
Gaurang Environmental Solutions Pvt. Ltd.
Peetal Factory, Jhotwara Road, Bani Park, Jaipur-302016
NABET Accreditation: NABET/EIA/23-26/RA 0338
Report No. -GESPL_743/ 2024-25/ FEIA/341
Rev. No. 01

May'2025

DRAFT EIA REPORT FOR OBTAINING ENVIRONMENTAL CLEARANCE FOR

"PROPOSED EXPANSION OF KAWAI THERMAL POWER PLANT UNDER PHASE–II BY ADDING 3200 (4X800) MW ULTRA SUPER CRITICAL THERMAL POWER PLANT TO EXISTING 1320 (2X660) MW AT VILLAGE KAWAI, TEHSIL ATRU, DISTRICT BARAN, RAJASTHAN"

Category 'A' of item 1(d) - Thermal Power Plants (> 500 MW - coal based) of the Schedule in the Environment Impact Assessment (EIA) Notification, 2006 and its subsequent amendments

Location: Kawai, Tehsil Atru, District Baran, Rajasthan

Total Plant Area: 822.45 Ha

Report No.	:	**GESPL_658/ 2024-25/ Draft EIA/ 344; Rev. No. 01**	
Details of ToR	:	**TOR F no. J-13012/154/2008-IA.II (T) dated 29.07.2024**	
Baseline monitoring details	:	**Name of laboratory engaged: Newcon Consultancy & Laboratories, Ghaziabad, Uttar Pradesh**	
		Baseline study period:	**(October 2024 to December 2024) Post Monsoon Season**
		NABL Certificate Number & Validity	**TC-12621; valid till 16.11.2025**
		CPCB	**Letter no F. No LB/99/7/2021-INST LAB-HO-CPCB-HO/Pvt./2849 dated 09.07.2024; valid till 16.11.2025**
Project cost	:	**Rs. 36,600 Crores.**	

PROJECT PROPONENT

Adani Power Limited

Adani Corporate House, Shantigram,
S.G Highway, Near Vaishnodevi Circle,
Ahmedabad – 382421, Gujarat.

ENVIRONMENTAL CONSULTANT

Gaurang Environmental Solutions Pvt. Ltd.

#102, SNG, Shree Ratna Apartment,
Peetal Factory, Jhotwara Road, Bani Park, Jaipur-302016
E-mail: info@gauranggroup.com
NABET Accreditation: NABET/EIA/23-26/RA 0338
Validity 07.12.2026

May'2025

INDEMNIFICATION

Utmost care has been taken in preparation of this Draft EIA Report vis a vis Proposed Expansion of Kawai Thermal Power Plant under Phase–II by adding 3200 (4x800) MW Ultra Super Critical Thermal Power Plant to Existing 1320 (2x660) MW at Village Kawai, Tehsil Atru, District Baran, Rajasthan by **Adani Power Limited.** The data incorporated in the report is generated through information received from project proponent in form of the details received through e-mails, telephonic discussions, meetings (in person/virtual mode) primary data collection and information derived from secondary sources. Due care has been taken to represent facts and figures and sources acknowledged. The purpose of this document is to facilitate environmental appraisal of the proposal and as such the exercise has been scientifically carried out. The quality assurance for the data received from the laboratory as well as from the experts/ data obtained from outsourcing has been done and then incorporated in this report. The Consultant stands indemnified against any consequences arising out of any inadvertent omissions.

REVISION HISTORY

Report No.	**GESPL_658/ 2024-25/ Draft EIA/ 344**		
Type of Report	Draft EIA Report		
Revision details	**Report ToR/ Draft EIA/ Final EIA**	**Rev. No.**	**Revision Date**
	Draft EIA	00	25.02.2025
		01	08.05.2025
Issue to	**Adani Power Limited**		
Issue Date	09.05.2025		

****

DISCLOSURE OF CONSULTANTS ENGAGED

Part A: Declaration by ACO and Experts contributing to the EIA Report for the Proposed Expansion of Kawai Thermal Power Plant under Phase–II by adding 3200 (4x800) MW Ultra Super Critical Thermal Power Plant to Existing 1320 (2x660) MW at Village Kawai, Tehsil Atru, District Baran, Rajasthan by Adani Power Limited (APL).

I, hereby, certify that I was a part of the EIA team in the following capacity that developed the above EIA.

EIA coordinator (EC)	
Sector & Category	Thermal Power Plant 1(d) Cat. A
Name	Dr. Ratnakumar Mudliar
Signature	Rel 09/05/25
Period of involvement	April - 2024 till date
Contact information	Gaurang Environmental Solutions Pvt. Ltd. #102, SNG Shri Ratna Apartment, Near Tambi Petrol Pump, Peetal factory, Jhotwara road, Jaipur-302016 e-mail: info@gauranggroup.com
Team Member	Mallikarjuna M Guttula
Signature	Mallika 9/5/25

Functional area experts:

S. No.	Functional areas	Name of the expert/s	Involvement (period and task**)	Signature and date	TM/ FAA/FAE
1	AP	Pooja Yadav	**Period:** April- 2024 till date **Task handled:** • Selection of monitoring locations • Review of baseline data • Identify the significant sources of Air emissions. • Identification of probable impacts of the different air emissions from the project Identification of suitable pollution Control device	Poojayadav 09/05/2025	Nidhi. 9/5/25 Nidhi Bhardwaj- (FAE- B Category)
2	WP	1.Vipul Khandelwal 2.Pooja Yadav	**Period:** April - 2024 till date **Task handled:** • Selection of monitoring locations Review of baseline data • Designing of water balance and • Developing schemes for cascading use (recycle, reuse) of water. • Identification of probable impacts of Effluent/ waste water discharges in to the receiving environment/ water bodies, if any.	09/05/25 Poojayadav 09/05/2025	Agautam 09.05.25 Abhishek Gautam – (TM)
3	SHW	Pooja Yadav	**Period:** April - 2024 till date **Task handled:** Identification of type of waste generated & Suggesting Methodologies for segregation, Collection, Transportation, Treatment & Disposal of Waste as per various rules & guidelines.	Poojayadav 09/05/2025	Ginni Barotia 09/05/25 Ginni Barotia – (FAE- B Category)
4	SE	Gajendra Rathore	**Period:** April - 2024 till date **Task handled:** • Conducting baseline socio-economic surveys	9/5/2025	Puran Singh Gurjar – (TM) 9/5/25

			• Conducting social needs assessment studies • Preparing need-based CER plans and its effective implementation plan		
5	EB	Mr. Abhishek Gautam	**Period:** April - 2024 till date **Task handled:** • Surveying flora and fauna in the study area • Identifying ecologically important areas around the project location • Identifying threatened species in the project area • Assessing the impact of the proposed expansion on flora and fauna • Recommending mitigation measures and a greenbelt development plan • Preparing a wildlife conservation plan	Gautam 09.05.25	Mahendra 9-5-25 Dr. Mahendra Singh – (TM)
6	HG	Mukesh Suroliya	**Period:** April - 2024 till date **Task handled:** • Conducting field surveys to assess the regional and local geology of the area	9.5.25	Shivam Joshi-(FAA) शिवम जोशी 09/05/2025
7	GEO	Mukesh Suroliya	**Period:** April - 2024 till date **Task handled:** • Analyzing surface hydrological data • Computing groundwater recharge, flow rate, and direction • Calculating and suggesting locations for RWH tanks	9.5.25	Shivam Joshi-(FAA) शिवम जोशी 09/05/2025
8	SC	Dr. Ratnakumar Mudliar	**Period:** April - 2024 till date **Task handled:** • Assessing soil fertility/productivity & nutrient availability • Controlling soil degradation and promoting soil conservation	09/05/25	Pooja Yadav- (TM) Poojayadav 09/05/2025

			• Evaluating the effect of waste handling on soil		
9	AQ	Jayesh Makwana	**Period:** April - 2024 till date **Task handled:** • Analysing micro-meteorological data for use in air quality modelling • Collecting and using secondary meteorological data (e.g., cloud cover, inversion data, mixing heights) for air quality modelling • Applying relevant air quality models to predict pollutant dispersion • Plotting isopleths of GLCs representing incremental pollution levels on suitable maps showing both the sources of pollution and environmentally sensitive receptors	J. Ymakwana 9/5/25	Malika Mallikarjuna M Guttula (FAE-B Category)
10	Noise & Vibration	S. Chandrasekhar Babu	**Period:** April - 2024 till date **Task handled:** • Identifying probable noise impacts • Assessing the impact of noise from project activities on fauna in ecologically sensitive areas • Suggesting control measures for noise from project activities	9/5/25	Malika Mallikarjuna M Guttula (TM)
11	LU	Dr. Mamta Pandey	**Period:** April - 2024 till date **Task handled:** • Studying changes in LULC and the extent of impact • Interpreting and preparing LULC maps	Mamta Pandey 9/5/25	Vinod Verma (FAE – B Category) Vinod Verma 9/5/25
12	RH	Dr. Sanjay Palnitkar	• Enumerating and selecting incidents for hazard identification, primarily focusing on Loss of Containment (LOC) of materials	9-5-25	Ginni Barotia (FAE – B Category)

			• Identifying and characterizing failures within the operational framework • Recognizing isolatable sections to streamline risk management • Supporting the execution of consequence analysis • Assisting in identifying hazards related to flammable materials, including damage criteria and consequential effects • Compiling a list of consequences resulting from exposure to heat radiation • Providing details on explosion scenarios • Collaborating in conducting a comprehensive risk assessment		Ginni Bansal 07/05/25

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Part B: Declaration by Head of the ACO / authorized person

I, Vipul Khandelwal, hereby, confirm that the above-mentioned experts prepared the EIA report for the Proposed Expansion of Kawai Thermal Power Plant under Phase–II by adding 3200 (4x800) MW Ultra Super Critical Thermal Power Plant to Existing 1320 (2x660) MW at Village Kawai, Tehsil Atru, District Baran, Rajasthan and EIA Coordinator (EC) is fully aware of the content. The consultant organization shall be fully accountable for any mis-leading information. No unethical practices have been carried out and external data / text has not been used without proper acknowledgement, while preparing this EIA report.

Title of the EIA Report:	:	Proposed Expansion of Kawai Thermal Power Plant under Phase–II by adding 3200 (4x800) MW Ultra Super Critical Thermal Power Plant to Existing 1320 (2x660) MW at Village Kawai, Tehsil Atru, District Baran, Rajasthan.
Name of Accredited Organisation	:	Gaurang Environmental Solutions Pvt. Ltd.
Name of EIA Co-ordinator	:	Mr. Vipul Khandelwal

Date and Sign of EIA Co-ordinator:

Name:	Dr. Ratnakumar Mudliar
Signature with date:	09/05/25

Date and Sign of Head of ACO / authorised person:

Signature	09/05/2025
Name:	**Vipul Khandelwal**
Designation:	**Director**
Name of the EIA consultant organization	**Gaurang Environmental Solutions Pvt. Ltd.**

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भारतीय गुणवत्ता परिषद्
QUALITY COUNCIL OF INDIA
QCI
Creating an Ecosystem for Quality

NABET

National Accreditation Board for Education and Training

Certificate of Accreditation

Gaurang Environmental Solutions Pvt. Ltd., Jaipur

102, SNG Shree Ratna Apartment, Peetal Factory, Jhotwara Road, Bani Park, Jaipur - 302016

*The organization is accredited as **Category-A** under the QCI-NABET **Scheme for Accreditation of EIA Consultant Organization, Version 3**: for preparing EIA/EMP reports in the following Sectors*

S. No	Sector Description	Sector (as per)		Cat.
		NABET	MoEFCC	
1.	Mining of minerals including Opencast/ underground mining	1	1 (a)(i)	A
2.	Onshore and Offshore oil and gas exploration, development & productions	2	1 (b)	A
3.	Thermal power plants	4	1 (d)	A
4.	Mineral beneficiation	7	2 (b)	A
5.	Metallurgical industries	8	3 (a)	A
6.	Cement plants	9	3 (b)	A
7.	Asbestos milling and asbestos based products	12	4 (c)	A
8.	Leather/skin/hide processing industry	15	4 (f)	B
9.	Chemical Fertilizers	16	5 (a)	A
10.	Synthetic organic chemicals industry	21	5 (f)	A
11.	Distilleries	22	5 (g)	A
12.	Isolated storage & handling of hazardous chemicals	28	-	B
13.	Airports	29	7 (a)	A
14.	Industrial estates/ parks/ complexes/areas, export processing Zones (EPZs), Special Economic Zones (SEZs), Biotech Parks, Leather Complexes	31	7 (c)	A
15.	Common hazardous waste treatment, storage and disposal facilities	32	7 (d)	A
16.	Bio-medical waste treatment facilities	32A	7 (d a)	B
17.	Ports, harbours, break waters and dredging	33	7 (e)	A
18.	Common Effluent Treatment Plants (CETPs)	36	7 (h)	B
19.	Common municipal solid waste management facility (CMSWMF)	37	7 (i)	B
20.	Building and construction projects	38	8 (a)	B
21.	Townships and Area development projects	39	8 (b)	B

Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in RAAC minutes dated June 21, 2024 posted on QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in QCI-NABET's letter of accreditation bearing no QCI/NABET/ENV/ACO/24/3314 dated July 16, 2024. The accreditation needs to be renewed before the expiry date by Gaurang Environmental Solutions Pvt. Ltd. following due process of assessment.

Issue Date
July 16, 2024

Valid up to
December 07, 2026

Mr. Ajay Kumar Jha
Sr. Director, NABET

Certificate No.
NABET/EIA/23-26/RA 0338

Varinder Kanwar

Prof (Dr) Varinder S Kanwar
CEO-NABET

For the updated List of Accredited EIA Consultant Organizations with approved Sectors please refer to QCI-NABET website.

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LIST OF ANNEXURES

LIST OF ABBREVIATIONS

AAQ	:	Ambient Air Quality
AAQM	:	Ambient Air Quality Monitoring
AMSL	:	Above Mean Sea Level
APCD	:	Air Pollution Control Device
APL	:	Adani Power Limited
BIS	:	Bureau of Indian Standards
COD	:	Commercial Operations Date
CPCB	:	Central Pollution Control Board
CTO	:	Consent to Operate
DMP	:	Disaster Management Plan
DM water	:	Demineralized Water
EAC	:	Expert Appraisal Committee
EC	:	Environmental Clearance
E	:	East
EIA	:	Environmental Impact Assessment
EMC	:	Environment Management Cell
EMP	:	Environmental Management Plan
ESE	:	East of South East
ENE	:	East of North East
EPA	:	Environmental Protection Act
ERDAS	:	Earth Resources Data Analysis System
ESP	:	Electro Static Precipitator
FPS	:	Fine Particulate Sampler
FCC	:	False Color Composite
FGD	:	Flue Gas Desulfurizer
GESPL	:	Gaurang Environmental Solution Pvt. Ltd.
Govt.	:	Government
GLC	:	Ground Level Concentration
GOI	:	Government of India
GPS	:	Global Positioning System
GSDP	:	Gross State Domestic Product
Ha	:	Hectare
HAP	:	Hazardous Air Pollutants
HSD	:	High Speed Diesel
IMD	:	India Meteorological Department
IRO	:	Integrated Regional Office
IS	:	Indian Standards
ISO	:	International Organization of Standardization
IUCN	:	International Union for Conservation of Nature
KLD	:	Kilo Litre Per Day

LOI	:	Letter of Intent
LU/LC	:	Land Use / Land Cover
MCM	:	Million Cubic Meter
MEE	:	Multi Effect Evaporator
MSIHC	:	Manufacture, Storage and Import of Hazardous Chemical
MoEF&CC	:	Ministry of Environment, Forest & Climate Change
MSL	:	Mean Sea Level
MT	:	Metric Tonnes
MTPA	:	Metric Tonnes Per Annum
MW	:	Mega Watt
N	:	North
NAAQS	:	National Ambient Air Quality Standards
NABET	:	National Accreditation Board for Education & Training
NABL	:	National Accreditation Board for Testing and Calibration Laboratories
NCLT	:	National Company Law Tribunal
NDCT	:	Natural Draft Cooling Tower
NE	:	North East
NH	:	National Highway
NNE	:	North of North East
NGO	:	Non-Governmental Organization
NNW	:	North of North West
NRSA	:	National Remote Sensing Agency
NRSC	:	National Remote Sensing Centre
NW	:	North West
OHS	:	Occupational Health and Safety
OSHA	:	Occupational Safety and Health Administration
PCCF	:	Principal Chief Conservator of Forest
pH	:	Potential of Hydrogen
PHCS	:	Public Health Centers
PM	:	Particulate Matter
PNG	:	Piped Natural Gas
PPE	:	Personal Protective Equipment
QCI	:	Quality Council of India
RF	:	Reserve Forest
RO	:	Reverse Osmosis
RSPM	:	Respirable Suspended Particulate Matter
SC	:	Scheduled Caste
SE	:	South East
SEAC	:	State Level Expert Appraisal Committee
SEIAA	:	State Level Impact Assessment Authority
SHE	:	Safety, Health & Environment

SOC	:	Synthetic organic chemicals
SOI	:	Survey of India
SPA	:	Severally Polluted Area
SPCB	:	State Pollution Control Board
SPM	:	Suspended Particulate Matter
SSW	:	South of South West
ST	:	Scheduled Tribe
STP	:	Sewage Treatment Plant
SW	:	South West
TDS	:	Total Dissolved Solids
ToR	:	Terms of Reference
TPA	:	Tonnes Per Annum
TPD	:	Tonnes Per Day
TPP	:	Thermal Power Plant
UNFC	:	United Nations Framework Classification
USEPA	:	United States Environmental Protection Agency
VOC	:	Volatile Organic Carbon
WRD	:	Water Resources Department
W	:	West
WNW	:	West of North West
WSW	:	West of South West
ZLD	:	Zero Liquid Discharge
µg/m3	:	Micro gram per meter cube
µm	:	Micro Meter
cu. m	:	Cubic meter
dB	:	Decibel
gm/sec	:	Gram per second
gm/cc	:	Grams per cubic centimeter
hr/day	:	Hour per day
kg	:	Kilogram
Kg/hr	:	Kilogram per hour
Kg/ha	:	Kilogram per hectare
km	:	Kilometer
m	:	Meter
mg/l	:	Milligram per Liter
mm	:	Millimeter
Sq.km	:	Square Kilometer
t/hr	:	Tonnes per hour

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EXECUTIVE SUMMARY

1. INTRODUCTION

Adani Power Limited (APL), a part of the diversified Adani Group, is the largest private thermal power producer in India. Having thermal power plants generation capacity of 17,510 MW comprising coal based thermal power plants in Gujarat, Maharashtra, Karnataka, Tamil Nadu, Rajasthan, Chhattisgarh, Madhya Pradesh, Jharkhand states of India.

Adani Power Limited (APL), Kawai has proposed Expansion of Kawai Thermal Power Plant under Phase–II by adding 3200 (4x800) MW Ultra Super Critical Thermal Power Plant to Existing 1320 (2x660) MW at Village Kawai, Tehsil Atru, District Baran, Rajasthan.

The proposal for Terms of Reference (ToR) was considered & appraised in 9th meeting & 11th meeting of Expert Appraisal Committee (Thermal Power Projects), MoEF&CC held on 07.05.2024 & 27-28. 05. 2024. The project was granted with Terms of Reference (ToR) vide F no. J-13012/154/2008-IA.II (T) dated 29.07.2024 by the MoEF&CC, New Delhi. Copy of ToR Letter for proposed expansion project of APL is enclosed as **Annexure 1.**

2. DESCRIPTION OF THE PROJECT

The salient features of the project are given below: -

Table 1: Salient features of the project

S. No.	Particular		Details		
1.	Project sector & category	:	1(d), Thermal Power Plants & Category "A"		
			Existing	**Proposed**	Total
2.	Plant capacity	:	1320 MW (2 x 660) MW	**3200 MW (4 x 800) MW**	4520 MW (1320+3200) MW
3.	Land requirement (In Hectare)	:	350	**472.45** *(includes 1.758 Ha. Forest Area outside power plant premises for Coal Conveyor after Forest dept. inspection)*	822.45

4.	Greenbelt & Plantation (In Hectare)	:	120	**169.44**	289.44 Ha (35%)
5.	Technology	:	Super-critical	**Ultra Super-critical**	Super-Critical & Ultra Super-Critical
6.	Coal requirement in (Million MTPA)	:	5.50	**12.9**	18.4
7.	Source of fuel	:	Coal from Coal Mines of Jitpur, Rampia, Ujheni & e-auction for proposed project.		
8.	Coal transportation	:	Through Rail.		
9.	Ash Generation (Million MTPA)	:	5.16		
10.	Project Cost (Crores)	:	8264.59	**36,600**	44864.59
11.	Water requirement & Water allocation	:	34	**56**	90
			WRD permission for 34 MCM has already been obtained and the application for additional water allocation of 56 MCM has been submitted to WRD, Jaipur.		
12.	Water Source	:	From Parwan River/Dam through water pipeline		

Table 2: Details of Environmental Setting & Site Connectivity

S. No.	Particular	Particulars with Aerial distance & Direction
1.	Project Address	Village Kawai, Tehsil Atru, District Baran, Rajasthan
2.	Geographical Coordinates	(see coordinates table below)
3.	SOI Toposheet	G43W9, G43W10, G43W13 & G43W14

S.NO.	Latitude	Longitude
1	24°48'49.45"	76°43'52.90"
2	24°49'52.57"	76°43'13.78"
3	24°49'18.09"	76°43'9.64"
4	24°50'16.91"	76°42'16.70"
5	24°50'17.26"	76°41'49.49"
6	24°48'52.21"	76°42'36.87"
7	24°48'12.53"	76°43'23.90"
8	24°48'7.23"	76°43'44.16"
9	24°47'20.05"	76°43'34.43"
10	24°47'17.07"	76°43'58.42"
11	24°47'2.40"	76°44'42.01"
12	24°45'43.52"	76°44'29.90"

S. No.	Particular	Particulars with Aerial distance & Direction
4.	Site elevation	Average site elevation – 315 m AMSL
1.	Areas protected under international conventions, national or local legislation for their ecological, landscape, cultural or other related value.	There are no protected areas under international conventions in study area for their landscape & cultural value. There are 15 no. of PF & R.F. within 10 km of the project site.
2.	Areas which are important or sensitive for ecological reasons - Wetlands, watercourses or other water bodies, coastal zone, biospheres, mountains, forests.	(see table below)
3.	Areas used by protected, important or sensitive species of flora or fauna for breeding, nesting, foraging,	None in 10 km radius

Particulars	**Distance (In km)**	**Direction**
Reserve Forest (R.F), Protected Forest (P.F)		
Kheldi birdagaddiyan block forest	Adjoining	E
Kawai kalan block forest	Adjoining	SSE
Dara block forest	Adjoining	W
Bir daranimoda block (R.F.)	Adjoining	N
Kawai block forest	0.12	W
Bir sunda umriwala block (R.F.)	0.4	E
Baldevpura block	0.55	N
Chhatarpura block forest	0.85	WNW
Bir parlya block forest	3	WSW
Ratan block forest	3.1	NNW
Dilod block (P.F.)	3.2	N
Narsinghpura (P.F.)	3.2	ENE
Ugrapura (P.F.)	6.3	WSW
Bir govindpura block	7.8	NNW
Sigri block (P.F.)	7.9	N
Rivers, Nala, Water Bodies		
Particulars	**Distance (in km)**	**Direction**
Lhasi nadi	0.35	SSE
Andheri nadi	0.55	E
Rhupsi nala	5	WSW
Kukar talav	6.9	WSW
Ghoghra nala	7.5	W
Prabati canal	7.7	NNW

<table>
<tr><th>S. No.</th><th>Particular</th><th>Particulars with Aerial distance & Direction</th></tr>
<tr><td></td><td>resting, over wintering, migration.</td><td></td></tr>
<tr><td>4.</td><td>Inland, coastal, marine or underground waters.</td><td>List of water bodies within the 10 km radius is given above.</td></tr>
<tr><td>5.</td><td>State, National boundaries</td><td>Rajasthan-Madhya Pradesh inter-state boundary at a distance of about 7.5 km in East direction.</td></tr>
<tr><td>6.</td><td>Nearest highway/major road/routes or facilities used by the public for access to recreation or other tourist, pilgrim areas</td><td>
<table>
<tr><th>Particulars</th><th>Distance (in km)</th><th>Direction</th></tr>
<tr><td>SH 37A</td><td>0.2</td><td>West</td></tr>
<tr><td>SH51</td><td>1.0</td><td>SW</td></tr>
<tr><td>MDR 4</td><td>4.9</td><td>NW</td></tr>
</table>
*Source: Distance taken from Google earth imagery.</td></tr>
<tr><td>7.</td><td>Défense installations</td><td>None in 10 km radius</td></tr>
<tr><td>8.</td><td>Densely populated or built-up area / Major Town</td><td>There is no densely populated habitation that exists near the proposed site. Atru town is located about 4.10 km in the NNW direction.</td></tr>
<tr><td>9.</td><td>Nearest habitation</td><td>
<table>
<tr><th>Habitation /Village</th><th>Distance (Km)</th><th>Direction</th></tr>
<tr><td>Kawai</td><td>1.0</td><td>SW</td></tr>
<tr><td>Phulbaroda</td><td>1.4</td><td>ESE</td></tr>
<tr><td>Bilkhera</td><td>2.0</td><td>E</td></tr>
<tr><td>Barlan</td><td>2.0</td><td>WSW</td></tr>
</table>
*Source: - Distance taken from Google earth imagery.</td></tr>
<tr><td>10.</td><td>Major industries / manufacturing units</td><td>None in 10 km radius</td></tr>
<tr><td>10.</td><td>Areas occupied by sensitive man-made land uses (hospitals, schools, places of worship, community facilities)</td><td>
<table>
<tr><th>Particulars</th><th>Distance (in km)</th><th>Direction</th></tr>
<tr><td colspan="3">Education Facilities</td></tr>
<tr><td>Government primary school Atru,</td><td>4.0</td><td>NW</td></tr>
<tr><td>Govt. Sr. Sec. School, Atru</td><td>5.6</td><td>NW</td></tr>
<tr><td>Govt. upper primary school Barawda</td><td>8.2</td><td>WSW</td></tr>
<tr><td>Govt. School Nayagav</td><td>2.8</td><td>E</td></tr>
<tr><td colspan="3">Worship Places</td></tr>
<tr><td>Hindu temple, Kawai</td><td>1.1</td><td>SW</td></tr>
<tr><td>Radhe krishna mandir, Kawai</td><td>0.9</td><td>WSW</td></tr>
<tr><td>Narbadeshvar mahadev, Kawai</td><td>0.3</td><td>W</td></tr>
<tr><td>Hanuman mandir, Dilod</td><td>4.6</td><td>ENE</td></tr>
<tr><td colspan="3">Health Facilities</td></tr>
<tr><td>Govt. Hospital Atru</td><td>5.4</td><td>NW</td></tr>
<tr><td>Govt. Hospital, Kolukhera</td><td>1.8</td><td>ENE</td></tr>
<tr><td>Govt. Hospital Kawai</td><td>0.9</td><td>WSW</td></tr>
</table></td></tr>
</table>

S. No.	Particular	Particulars with Aerial distance & Direction
		**Source: - Distance taken from Google earth imagery*
16.	Areas already subjected to pollution or environmental damage.	The project area of APL does not comes under any CPCB declared Critically or Severely Polluted Areas.
17.	Areas susceptible to natural hazard which could cause the project to present environmental problems.	The project falls in Baran district of Rajasthan. The entire Baran District of Rajasthan falls under Seismic Zone II, low damage risk zone as per BMTPC, Vulnerability atlas Seismic Zone of India IS: 1893-2002.

Site Connectivity ***(aerial distance as per google earth imagery from project boundary and direction from centre of project)***

S. No.	Description	Details		
1.	Nearest Highway / Major Road	**Particulars**	**Distance (in km)**	**Direction**
		SH 37A	0.2	West
		SH51	1.0	SW
		MDR 4	4.9	NW
		**Source:-All distances are taken with respect to S.O.I. Toposheet*		
2.	Nearest Railway Station	**Particulars**	**Distance (in km)**	**Direction**
		Salpura Railway Station on Katni-Bina line	Adjacent to the plant boundary	SW
3.	Nearest Airport	**Particulars**	**Distance (in km)**	**Direction**
		Jaipur International Airport	238	NNE

2.1 Process & Methodology

The proposed expansion project of 4x800 MW capacity power plant is mooted to deploy the state-of-art technology and accordingly four units of 800 MW are being considered with ultra-supercritical steam parameters to attain high cycle efficiency.

MAIN TECHNICAL FEATURES OF THE PROPOSAL

Power Generating Unit	:	Four units of 800 MW turbine generator sets fed by steam from coal fired P.F. boiler operating at Ultra Super-Critical range.
Cooling System	:	Closed recirculating condenser cooling system with induced draft cooling tower.
Coal Handling System	:	Coal handling facility, which comprises receipt of coal through Indian Railway, with in-plant coal handling system and finally feeding the bunker level conveyors.

Ash Disposal System	:	The Fly Ash will be collected in dry form in silos for all efforts will be made for 100% utilization of ash. Ash will be used for Cement manufacturing industries, abandoned mine, filling of low-lying area, manufacturing bricks, road construction, aggregate placement in concrete, etc. in compliance of Fly Ash Notification, 31.12.2021 and amendments. Provision will be made for disposal of un-utilized ash in high concentration slurry form to ash dyke.
Power Evacuation	:	At 400 kV level to State Transmission Utility (STU) or Central Transmission Utility (CTU)
Environmental Aspects	:	Elaborate arrangements for adequately designed electrostatic precipitator with more than 99.99% efficiency and Selective Catalytic Reduction (SCR)/SOFA systems complying with emission norms as per latest MoEF&CC are envisaged. Wastewater quality to be maintained as per MoEF&CC notification. Zero Plant Discharge facility shall be present since the cooling water, blow down water, wastewater and ash water would be recycled back to the system for Ash Handling after suitable treatment for reuse.

2.2 Ash Handling System

For each unit, Bottom ash will be collected in wet form; while fly ash will be collected in dry form to facilitate utilization. Fly ash and bottom ash shall be disposed via lean slurry /High Concentration Slurry disposal (HCSD/MCSD) system to Ash dyke in case of exigencies; Ash extraction system is unitized basis and ash disposal systems will be common for 4x800MW. Provision for truck disposal of both bottom and fly ash is provided.

For the design of the Ash Handling System, the following data has been considered for each Unit. Necessary design margin shall be considered while selecting the equipment capacity.

Table 3: Quantum of Ash Generation

Parameter	4x800MW
Hourly coal (3,200-4300 kCal/kg GCV) firing rate at TMCR condition based on 85% PLF, per Unit (Approx.)	368.15 TPH
Total ash content	40%
Bottom ash (BA + Eco. Ash) generation @ 20% (T/day)	2,828
Fly ash (ESP + APH Ash) generation @ 80% (T/day)	11,308
Total Ash generation (T/day)	14,136
Annual ash generation @ 85% PLF (MMTPA)	5.16

An MoU has been signed between APL and Ashtech (India) Private Limited, Mumbai, India for utilization of Fly ash for the proposed project.

2.3 DESCRIPTION OF THE ENVIRONMENT

The baseline environmental quality of air, water, soil, noise, socio-economic status, and ecology has been assessed during the period of October to December 2024 in the study area of project site.

2.3.1 Baseline data

Ambient air quality:

Eleven ambient air quality monitoring stations were selected in and around the project site. The results of the monitored data indicate that the ambient air quality were well within the prescribed limits by CPCB.

- PM10: The maximum value for PM10 was 69.5 µg/m3 and minimum value for PM10 was 42.5 µg/m3.
- PM2.5: The maximum value for PM2.5 was 48.3 µg/m3 and minimum value for PM2.5 was 24.2 µg/m3.
- SO2: The maximum value for SO2 was 10.9 µg/m3 and minimum value for SO2 was 2.1 µg/m3.
- NOx: The maximum value for NOx was 23.8 µg/m3 and minimum value for was 5.9 µg/m3.
- CO: The maximum value for CO was 0.9 mg/m3 and minimum value for CO was 0.3 mg/m3.
- Hg: Mercury levels were below detection limit at all the locations.

Water quality:

The baseline water quality status in the region is established by analyzing samples at nineteen locations consisting of eight ground water samples and seven surface water samples. It was found that both ground water and surface water quality is well within prescribed limits.

Results

Ground Water

Parameters	:	Results
PH	:	7.65 to 7.76
TDS	:	1038 mg/l – 1214 mg/l
Total Hardness	:	408 mg/l –477 mg/l
Total Alkalinity	:	160 mg/l –176 mg/ l

Surface Water

Parameters	:	Results
PH	:	6.78 to 7.11
DO	:	5.2 mg/l – 6 mg/l
BOD	:	2 mg/l -4 mg/l
COD	:	6 mg/l – 12 mg/l

Noise levels:

The observed noise levels adhere to CPCB standards, indicating acceptable noise pollution levels in the monitored locations.

Daytime Noise Level Leq(day)

Day time (Leqday) noise level is observed within the prescribed limit and standards.

Night time noise level Leq(night)

Night time (Leq night) noise level is observed within the prescribed limit and standards.

Soil Quality:

Samples collected from identified locations indicate that the soil is slightly alkaline with pH ranging from 7.41 to 7.65. The organic matter in the soil ranged from 0.73 % to 0.94%. The texture of soil observed in the study area is mostly sand.

Parameters	:	Results
PH	:	7.41 to 7.65 (Slightly alkaline)
Organic Carbon	:	0.73 % to 0.94%
NPK	:	10.4 to 12.6 mg/kg 10.8 to 14.8 mg/kg 160 to 210 mg/kg

Biological environment:

Core Zone: Flora:

Flora:

Core zone has been reported 22 trees, 9 shrubs, 14 Common Herb, Grasses and Climbers' species were found in core zone during field survey.

Fauna:

2 Mammalian species, 19 avifaunal, 2 herpetofauna, 3 butterflies, were observed.

Buffer zone:

Flora:

Buffer zone of the project area has been reported 110 trees, 42 shrubs & herbs, 13 Grasses, 12 climbers & 24 medicinal species.

11 agricultural species, 9 vegetable species & 10 fruits species were found in buffer zone during field survey.

About 13 aquatic flora, 13 phytoplankton species were reported.

Fauna:

17 Mammalian species, 141 Birds, 14 Herpetofauna, 18 butterflies', 15 moths and 09 aquatic species were observed in the 10 km buffer study area of the project.

Socio-Economic Environment:

Total population

In the study area, there are 20,014 households. The total population falling in the project area is 1,01,964 in 10 km radius. The total male population consists of 51.89% and female population accounts to be 48.11% of the total population. The sex ratio of the 10.0 km study area is 927 females over thousand males. There are approx 4 to 5 members in a family. The 0-6 population comprises of 14.82% of the total population of the study area. The sex ratio of 0-6 population is 898 females over thousand males. Figure shows the sex ratio of total population.

Literacy

Persons aged seven years and above, who can both read and write with understanding in any language, are considered literate. In the study area, the literate people are 1,03,634 which is 57.80% of the total population. The male literates are 69.49% of the total male population, and female literates are 45.18 % of the total female population.

In the study area, the illiterate people are 75,670 which is 42.20 % of the total population. The male illiterates are 30.50% of the total male population, and female literates are 54.81% of the total female population. Figure literates & illiterates within 10.0 km of the study area.

Working population

The work participation in the study area is 84,002 which accounts to be 46.85 % of the total population. The male work participation is 52.17 % with respect to male population and female work participation accounts to be 41.11 % with respect to female population in the study area. Figure shows the Total work participation population over the total population.

4. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

During Construction Phase:

No significant impact is envisaged on the soil quality of the project area. Construction activities would be confined to the plant boundary. Therefore, no impact on the soil quality of the study area located beyond the plant boundary has been envisaged.

During Operational Phase:

4.1 Air Environment

PM from boilers will be controlled by the installation of ESP Dust suppression and bag filters for the coal handling systems will control PM emissions. De-NOx systems shall be provided to effectively control emission levels. Ash silos will be provided for collection of fly ash in dry form for further transportation to utilities.

Mitigation measures

APL, Kawai will comply as per the norms of MoEFCC, CPCB/SPCB standards for SO2, Nox & PM. Electrostatic Precipitator (ESP), De NOx system of SCR/ SOFA with low NOx burner, adequate Stack height is proposed with these controls, Hg emission is expected to be brought below the emission limits as measured in various other TPPs in India.

Necessary dust suppression arrangement and bag filters will be used in railway siding and coal handling plant. The top surface of coal wagons will be adequately sprinkled to reduce fugitive emissions during transportation. Belt conveyors will be covered to minimize the fugitive dust emissions. Auxiliary fuel transportation will be occasional; hence its impact will be for a limited time period. The fly ash silos will be provided with bag filters to control emission. Regular housekeeping will be done at plant roads, platforms, and storage area.

4.2 Water Environment

Total wastewater from the project will be recycled, focusing on effluents from CW blowdown, WT plant, coal pile area runoff, and plant drains. Domestic sewage will be treated in the STP will be utilized in greenbelt/ plantation. Total Annual Recharge to Ground Water Regime of the area through rainwater harvesting structure would be **1,349,537.04 m^3/ annum**. No groundwater extraction, ensuring minimal impact on water resources.

The water requirement of 56 MCM/Year for makeup to the closed cycle re-circulation system of condenser cooling will be drawn from Parwan River/ Dam to plant site through existing water pipeline of about 18.4 km in length. The water drawl permission from WRD Jaipur, Rajasthan for 34 MCM/Year vide letter no. CEWR/TA (W)/1482 dated 11.08.2009 has already been obtained for 2x660 MW TPP. The application for additional water allocation of 56 MCM /annum has been submitted on 03.06.2024 to WRD, Jaipur (R.J) and will be obtained. It is proposed to utilise the power plant wastewater for plant reuse to achieve the Zero Liquid Discharge (ZLD) concept. It is envisaged to utilize cooling water blow down for ash handling purposes and treated wastewater will be used for plantation and gardening activities.

4.3 Noise Environment

- Noise reduction measures include insulation, damping pads, and acoustic enclosures.
- Regular equipment maintenance and safety gear for workers will be provided.
- Noise levels will comply with regulations, not exceeding 75 dB (A) at 1 m distance.
- Extensive oiling, lubrication, and preventive maintenance will minimize noise generation.
- Earplugs will be provided in areas where noise levels may exceed permissible limits.
- Supervisors will ensure machinery conditions and silencers are maintained.
- Adequate greenbelt will be developed within the project premises and around the plant boundary.

4.4 Socio-Economic Environment

The company will take various steps for social & environmental development for the villagers in more then one ways. The details of the various activities undertakto be taken by the company's CSR activities are described in detail in Chapter 8 of "Project Benefits" of the report. The company will continue to work for development of the society in future also. The additional economic opportunities for local population will create a long term positive impact in the society. Project also does not involve discharge of any pollutant and follows zero discharge, thus the environment will not be negatively impacted. All due care will also be taken to manage the odour as per present practices and the same will be improved to match the best industry practices.

4.4.1 Solid & Hazardous Waste

- Fly ash and bottom ash will be main solid waste to be generated from the plant. The details of the ash generated from the proposed power plant are given in Table 4.16. 100% utilization of fly ash as per MoEF&CC guidelines is proposed.
- The bottom ash will be collected in wet form and fly ash in dry form. Fly ash will be collected in dry form to facilitate utilization.

- Ash Dyke is proposed in 57.06 Ha, which is less than **0.1 Ha./MW** (i.e 320 Ha. for 3200 MW) allowed as per Fly Ash Notification dated 31.12.2021.
- Unutilized Fly ash and bottom ash shall be disposed via High Concentration Slurry disposal (HCSD/MCSD) system to Ash dyke in case of exigencies.
- Bottom ash generated shall be supplied to the Road Mix Concrete (RMC) / brick producers / filling of low lying area / filling of mine voids as per the statutory guidelines thereby eliminating the need for separate area shall be explored.

Table 4: Ash generation from the Proposed Plant

S. No.	Description	Ash quantity in Million TPA	Management & disposal
1.	Fly ash	4.12	Collection in dry form, pneumatic transfer to closed silos & sent to cement manufacturing, Construction work (RMC plant, Roads, Highways), Brick Manufacturing, etc.
2.	Bottom ash	1.04	Collection in wet form & Road Mix Concrete (RMC) / brick producers / filling of low lying area / filling of mine voids
Unutilized Fly ash and bottom ash shall be disposed via High Concentration Slurry disposal (HCSD/MCSD) system to Ash dyke in case of exigencies.			

IMPACT

- Improper storage, handling and disposal of solid & hazardous waste leads to contamination of soil, ground water and surface water.
- Contamination may also be caused by spillage of hazardous waste, run-off from hazardous waste storage area etc.
- Plants may take up contaminants from soil and accumulate toxic substances ultimately adversely affecting human / animal health due to ingestion.

Hazardous Waste

- Hazardous waste will be handled, stored & disposed off in line with Hazardous & Other waster (management & transboundary movement) Rules 2016, amended till date.
- Separate covered storage area with impervious flooring and catch drains connecting to WTP will be provided with Hazardous waste storage area.

- E-Waste (~2.0 TPA), Battery waste (~3 TPA), Bio-medical waste (0.02 TPA) will be handled, stored & disposed of as per applicable rules & guidelines.
- Used batteries will be will be given back to the supplier under buy back agreement with supplier.
- Bio-medical waste generated from medical unit will be handed over to nearest CBWTF &/or hospital having BMW disposal agreement with CBWTF.

Municipal Solid waste generation & management

Improper disposal of MSW may cause contamination of soil, ground water and surface water over time. It may lead to odour nuisance as well as increased disease vectors in the area.

Table 5: Municipal Solid waste generation & disposal

Particulars	Population	Basis	Quantity of waste generated (in kg/day)
Workers	2700	@0.3 kg/day	810.0
Landscaping	714.91 acre	@0.2kg/acre/day	143.0
STP sludge (dry)	--	--	50
Total			**1003**

MSW generated to the tune of ~1.0 TPD will be collected, segregated at source itself using color coded bin collection system placed strategically in the plant premises.

The organic component of MSW will be segregated and composted in Organic waste converters proposed at site. The remaining waste will be handed over to contractor for final disposal to municipal waste dump site.

5. ANALYSIS OF ALTERNATE SITE & TECHNOLOGY

The proposed expansion is proposed in an area of 470.70 Ha adjacent to the existing Thermal Power Plant with area admeasuring 350 Ha. The total area of Thermal Power plant after expansion will be 820.70 Ha. The Forest Area outside plant boundary (1.758 Ha.) is involved in the Coal Convey System for Proposed Project. Since the expansion is proposed of the already operational Kawai Thermal Power Plant in Village Kawai, Tehsil Atru, District Baran, Rajasthan, no alternative sites have been examined for the Thermal

Power Plant. However, alternative route analysis has been carried out for proposed Coal Conveyor Belt route to transfer coal from coal handling plant to BTG area.

Ultra Super Critical thermal power plants combine high efficiency, reduced emissions, and operational flexibility, making them a compelling choice for large-scale power generation projects aiming for both economic and environmental sustainability.

6. ENVIRONMENTAL MONITORING PROGRAMME

Environmental Management Division

Monitoring is as important as that of control of pollution since the efficiency of control measures can only be determined by monitoring. The following routine monitoring program will be implemented under the post-project monitoring as per CECB/CPCB guidelines. The major environmental considerations involved in the construction and operation of the thermal power station will be taken up by a full-fledged multi-disciplinary Environmental Management Division (EMD) with key functions of environmental, safety and occupational health for management of the entire plant and surrounding environment. It is predicted that socio-economic impact due to the proposed expansion project will positively increase the employment opportunities for local inhabitants. The project infrastructure will be of use to the people of the area. The contribution to the revenue of the State Govt. will be put in public welfare and augmented growth. The entire project area is devoid of any endangered flora and fauna. Thus, the proposed project is not likely to affect the environment or adjacent staff etc. This EMD will take up additional responsibility of environmental functions related to proposed mega power plant.

Operation Head would represent the Company's interest in the operation & maintenance of the power station and would oversee the functioning of O&M Cell.

Green Belt:-

The greenbelt development will be as per the CPCB guidelines with re-densification of existing greenbelt.

EMP costing

The heads for EMP are: Electrostatic Precipitator, Chimney/Stack, Cooling Tower including civil works, Ash Handling including ash water recirculation, Ash disposal civil work, Dust extraction & suppression system, DM Plant Waste Treatment System, Sewerage collection, treatment & disposal, Green Belt & landscaping, SCR/SOFA, Rainwater harvesting, Solar power harnessing, Enhancing Environmental Laboratory & Environmental Monitoring, CEMS, CAAQMS, EQMS monitoring system & Main gate display board and Wind Breaking Wall, Dry Fog System & RCC Flooring in Coal Storage Area.

A cost provision of Rs. 5,992.94 Cr. has been earmarked towards environmental measures.

7. ADDITIONAL STUDIES

Risk Assessment, Hazard Analysis: Risk associated with process and raw materials (LDO/HSD) was anticipated and proper mitigation measures provided.

Hazard due to toxic release of Chlorine and Aqueous Ammonia has been assessed with the help of ALOHA software and the threat zone marked on google earth.

Within the plant: Personnel working in the plant during the operational phase.

Outside the plant: There are no major habitation within 1.0 km of project site.

However, by implementing all the possible risk mitigation measures the same could be minimized

Disaster Management Plan: On Site & Offsite Emergency Plan with level I, II and III emergency has been prepared and detailed in chapter 7 of this EIA/ EMP report.

8. PROJECT BENEFITS

Adani Foundation is the CSR arm of Adani Group of companies implementing CSR projects and activities at different locations in India. A separate budget Rs. 66.00 crore towards CER activities (as per Ministry’s OM dated 01.05.2018) is allocated for CER activities, and efforts will be made to address concerns raised after the public consultation during the final EIA ensuring responsible corporate practices.

9. CONCLUSIONS

It is predicted that socio-economic impact due to the proposed expansion project will positively increase the employment opportunities for local inhabitants. The proposed expansion project will be within the existing plant premises. The project infrastructure will be of use to the people of the area. The contribution to the revenue of the State Govt. will be put in public welfare and augmented growth. The entire project area is devoid of any endangered flora and fauna. Thus, the proposed expansion project is not likely to affect the environment or adjacent ecosystem adversely.

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CHAPTER - I
INTRODUCTION

1.1 PURPOSE OF THE REPORT

Gaurang Environmental Solutions Pvt. Ltd. has been assigned the job to carry out Environmental Impact Assessment (EIA) studies and preparation of EIA report with suitable Environment Management Plan (EMP) for Proposed Expansion of Kawai Thermal Power Plant under Phase–II by adding 3200 (4x800) MW Ultra Super Critical Thermal Power Plant to Existing 1320 (2x660) MW at Village Kawai, Tehsil Atru, District Baran, Rajasthan by Adani Power Limited (APL).

The proposed expansion project falls under Category 'A' of item 1(d) - Thermal Power Plants (> 500 MW - coal based) of the Schedule in the Environment Impact Assessment (EIA) Notification, 2006 and its subsequent amendments & therefore requires prior environmental clearance from MoEF&CC, New Delhi.

The proposal for Terms of Reference (ToR) was considered & appraised in 9th meeting & 11th meeting of Expert Appraisal Committee (Thermal Power Projects), MoEF&CC held on 07.05.2024 & 27-28. 05. 2024. The project was granted with Terms of Reference (ToR) vide F no. J-13012/154/2008-IA.II (T) dated 29.07.2024 by the MoEF&CC, New Delhi. Copy of ToR Letter for proposed expansion project of APL is enclosed as **Annexure 1.**

The objective of this Environment Impact Assessment (EIA) report is:

- To comply with Terms of Reference (ToR) prescribed by the MoEF&CC, New Delhi**.**
- To identify, predict and evaluate the environmental, economical & social impact due to the proposed project activities.
- To provide information on the environmental consequences for decision making and;
- To promote environmentally sound and sustainable development through the identification of appropriate alternatives and mitigation measures.

Baseline data generation for one season (Post-Monsoon Season) was carried out during October to December 2024 by Newcon Consultancy & Laboratories, Ghaziabad, Uttar Pradesh {NABL certified vide No.: TC-12621; valid till 16.11.2025 and CPCB recognized vide letter no F.No LB/99/7/2021-INST LAB-HO-CPCB-HO/Pvt./2849 dated 09.07.2024; valid till 16.11.2025}. Field surveys were conducted during study period and potential environmental impacts of the proposed expansion project activities were identified, assessed and their mitigation measures are documented in this EIA/EMP report.

1.2 IDENTIFICATION OF PROJECT & PROJECT PROPONENT

1.2.1 IDENTIFICATION OF THE PROJECT

The present proposal is for the installation of 4x800 MW (3200 MW) superior thermal efficiency Power Plant with Ultra Supercritical steam parameters at Village Kawai, Tehsil Atru, District Baran, Rajasthan by Adani Power Limited (APL).

The total land required for proposed expansion project is 472.45 Ha. The estimated capital cost for the proposed expansion project is Rs. 36,600 Crore.

Environmental Clearance (EC) was granted by MoEFCC, New Delhi vide File no. J-13012/154/2008-IA.II(T) dated 04.05.2011 in the name of M/s Adani Power Rajasthan Ltd. Subsequently, EC amendment was granted on 13.03.2014 for change of source of coal and later EC was transferred to Adani Power Limited (APL, Kawai) from M/s Adani Power Rajasthan Ltd on 24.04.2023.

Consent to Operate (CTO) for operation 1320 (2x660) MW renewed with validity up to 28.02.2029 from RSPCB, Jaipur, Rajasthan. Both the units are operational since 2013.

Chronology of the earlier environmental clearance for the existing capacity is given in

Table **1.*1*** of this Chapter.

1.2.2 IDENTIFICATION OF THE PROJECT PROPONENT

Adani Group is a diversified organization in India comprising 10 publicly traded companies with market cap of over $150.66 billion. It has created a world class transport and utility infrastructure portfolio that has a Pan-India presence. Adani Group is headquartered in Ahmedabad, in the state of Gujarat, India. Over the years, Adani Group has positioned itself to be the market leader in its transport logistics and energy utility portfolio businesses focusing on large scale infrastructure development in India with O&M practices benchmarked to global standards. With four IG rated businesses, it is the only Infrastructure Investment Grade issuer in India.

Adani Power Limited (APL), a part of the diversified Adani Group, is the largest private thermal power producer in India. Having thermal power plants generation capacity of 17,510 MW comprising coal based thermal power plants in Gujarat, Maharashtra, Karnataka, Tamil Nadu, Rajasthan, Chhattisgarh, Madhya Pradesh, Jharkhand states of India.

The Vision document specifying the prospective long-term plan is enclosed as **Annexure 3.**

The Adani Group is one of India's leading business conglomerates with combined revenues of USD 15 Billion and with business interests spanning across Power Generation (Thermal and Renewable), Power Transmission and Distribution, Port Development & Operations, Development of Industrial Clusters & Special Economic Zones, Shipping & Logistics, City Gas Distribution, Solar Manufacturing, Real Estate, Coal Trading & Mining, Roads, Power Trading and Edible Oil Refining & Agro based infrastructure development, Defence, Aerospace & Airports. The group has demonstrated capabilities in conceptualization and implementation of large projects and excellent records of establishing benchmarks in the industry. The group has a rich and extensive experience of working with government agencies and development of large infrastructure projects.

Mr. R N Shukla, Head Environment & Forest, has been assigned as the Authorized Signatory for the project appraisal.

1.3 BRIEF DESCRIPTION OF NATURE, SIZE, LOCATION OF THE PROJECT AND ITS IMPORTANCE TO THE COUNTRY, REGION

1.3.1 NATURE OF THE PROJECT

The project is an expansion of the existing 1320 (2x660) MW Thermal Power Plant in Kawai by installation of 3200 (4x800) MW superior thermal efficiency Power Plant with Ultra Supercritical steam parameters in an area of 822.458 Ha [Existing-350 Ha+ Proposed-472.45 Ha extending between 24°45'43.52"N to 24°50'16.91"N latitude / 76°41'49.49"E to 76°44'42.01"E longitude. The proposed expansion is in villages Village Kawai, Tehsil Atru, District Baran, Rajasthan.

1.3.1.1 Screening Category

As per the EIA notification of 2006 and its subsequent amendments, the Government of India directed that on or from the dates of its publication, the required construction of new projects or activities or the expansion or modernization of existing projects or activities listed in the Schedule to the said notification entailing the capacity addition with change in process and or technology shall be undertaken in any part of India only after prior environmental clearance from the Central Government, duly constituted by the Central Government under sub-section (3) of section 3 of the said Act in accordance with the procedure specified therein. Thermal power plant projects are divided into two categories as mentioned in **Table 1.1: Screening of Category 1(d) Projects**.

Table 1.1: Screening of Category 1(d) Projects

Project or Activity		Category with threshold limit		Conditions if any
		A	B	
1 (d)	Thermal Power Plants	**≥ 500 MW (coal/ lignite/ naphtha & gas based);** ≥ 50 MW (all other fuels except biomass); ≥ 20 MW (using municipal solid non-hazardous waste, as fuel)	≥ 50 MW to < 500 MW (coal/ lignite/ naphtha & gas based); < 50 MW and ≥ 5 MW (all other fuels except biomass and municipal solid non-hazardous waste); < 20 MW > 15MW (using municipal solid non-hazardous waste, as fuel); ≥ 15 MW plants based on biomass fuel.	General Condition shall apply **Note:** Thermal Power plants up to 15 MW based on biomass or non-hazardous municipal solid waste using auxiliary fuel such as coal, lignite / petroleum products up to 15% are exempt. Thermal power plants using waste heat boilers without any auxiliary fuel are exempt.”

In line with the specifications mentioned in **Table 1.1:**, the Expansion Project falls under Category ‘A’ of **item 1(d) - Thermal Power Plants** of the Schedule to the Environment Impact Assessment (EIA) Notification, 2006 and its subsequent amendments & therefore requires prior environmental clearance from MoEF&CC, New Delhi.

1.3.2 SIZE OF THE PROJECT

Brief description of the size of project is detailed in the table below:

Table 1.1: Size of Project

S. No.	Particular		Details		
1.	Nature of the Project	Proposed Expansion of Kawai Thermal Power Plant under Phase–II by adding 3200 (4x800) MW Ultra Super Critical Thermal Power Plant to Existing 1320 (2x660) MW at Village Kawai, Tehsil Atru, District Baran, Rajasthan			
2.	Size of Project	Coal based 3200 (4x800) MW			
3.	Project sector & category	:	1(d), Thermal Power Plants & Category “A”		
			Existing	**Proposed**	Total
4.	Plant capacity	:	1320 MW (2x660) MW	**3200 MW (4x800) MW**	4520 MW (1320+3200) MW
5.	Land requirement (In Hectare)	:	350	**472.45**	822.45

				(includes 1.758 Ha. Forest Area outside power plant premises for Coal Conveyor after Forest dept. inspection)	
6.	Greenbelt & Plantation (In Hectare)	:	120	**169.44**	289.44 Ha (35%)
7.	Technology	:	Super-critical	**Ultra Super-critical**	Super-Critical & Ultra Super-Critical
8.	Coal requirement in (Million MTPA)	:	5.50	**12.9**	18.4
9.	Source of fuel	:	Coal from Coal Mines of Jitpur, Rampia, Ujheni & e-auction for proposed project.		
10.	Coal transportation	:	Through Rail		
11.	Ash Generation (Million MTPA)	:	5.16		
12.	Project Cost (Crores)	:	8264.59	**36,600**	44864.59
13.	Water requirement & Water allocation	:	34	**56**	90
			WRD permission for 34 MCM is already obtained and the application for additional water allocation of 56 MCM has been submitted to WRD, Jaipur.		
14.	Water Source	:	From Parwan River/Dam through water pipeline		
15.	Manpower requirement	:	300 nos.	**Construction Phase** Permanent : 350, Contract :8000 **Operational Phase** Permanent : 550, Contract: 350	-

1.3.3 LOCATION OF THE PROJECT

The proposed expansion project is coming at Village Kawai, Tehsil Atru, District Baran, Rajasthan.

Table 1.2: Location details

S. No	Particulars	Details
1.	Project Address	Village Kawai, Tehsil Atru, District Baran, Rajasthan
2.	Geographical Coordinates	(see coordinates table below)
3.	SOI Toposheet	• Core Zone: G43W9 • Buffer Zone: G43W9, G43W10, G43W13 & G43W14
4.	Site elevation	Maximum Elevation – 328 m AMSL Minimum Elevation – 302 m AMSL Average site elevation – 315 m AMSL

S.NO.	Latitude	Longitude
1	24°48'49.45"	76°43'52.90"
2	24°49'52.57"	76°43'13.78"
3	24°49'18.09"	76°43'9.64"
4	24°50'16.91"	76°42'16.70"
5	24°50'17.26"	76°41'49.49"
6	24°48'52.21"	76°42'36.87"
7	24°48'12.53"	76°43'23.90"
8	24°48'7.23"	76°43'44.16"
9	24°47'20.05"	76°43'34.43"
10	24°47'17.07"	76°43'58.42"
11	24°47'2.40"	76°44'42.01"
12	24°45'43.52"	76°44'29.90"

1.3.3.1 Photographs Showing Project Site

Figure 1.1 Photographs showing proposed project site

1.3.3.2 Environmental Settings & Site Connectivity

Table 1.3: Details of Environmental Settings & site connectivity

<table>
<tr><th>S. No.</th><th>Areas</th><th>Particulars with Aerial distance & Direction</th></tr>
<tr><td>1.</td><td>Areas protected under international conventions, national or local legislation for their ecological, landscape, cultural or other related value.</td><td>There are no protected areas under international conventions in study area for their landscape & cultural value. There are 15 no. of PF & R.F. within 10 km of the project site.</td></tr>
<tr><td>2.</td><td>Areas which are important or sensitive for ecological reasons - Wetlands, watercourses or other water bodies, coastal zone, biospheres, mountains, forests.</td><td>
<table>
<tr><th>Particulars</th><th>Distance (In km)</th><th>Direction</th></tr>
<tr><th colspan="3">Reserve Forest (R.F), Protected Forest (P.F)</th></tr>
<tr><td>Kheldi birdagaddiyan block forest</td><td>Adjoining</td><td>E</td></tr>
<tr><td>Kawai kalan block forest</td><td>Adjoining</td><td>SSE</td></tr>
<tr><td>Dara block forest</td><td>Adjoining</td><td>W</td></tr>
<tr><td>Bir daranimoda block (R.F.)</td><td>Adjoining</td><td>N</td></tr>
<tr><td>Kawai block forest</td><td>0.12</td><td>W</td></tr>
<tr><td>Bir sunda umriwala block (R.F.)</td><td>0.4</td><td>E</td></tr>
<tr><td>Baldevpura block</td><td>0.55</td><td>N</td></tr>
<tr><td>Chhatarpura block forest</td><td>0.85</td><td>WNW</td></tr>
<tr><td>Bir parlya block forest</td><td>3</td><td>WSW</td></tr>
<tr><td>Ratan block forest</td><td>3.1</td><td>NNW</td></tr>
<tr><td>Dilod block (P.F.)</td><td>3.2</td><td>N</td></tr>
<tr><td>Narsinghpura (P.F.)</td><td>3.2</td><td>ENE</td></tr>
<tr><td>Ugrapura (P.F.)</td><td>6.3</td><td>WSW</td></tr>
<tr><td>Bir govindpura block</td><td>7.8</td><td>NNW</td></tr>
<tr><td>Sigri block (P.F.)</td><td>7.9</td><td>N</td></tr>
<tr><th colspan="3">Rivers, Nala, Water Bodies</th></tr>
<tr><th>Particulars</th><th>Distance (in km)</th><th>Direction</th></tr>
<tr><td>Lhasi nadi</td><td>0.35</td><td>SSE</td></tr>
<tr><td>Andheri nadi</td><td>0.55</td><td>E</td></tr>
<tr><td>Rhupsi nala</td><td>5</td><td>WSW</td></tr>
<tr><td>Kukar talav</td><td>6.9</td><td>WSW</td></tr>
<tr><td>Ghoghra nala</td><td>7.5</td><td>W</td></tr>
<tr><td>Parbati River</td><td>7.7</td><td>NNW</td></tr>
</table>
</td></tr>
<tr><td>3.</td><td>Areas used by protected, important or sensitive species of flora or fauna for breeding, nesting, foraging, resting, over wintering, migration.</td><td>None in 10 km radius</td></tr>
<tr><td>4.</td><td>Inland, coastal, marine or underground waters.</td><td>List of water bodies within the 10 km radius is given above.</td></tr>
<tr><td>5.</td><td>State, National boundaries</td><td>Rajasthan-Madhya Pradesh inter-state boundary at a distance of about 7.5 km in East direction.</td></tr>
</table>

<table>
<tr><th>S. No.</th><th>Areas</th><th>Particulars with Aerial distance & Direction</th></tr>
<tr><td>6.</td><td>Nearest highway/major road/routes or facilities used by the public for access to recreation or other tourist, pilgrim areas</td><td>
<table>
<tr><th>Particulars</th><th>Distance (in km)</th><th>Direction</th></tr>
<tr><td>SH 37A</td><td>0.2</td><td>West</td></tr>
<tr><td>SH51</td><td>1.0</td><td>SW</td></tr>
<tr><td>MDR 4</td><td>4.9</td><td>NW</td></tr>
</table>
*Source: Distance taken from Google earth imagery.</td></tr>
<tr><td>7.</td><td>Défense installations</td><td>None in 10 km radius</td></tr>
<tr><td>8.</td><td>Densely populated or built-up area / Major Town</td><td>There is no densely populated habitation that exists near the proposed site. Atru town is located at about 4.10 km in the NNW direction.</td></tr>
<tr><td>9.</td><td>Nearest habitation</td><td>
<table>
<tr><th>Habitation /Village</th><th>Distance (Km)</th><th>Direction</th></tr>
<tr><td>Kawai</td><td>1.0</td><td>SW</td></tr>
<tr><td>Phulbaroda</td><td>1.4</td><td>ESE</td></tr>
<tr><td>Bilkhera</td><td>2.0</td><td>E</td></tr>
<tr><td>Barlan</td><td>2.0</td><td>WSW</td></tr>
</table>
*Source: - Distance taken from Google earth imagery.</td></tr>
<tr><td>10.</td><td>Major industries / manufacturing units</td><td>None in 10 km radius</td></tr>
<tr><td>11.</td><td>Areas occupied by sensitive man-made land uses (hospitals, schools, places of worship, community facilities)</td><td>
<table>
<tr><th>Particulars</th><th>Distance (in km)</th><th>Direction</th></tr>
<tr><td colspan="3">Education Facilities</td></tr>
<tr><td>Government primary school Atru,</td><td>4.0</td><td>NW</td></tr>
<tr><td>Govt. Sr. Sec. School, Atru</td><td>5.6</td><td>NW</td></tr>
<tr><td>Govt. upper primary school Barawda</td><td>8.2</td><td>WSW</td></tr>
<tr><td>Govt. School Nayagav</td><td>2.8</td><td>E</td></tr>
<tr><td colspan="3">Worship Places</td></tr>
<tr><td>Hindu temple, Kawai</td><td>1.1</td><td>SW</td></tr>
<tr><td>Radhe krishna mandir, Kawai</td><td>0.9</td><td>WSW</td></tr>
<tr><td>Narbadeshvar mahadev, Kawai</td><td>0.3</td><td>W</td></tr>
<tr><td>Hanuman mandir, Dilod</td><td>4.6</td><td>ENE</td></tr>
<tr><td colspan="3">Health Facilities</td></tr>
<tr><td>Govt. Hospital Atru</td><td>5.4</td><td>NW</td></tr>
<tr><td>Govt. Hospital, Kolukhera</td><td>1.8</td><td>ENE</td></tr>
<tr><td>Govt. Hospital Kawai</td><td>0.9</td><td>WSW</td></tr>
</table>
*Source: - Distance taken from Google earth imagery</td></tr>
<tr><td>12.</td><td>Areas already subjected to pollution or environmental damage.</td><td>The project area of APL does not come under any CPCB declared Critically or Severely Polluted Areas.</td></tr>
<tr><td>13.</td><td>Areas susceptible to natural hazard which could cause the project to present environmental problems.</td><td>The project falls in Baran district of Rajasthan. The entire Baran District of Rajasthan falls under Seismic Zone II, low damage risk zone as per BMTPC, Vulnerability atlas Seismic Zone of India IS: 1893-2002.</td></tr>
</table>

<table>
<tr><th>S. No.</th><th>Areas</th><th colspan="3">Particulars with Aerial distance & Direction</th></tr>
<tr><td colspan="5">Site Connectivity (aerial distance as per google earth imagery from project boundary and direction from centre of project)</td></tr>
<tr><td>S. No.</td><td>Description</td><td colspan="3">Details</td></tr>
<tr><td rowspan="5">1.</td><td rowspan="5">Nearest Highway / Major Road</td><td>Particulars</td><td>Distance (in km)</td><td>Direction</td></tr>
<tr><td>SH 37A</td><td>0.2</td><td>West</td></tr>
<tr><td>SH51</td><td>1.0</td><td>SW</td></tr>
<tr><td>MDR 4</td><td>4.9</td><td>NW</td></tr>
<tr><td colspan="3">*Source:-All distances are taken with respect to S.O.I. Toposheet</td></tr>
<tr><td rowspan="2">2.</td><td rowspan="2">Nearest Railway Station</td><td>Particulars</td><td>Distance (in km)</td><td>Direction</td></tr>
<tr><td>Salpura Railway Station on Katni-Bina line</td><td>Adjacent to the plant boundary</td><td>SW</td></tr>
<tr><td rowspan="2">3.</td><td rowspan="2">Nearest Airport</td><td>Particulars</td><td>Distance (in km)</td><td>Direction</td></tr>
<tr><td>Jaipur International Airport</td><td>238</td><td>NNE</td></tr>
</table>

**Source: - All distances are taken with respect to S.O.I. Toposheet, which is pertinent to this project.*

1.4 PROJECT IMPORTANCE TO COUNTRY/ REGION

India's power generation capacity boasts a diverse array of sources, with coal dominating the landscape. Over the last decade, driven by sustained economic growth and industrialization, India's electricity demand has consistently grown at a rate exceeding 4.4% year-on-year. Despite a per capita electricity consumption increase of around 5% annually, reaching approximately 1,208 kWh/person in FY 20, this figure remains notably lower than the global average of about 2,700 kWh/person.

As living standards rise and electronic appliances become more prevalent, even in rural areas, there is an anticipated surge in per capita consumption and overall power demand. However, the end consumers, encompassing households, farmers, commercial establishments, and industries, continue to grapple with the challenges of frequent power cuts—both scheduled and unscheduled—across many parts of the country. Therefore, the proposed expansion project will play an important factor in reducing the power demand & supply gap of the region.

1.4.1 REGIONAL IMPORTANCE OF THE PROJECT

The proposed expansion of Kawai Thermal Power Plant in Rajasthan holds significant regional importance by addressing the surging power demand in the state. With Rajasthan facing a growing need for electricity, the proposed expansion project is poised to play a crucial role in enhancing the state's power generation capabilities. By catering to the needs of households and contributing to the Gross State Domestic Product (GSDP), the project becomes a vital component of Rajasthan's energy infrastructure. It not only ensures a reliable power supply for the region but also supports economic growth, thereby strengthening the overall energy landscape in Rajasthan.

1.5 SCOPE OF THE STUDY – DETAILS OF REGULATORY SCOPING CARRIED OUT (AS PER TERMS OF REFERENCE)

EIA studies for the proposed expansion project have been carried out as per Terms of Reference (ToR) prescribed by MoEF&CC, New Delhi vide TOR Identification No: TO24A0601RJ5203867N dated 29/07/2024. (Copy of ToR letter enclosed as **Annexure 1**). The regulatory scoping of the project as per the ToR has been covered and detailed in "Point-wise reply of ToR" is given in this EIA/EMP Report.

Radial distance of 10 Km from project site boundary has been considered as study area. Project area is taken as core zone and 10 Km area from project site boundary is taken as buffer zone for the purpose of this EIA/EMP report. Toposheet showing project site & 10 Km radius study area is given as Figure 1.2 below.

Baseline data generation for one season (Post-Monsoon Season) was carried out during October to December 2024 by NABL accredited & CPCB recognized environmental monitoring laboratory Newcon Consultancy & Laboratories, Ghaziabad, Uttar Pradesh {NABL certified vide No.: TC-12621; valid till 16.11.2025 and CPCB recognized vide letter no F.No LB/99/7/2021-INST LAB-HO-CPCB-HO/Pvt./2849 dated 09.07.2024; valid till 16.11.2025}.

The draft EIA/EMP report is being prepared & submitted for the purpose of public consultation for the proposed expansion project.

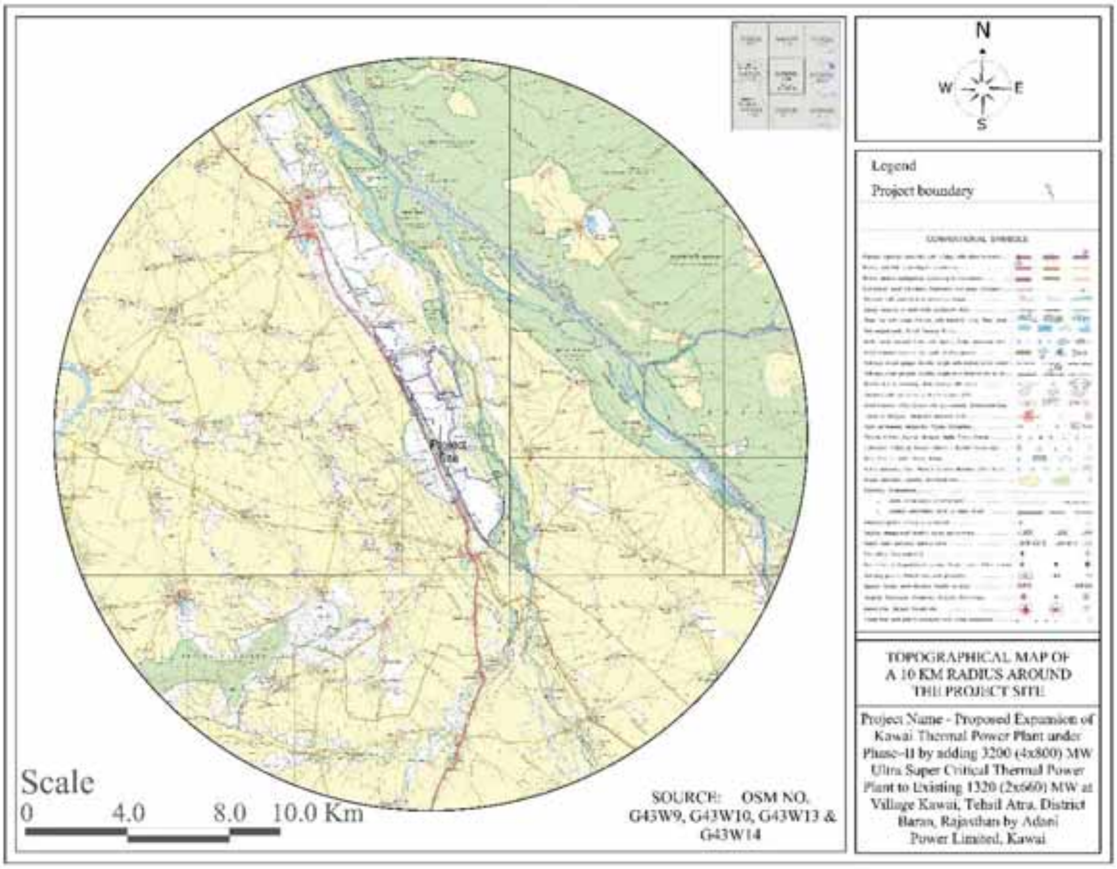

Figure 1.2: 10 km radius toposheet showing project site and study area

The scope of EIA Study Report includes,

- Literature review and collection of data relevant to the study area;
- Collection of data related to the project related activities;
- Establish the baseline environmental aspects in and around the proposed Integrated project;
- Collate secondary data including socio-economic data from published literature / government publications;
- Identify various pollution loads due to proposed activities;
- Predict incremental levels of pollutants in the study area due to the proposed operations;

- Evaluate the predicted impacts on various environmental attributes in the study area by using scientifically developed and widely accepted environmental impact assessment methodologies;
- Preparation of cost effective and appropriate Environmental Management Plan (EMP) encompassing strategies for minimization of potential adverse impacts on various environmental components along with budgetary provisions for implementation of pollution control measures;
- To delineate measures for human health and safety during operational of proposed project; and
- Delineation of post-study Environmental quality monitoring programme

1.5.1 STRUCTURE OF EIA REPORT

This EIA/EMP report includes total thirteen chapters as per Appendix-III of the EIA Notification, 2006 and the ToR issued to the project, the same are briefed as under:

- **Chapter 1: Introduction:** Provides a background to the project, identification of the project and project proponent, brief description of the project, details of the project proponent, scope of the study and structure of this report.
- **Chapter 2: Project description:** Provides details of project, infrastructure required, technology and process description with process flow diagram, information on the needs and desirability of the project and sources of pollution with pollution control measures.
- **Chapter 3: Description of the Environment:** Provides description of the receiving Environment details, baseline conditions identified for the project within 10 km radius from the project site.
- **Chapter 4: Anticipated Environmental Impact and Mitigation Measures**: describes the anticipated impacts identified during the EIA process during the various project phases.
- **Chapter 5: Analysis of alternatives**: provides the different technology alternatives which were considered for the project.

- **Chapter 6: Environment Monitoring program:** provides the monitoring schedule and implementation plan during the operation phase of the project.
- **Chapter 7: Additional Studies:** has the information about risk and hazard assessment and details of disaster management plan along with traffic study details.
- **Chapter 8: Project benefits:** associated with the proposed project are discussed in this chapter.
- **Chapter 9: Environmental Cost Benefit Analysis:** Provides information about organizational framework for identifying, quantifying, and comparing the costs and benefits (measured in monitory values) of a proposed policy action.
- **Chapter 10: EMP:** Details of the administrative aspects for ensuring that mitigative measures are implemented and their effectiveness monitored, after approval of the EIA
- **Chapter 11: Summary & Conclusion**
- **Chapter 12: Disclosure of Consultants engaged**
- **Chapter 13: Cumulative Assessment Study:** In this chapter, the industries within a 15 km radius are identified and a Cumulative Study is done for the industries, existing and proposed project, to check whether the proposed expansion project can be allowed over and above the existing industries.

1.6 DETAILS OF REGULATORY COMPLIANCES

Details of regulatory compliances (limited to Environment, safety and/or required by MoEF&CC/ EAC) with respect to the project are as under:

Table 1.1: Regulatory compliances

S. No.	Regulatory compliance	Applicable Rules/ Regulations/ Acts	Compliance Status	Remarks
1.	Land Documents	-	The total land required for proposed expansion project is 472.45 Ha. Land diversion for coal conveyor outside the plant premises (FC proposal no.FP/RJ/OTHERS/467838/2024) is under progress.	
2.	Environmental Clearance	EIA Notification, 2006	**Particular** / **Date** Environmental clearance for 2x660 MW Super critical Coal based thermal power plant granted by MoEFCC, New Delhi. — 04.05.2011 Amendment in Environmental Clearance was granted for change in source of coal. — 13.03.2014 Transfer of Environmental Clearance was issued to Adani Power Limited (APL). — 24.04.2023	Copies of Environmental Clearances and transfer are enclosed as **Annexure 2.**
3.	Certified EC Compliance	EIA Notification, 2006 & amendments.	Certified by Integrated Regional Office of MoEFCC, Jaipur vide File No. IV/ENV/R/TH-44/821/2011 dated: 26.05.2013 & 09.10.2015. MoEFCC, Lucknow Office had visited the Kawai TPP dated 23rd and 24th November in 2020.	APL, Kawai has submitted a request letter to IRO, Jaipur for Certified EC Compliance Report (CCR) vide letter no. APL/Kawai/TPP/EC/IRO/MoEFCC/201 /2025 dated 02.01.2025 and Site Visit has been completed on 07.01.2025.
4.	Consent to Establish	Section 25 of the Water (Prevention &	Consent to Establish was issued vide dated 25.07.2011 from Rajasthan State Pollution Control Board (RSPCB).	Obtained for existing TPP

S. No.	Regulatory compliance	Applicable Rules/ Regulations/ Acts	Compliance Status	Remarks
		Control of Pollution) Act,1974 & under section 21 of the Air (Prevention & Control of Pollution) Act,1981		
5.	Consent to Operate	Section 25 of the Water (Prevention & Control of Pollution) Act,1974 & under section 21 of the Air (Prevention & Control of Pollution) Act,1981	Consent to Operate (renewed) was issued vide letter No. F. No: F(CPM)/Baran(Atru)/1028(1)/2020-2021/7187-7189 is valid upto 28.02.2029 from Rajasthan State Pollution Board (RSPCB).	Obtained for existing TPP
6.	Authorization from MPPCB to handle Hazardous waste	Hazardous & Other Waste Management Rules, 2016	HW Authorization issued vide letter No. F. No: F(HSW)/Baran(Atru)/2(1)/2023-2024/7190-7192 valid up to 28.02.2029 from Rajasthan State Pollution Control Board (RSPCB)	Obtained for existing TPP
7.	PCCF letter stating that No National Park, Sanctuary, Elephant/Tiger Reserve, or migratory	Wildlife Protection Act (WPA) 1972, Wildlife Protection (Amendment) Act 2023 & subsequent amendments.	No National Park, Sanctuary, Elephant/Tiger Reserve, or migratory routes/wildlife corridors exist within 10 Km of the plant.	Copy of Acknowledgment of request letter for obtaining distance certificate from any PA & for obtaining certificate for no involvement of forest land in project site submitted on 03.01.2025.

S. No.	Regulatory compliance	Applicable Rules/ Regulations/ Acts	Compliance Status	Remarks
	routes/wildlife corridors exist within 10 Km of the plant and No involvement of forest land.			
8.	Water Allocation	Water (Prevention and Control of Pollution) Act, 1974 and its subsequent amendments	Water allocation of 34 MCM/year is already obtained from Water Resource Department (WRD), Jaipur, Rajasthan and water allocation for additional 52 MCM/Year water allocation has been submitted on 03.06.2024 to WRD, Jaipur (R.J) and will be obtained.	Will be obtained.
9.	Public Liability Insurance	Public Liability Insurance Act 1991	Obtained for Existing TPP.	Will be obtained before commencement of operations for proposed expansion.
10.	Approval for storage of explosive chemicals	Petroleum & Explosive Safety Organization	Obtained for Existing TPP.	Will be obtained before commencement of operations for proposed expansion.

1.7 APPLICABLE RULES/REGULATION/ACTS

The applicable Environmental Rules/Act/Regulation are applicable upon the project: -

- EIA Notification, 2006 & subsequent amendments till date
- Indian Boiler Act, 1923 and its amendments till date, Indian Boiler Regulations 1950 and their amendments
- The Water (Prevention and Control of Pollution) Act, 1974 & subsequent amendments till date
- The Air (Prevention and Control of Pollution) Act, 1981 & subsequent amendments till date
- Fly ash notification 2021 & subsequent amendments till date
- Environment (Protection) Act, 1986 & subsequent amendments till date
- The Wildlife Protection Act, 1972 & subsequent amendments till date
- Labour Laws as applicable to the project activity.
- Motor Vehicles Act, 1988 and the amendments thereunder
- Manufacture, Storage and Import of Hazardous Chemicals Rules 1989 (MSIHC Rules) & subsequent amendments till date
- Public Liability Insurance Act, 1991 and amendments till date
- The Noise Pollution (Regulation and Control) Rules, 2000 & subsequent amendments till date
- The Petroleum Act, 1934 and amendments there under
- The Factories Act, 1948
- The Biological Diversity Act, 2002 & subsequent amendments till date
- Construction and Demolition Waste Management Rules 2016 & subsequent amendments till date.

- Solid Waste Management Rules, 2016 & subsequent amendments till date
- Hazardous and Other Waste (Management and Trans boundary Movement) Rules 2016 & subsequent amendments till date
- E-Waste (Management) Rules 2016 & subsequent amendments till date
- Plastic Waste Management Rules 2016 & subsequent amendments till date
- Bio-Medical Waste Management Rules, 2016 & subsequent amendments till date

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CHAPTER - II
PROJECT DESCRIPTION

2.1 TYPE OF PROJECT

Adani Power Limited (APL) has Proposed Expansion of Kawai Thermal Power Plant under Phase–II by adding 3200 (4x800) MW Ultra Super Critical Thermal Power Plant to Existing 1320 (2x660) MW at Village Kawai, Tehsil Atru, District Baran, Rajasthan. Please refer to section **1.2.1 given in Chapter 1** for brief on the project.

The total land required for proposed expansion project is 472.45 Ha. The estimated capital cost for the proposed expansion project is Rs. 36,600 Crore. The salient features of the projects are given in **Section 1.3.1 of Chapter 1** of this report.

The 3200 MW coal-based USCTPP at Baran District, Rajasthan, is proposed by utilizing domestic coal and advanced technology. The design includes four 800 MW units with Ultra-Supercritical Steam parameters, ensuring high efficiency. The Water requirement for the proposed expansion project is optimized as 56 MCM/Year (2.0 m^3/MW) to be sourced from Parwan River/Dam, Rajasthan, about 30 km with respect to Kawai TPP. The unitized concept, spare capacities, and tailored reservoir size aim for continuous plant operation.

The proposed 3200 MW Power Project adopts ultra-supercritical steam parameters for improved combustion efficiency, highlighting the evolution in technology despite challenges like the use of higher alloy steels in heat transfer surfaces.

The total capital cost estimated for the proposed expansion project is Rs. 36,600 Crores.

2.2 NEED FOR THE PROJECT

The proposed expansion project is essential to bridge the gap between increasing electricity demand and the existing power generation capacities in Rajasthan. It not only addresses the immediate need for additional capacity but also anticipates and prepares for future requirements, ensuring a reliable and sustainable power supply for the region.

The need for the proposed expansion project is evident from various aspects of the current power landscape.

- The State's Energy Demand has increased at an average of around 8.5% y-o-y over a period for past 10 years, whilst Peak demand has grown at around 1.1% y-o-y.
- The project aligns with national grid connectivity, allowing for economically viable power generation in Kawai.

Present Power Scenario in India: India's power sector has grown into a massively over the past decade. As per Central Electricity Authority (CEA), India's fuel wise Installed Capacity is given in **Table 2.1** below:

Table 2.1: Installed Generation capacity categorized by fuel type

Installed Capacity Category wise (from Jan-2023 to Jan-2024)		
Category	**Installed Capacity (MW)**	**Installed Capacity (%)**
Coal	206544.67	48.60
Gas	26318.65	6.19
Diesel	619.2	0.15
Nuclear	7188.33	1.69
Hydro	48546.83	11.42
RES	129131.09	30.39

Source: Central Electricity Authority (CEA) Jan-2023 to Jan-2024

Coal based installed capacity has the highest share of 48.60%, followed by RES (MNRE) with 30.39% and hydro 11.42%.

Present Power Scenario of Rajasthan:

The State of Rajasthan falls within Northern region as per Central Electricity Authority (CEA) The total Installed capacities of Power Utilities as on 31.03.2023 with break-up in Western region are as follows in **Table no. 2.2**

Table 2.2: Fuel based Power break up in Rajasthan

Sector	Installed Generation Capacity (MW)	% Share in total
Thermal		
Coal	11747.56	30.12
Lignite	1580.0	4.05
Gas	774.63	1.99
Diesel	0.00	0.00
Nuclear	556.74	1.43
Renewable		
Hydro	1941.93	4.98
RES*(MNRE)	22398.05	57.43
Grand Total	**38998.91**	**100 %**

Source: CEA Annual Report

As per ‘Annual Report published by CEA, the following Demand, Supply and Deficit scenario has been captured in the state of Rajasthan during April, 2022 - March, 2023 revised, which is the latest published data:

- Peak Demand: 17,399 MW
- Peak Met: 17,206 MW
- Demand not met: 193 MW (1.1%)
- Energy Requirement: 101,801 MU
- Energy Supplied: 100,057 MU
- Energy not supplied: 1,745 MU (1.7 %)

From the above, it is obvious that in present scenario demand supply situation in M Rajasthan is closely matched and there is little room for accommodating large industrial load. To meet projected energy requirement and peak demand in the coming five years, significant new capacity addition is essential. Moreover, with the National grid being set up in the country, it makes sense to generate power economically at one location and transmit the same elsewhere where there is shortage of power.

Considering all above, the proposed project of 4x800 MW coal based power station by M/s. Adani Power Limited (APL) at Kawai in Baran District, Rajasthan fits well in the overall power scenario of the state as well as country. Consequently, plant operation at high plant load factor can be expected by addition of new units.

2.3 LOCATION OF THE PROJECT (MAP SHOWING GENERAL LOCATION, SPECIFIC LOCATION, PROJECT BOUNDARY & PROJECT SITE LAYOUT)

2.3.1 GENERAL LOCATION

The project is located at Village Kawai, Tehsil Atru, District Baran, Rajasthan. The project area falls in SOI (OSM) No G43W9 and has an average elevation of 315 m AMSL. The general road location map is shown in Figure 2.1. The Google Earth imagery showing project site boundary with geographical coordinates & surrounding area of the project site is given as Figure 2.2:

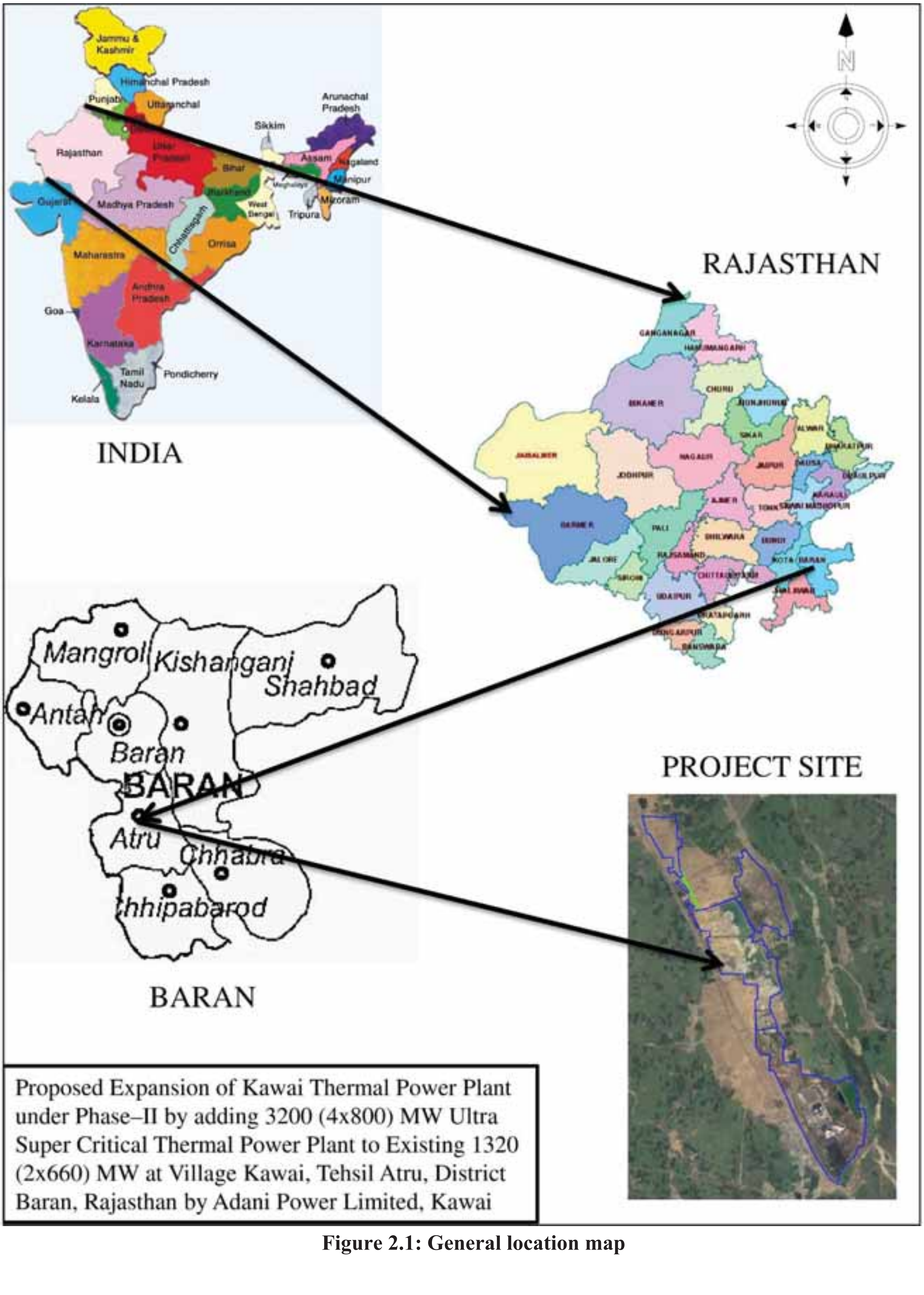

Figure 2.1: General location map

2.3.2 SPECIFIC LOCATION

The map showing specific location of the plant site on Google Earth downloaded image along with geographical coordinates is given in **Figure 2.2.**

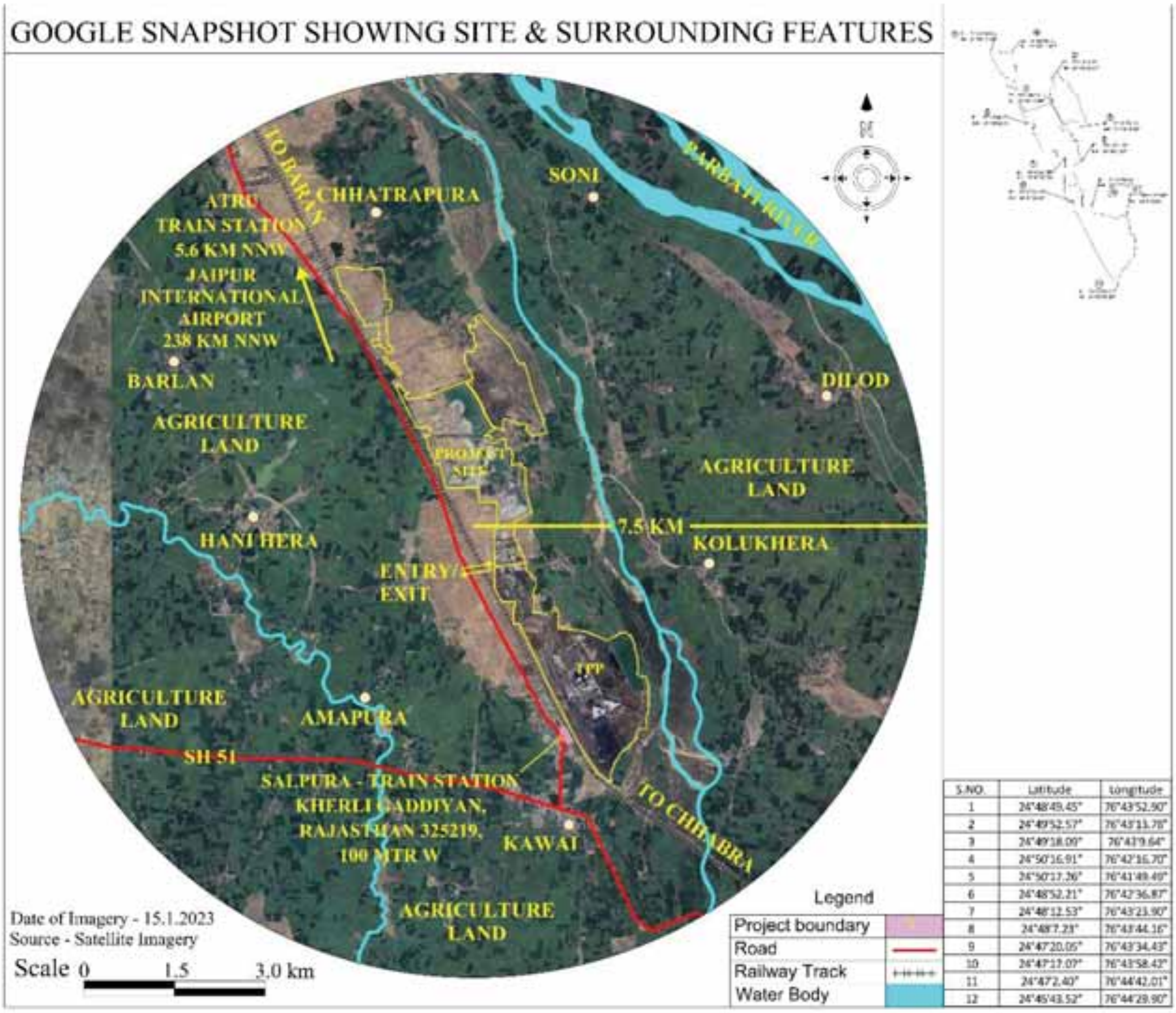

Figure 2.2: Google Image of Project Site with boundary (Coordinates)

Site photographs are given in **Section 1.3.3.1 of Chapter 1** of this report and project site boundary marked on 10 km radius toposheet is given as **Figure 1.2 in Chapter 1** of this EIA/EMP report.

Surrounding features, site coordinates and boundary of project site on Google earth imagery is given in **Figure 2.2**. Plant Layout is given **as Figure 2.3.**

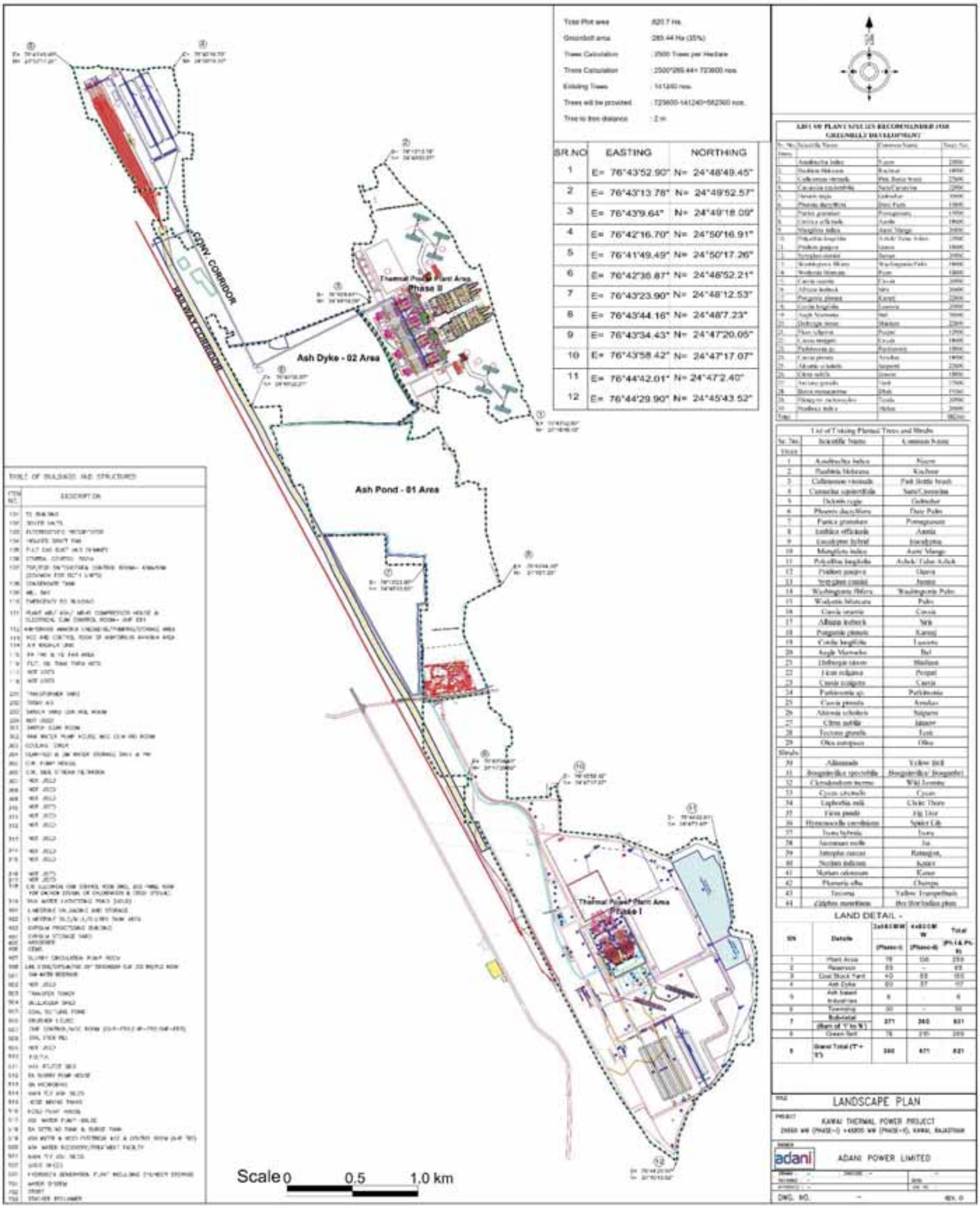

Figure 2.3: Plant layout showing existing & proposed project components

2.4 SIZE OR MAGNITUDE OF OPERATION

2.4.1 MAGNITUDE OF PROPOSED EXPANSION PROJECT

APL intends to implement a coal-based 4x800 MW capacity Power Project firing domestic Indian coal sourced from Coal from Commercial Coal Mines. The proposal is mooted to deploy the state-of-the-art technology and accordingly four units of 800 MW i.e. total capacity of 3200 MW; are being considered with ultra-supercritical steam parameters to attain high cycle efficiency.

a. Fuel Requirement, Source & Transportation:

i. Main Fuel:

For the proposed expansion 4x800 MW Power Project, annual fuel requirement is estimated at 12.9 million MTPA at 85% plant load factor with design Coal GCV of 3200-4300 kcal/kg.

Table 2.3: Details of Fuel for the proposed expansion project

Fuel	Quantity (Million MTPA)	Source	Distance (km)	Mode of Transport
Coal	**12.9**	Coal from Commercial Coal Mines	700-1200 km	Through Rail

Coal will be transported through BG Railway line BOXN Wagons from coal mines upto TPP, using existing railway line and siding.

The Govt. of India has opened up the coal mining sector, allowing private sector to mine coal for any end use. There are several commercial coal mines which are expected to commence coal production by the time the proposed 3200 MW expansion project nears completion.

Table 2.4: Preliminary Coal Analysis

Preliminary Coal Analysis	4x800 MW Kawai TPP		
Coal Specifications	**Design**	**Best**	**Worst**
TM	15	12	17
ASH	34.0	29.0	40.0
VM	22.86	24.04	19.0
FC	28.14	34.69	22.0
GCV	3700	4300	3200
Sulphur	0.45	0.40	0.50

FC/VM Ratio	1.23	1.45	1.16

Table 2.5: Coal requirement for 4x800 MW

Particulars	Unit	Coal Requirement
		Design Coal
Station Heat Rate	kCal/kWh	2248
GCV of Coal (Design/Worst)	kCal/Kg	3200-4300
PLF	%	85
Hourly Coal Requirement per unit	TPH	368.15
Daily Coal Requirement per unit (85% PLF)	TPD	8835
Annual Coal Requirement per unit (85% PLF)	Million MTPA	3.225
Annual Coal Requirement for four units (85% PLF)	**Million MTPA**	**12.9**

ii. Auxiliary Fuel:

The fuel oil system will be provided for boiler start up; and for flame stabilization during low load operation with or without coal firing. Light Diesel Oil (LDO) / High Speed Diesel (HSD) oil will be used for boiler start up (up to 7.5% of BMCR) and for low load operation & flame stabilization (30% of BMCR), as necessary. Micro/Minor oil gun ignition system will be explored to reduce specific oil consumption during cold start up.

The annual requirement of secondary fuel-Light Diesel Oil (LDO) for cold start up and High-Speed Diesel (HSD) is estimated to be about 30000 KL per annum considering 85% PLF and LDO/HSD shall be sourced from the nearby POL depots/ refineries located nearer to the project. As the quantity and frequency shall not be significant and distance is short, it is suggested that the required quantity shall be transported by road using road tankers and stored in vertical cylindrical steel tanks. The transfer of HSD/LDO to the boilers is intended to be facilitated directly from the storage tanks through unloading pumps. Each tank will be equipped with a radar-type level transmitter to provide indications in the Central Control Room (CCR).

Power Evacuation:

Power Generated by the station will be stepped up to 400 kV level through Generator Transformers. A 400 kV Switchyard has been envisaged at the Power Plant. Power evacuation to the grid will be at 400 kV from the Power Plant switchyard to nearby STU sub-station or Central Transmission Utility (CTU) at 400 kV level.

b. Technical Features

Power Generating Unit	:	Four units of 800 MW turbine generator sets fed by steam from coal fired P.F. boiler operating at Ultra Super-Critical range.
Cooling System	:	Closed recirculating condenser cooling system with induced draft cooling tower.
Coal Handling System	:	Coal handling facility, which comprises receipt of coal through Indian Railway, with in-plant coal handling system and finally feeding the bunker level conveyors.
Ash Disposal System	:	The Fly Ash will be collected in dry form in silos for all efforts will be made for 100% utilization of ash. Ash will be used for Cement manufacturing industries, abandoned mine, filling of low-lying area, manufacturing bricks, road construction, aggregate placement in concrete, etc. in compliance of Fly Ash Notification, 31.12.2021 and amendments. Provision will be made for disposal of un-utilized ash in high concentration slurry form to ash dyke. An MoU has been signed between APL and Ashtech (India) Private Limited, Mumbai, India for utilization of Fly ash for the proposed 3200 (4x800) MW.
Power Evacuation	:	At 400 kV level to State Transmission Unit (STU) or Central Transmission Utility (CTU)
Environmental Aspects	:	Elaborate arrangements for Selective Catalytic Reduction (SCR)/ Separated Over Fire Air (SOFA) /Low NO_x burners systems complying with emission norms as per latest MoEF&CC and adequately designed electrostatic precipitator with more than

99.99% efficiency are envisaged. Wastewater quality to be maintained as per MoEF&CC notification. Zero Plant Discharge facility shall be present since the cooling water, blow down water, wastewater and ash water would be recycled back to the system after suitable treatment for reuse.

2.5 PROPOSED SCHEDULE FOR APPROVAL & IMPLEMENTATION

The project will be undertaken in phases - 54 months from Zero Date i.e., the date of 'Financial Closure' for Commercial Operation. The construction of new units and installation of plant & machinery for the proposed expansion project will be commenced within one month of obtaining all statutory clearances including Environmental clearance from MoEF&CC and Consents to establish & operate from RSPCB & all other statutory clearances from concerned authority.

2.6 PROJECT DESCRIPTION

2.6.1 INTRODUCTION:

Kawai TPP has Proposed Expansion of Kawai Thermal Power Plant under Phase–II by adding 3200 (4x800) MW Ultra Super Critical Thermal Power Plant to Existing 1320 (2x660) MW at Village Kawai, Tehsil Atru, District Baran, Rajasthan, utilizing domestic coal and advanced technology. The design includes four 800 MW units with Ultra-Supercritical Steam parameters for improved combustion efficiency, highlighting the evolution in technology despite challenges like the use of higher alloy steels in heat transfer surfaces. The Water requirement for the proposed expansion project is optimized as 56 MCM/Year sourced from Parwan River/ Dam, located 30 km from the project site. The unitized concept, spare capacities, and tailored reservoir size aim for continuous plant operation.

The proposed 3200 MW expansion Power Project adopts ultra-supercritical steam parameters for improved combustion efficiency, highlighting the evolution in technology despite challenges like the use of higher alloy steels in heat transfer surfaces.

Table 2.6: Electricity generation Technology & Fuel details

Particulars	Existing	Proposed	Total
Electricity Generation	1320 (2x660) MW	3200 (4x800) MW	4520 MW (1320+3200) MW
Technology & Unit	Super critical Thermal Power Plant	Ultra Super-Critical Thermal Power Plant	Super critical & Ultra Super-Critical TPP
Fuel	Coal Based	Coal based	Coal Based

2.6.2 LAND

The total land required for proposed expansion project is 472.45 Ha. The land is envisaged above for the Power Plant considers installation of 4x800 MW capacity Ultra Super Critical Coal based thermal power plant including its water pre-treatment facility, induced draft cooling towers, fuel oil system, 400 kV switchyard, ash handling facility, coal handling system, coal conveyor belt mandatory space provision for desulphurisation plant, green verge to satisfy RSPCB/CPCB/MoEF&CC norms, fabrication yard, coal storage area, in-plant roads, etc. The layout of the plant and facilities for the proposed expansion 4x800 MW Coal based Thermal Power Plant (TPP) at Kawai, Tehsil Atru, District Baran, Rajasthan, has been largely dictated by its location, contour, shape, rail and road access, water source, windrose pattern, land use pattern of adjoining areas and the direction of power evacuation.

The green belt is anticipated to cover an extensive area of 289.44 Ha Ha i.e. 35% of total project area, contributing to environmental sustainability and landscaping around the plant. The internal break-up for land utilization is as below.

Table 2.7: Land Use Break Up

Sr.	Details	2x660MW (Phase-I)	4x800MW (Phase-II)	Total (Ph I & Ph-II)
1	Plant Area	70	138	208
2	Reservoir	65	-	65
3	Coal Stock Yard	40	65.2	105.2
4	Ash Dyke	60	57.06	117.06
5	Ash based Industries	6	-	6

6	Township	30	-	30
7	Green Belt	120	169.44	289.44
8	Total	350	470.7	820.7
Proposed Facilities outside the Power Plant Area*				
9	Coal Conveyor Belt**			1.758
***** FC Proposal No. FP/RJ/OTHERS/467838/2024 - Coal Conveyor Belt (ROW/ROU) – 1.758 Ha. (Revised forest area after Forest Dept. survey)***				

2.7 TECHNOLOGY & PROCESS DESCRIPTION

The proposed expansion project of 3200 MW capacity power plant is mooted to deploy the state-of-art technology and accordingly four units of 800 MW are being considered with ultra-supercritical steam parameters to attain high cycle efficiency.

MAIN TECHNICAL FEATURES OF THE PROPOSAL

Power Generating Unit	:	Four units of 800 MW turbine generator sets fed by steam from coal fired P.F. boiler operating at Ultra Super-critical range.
Cooling System	:	Closed recirculating condenser cooling system with Induced Draft Cooling Tower (IDCT).
Coal Handling System	:	Coal handling facility, which comprises receipt of coal through Indian Railway, with in-plant coal handling system and finally feeding the bunker level conveyors.
Ash Disposal System	:	The Fly Ash will be collected in dry form in fly-ash silos before transportation through rail wagons / closed trucks to Cement Plants in nearby area for further utilization. 100% of the Fly ash generated will be utilized in Cement Industries as per Fly Ash Notification, 31.12.2021 & bottom ash utilization in reclamation of abandoned mines, manufacturing of bricks, road construction, and aggregate replacement in concrete, etc. Un-utilized Botttom ash is being / will be stored in ash dyke using high/ medium concentration slurry disposal system.

		An MoU has been signed between APL and Ashtech (India) Private Limited, Mumbai, India for utilization of Fly ash for the proposed 3200 (4x800) MW.
Ash water recovery system	:	Ash water recovery system shall be common for two units & will consists of ash water tank and pump house for recirculation of for use in the Ash Handling system

2.7.1 DETAILS OF PROCESS & MACHINERY

The following are the existing facilities in the plant:

- Coal Handling Plant
- Ash Handling System
- Fuel Oil Handling System
- Ultra Super Critical Units/boilers having Advanced Low NOx System
- Turbine & Generator
- Ventilation & Air Conditioning System
- DM Plant & Heat cycle Make-up system
- Sanitary wastewater treatment
- Industrial wastewater treatment
- Reuse water treatment / coal bearing water treatment.
- Highly Efficient (99.99%) Electrostatic Precipitator (ESP)
- Selectic Catalytic Reduction (SCR)

- Separated Overfire Air (SOFA) systems
- Fire Protection & Detection System.
- Turbine Oil Purification System
- Condensate Polishing System
- CW Chlorination System
- Hydrogen Generation Plant

For the proposed expansion project, the details of power cycle equipment for 800 MW ultra-supercritical units are given below:

Table 2.8: Proposed machinery for 800 MW ultra-supercritical units

Equipment	Details
Boiler	Re-circulating
Turbine	1HP+1 IP+ 2LP
Generator (MVA)	940
LP Heaters	Four (4) to Five (5) Nos.
HP Heaters	Three (3) Nos. + one (1) dry heater
Deaerator	One (1) No.
Condensate Extraction Pumps	3 x 50%
Boiler Feed Pump	2x50% TD + 1x30% MD
Vacuum Pumps	4 x 50%
Condensate Polishing Units	4 x 33.3%
HP Bypass Valves	Two (2) Nos.
LP Bypass Valves	Two (2) to Four (4) Nos.
Recirculation Pumps	Two (2) Nos.

The steam parameters and basic inputs are given here under:-

800 MW Ultra Supercritical : M.S. – 270 Bar(a), 600 °C, 2195 TPH

R.H. – 600 / 610 °C

Feed Water Temp. : 194.8^{0}C (BFP Outlet)

Condensate Flow : 1435 TPH

2.7.1.1 Turbine Generator Unit

Steam Turbine Plant:

The steam turbine will be Ultra-Super-Critical, multi-stage, tandem compound, single reheat, condensing type machine operating at 3000 rpm with eight (8) uncontrolled extractions for regenerative feed heating. The turbine will be designed for main steam inlet parameters of around 27 MPa (a) pressure and 600°C temperature before the emergency stop valves of the HP turbine, reheat steam temperature of 600/610°C at IP turbine inlet with optimized condenser pressure and design condenser cooling water temperature of 33°C and temperature rise across Condenser limited to 8.5°C at TMCR condition. The turbo generator set will be designed for a maximum throttle steam flow at turbine valve wide open (VWO) condition of 105% of turbine maximum continuous rating (TMCR) flow. A quick acting HP and LP turbine bypass station will be provided as a part of the turbine package. The bypass station will act not only to stabilize boiler condition with sudden load dump/turbine trip out but also as a protection to the turbine during pressure rise resulting from sudden load throw off. In addition, it will enable quick start-up of the unit following a hot trip out by proper matching of boiler steam and turbine metal temperature. The bypass station will be sized for a flow corresponding to about 60% of Boiler MCR.

The steam turbine will be equipped with hydraulic turning gear for uniform heating/cooling of the rotor during start-up/shut-down. Highly sensitive electro-hydraulic governing system will be provided with suitable hardware to ensure fast speed of operation and safety. The electro-hydraulic governing system will be backed by hydromechanical governing and safety system ensuring stable operation under any grid fluctuation and load throw off condition. The turbogenerator unit will be provided with self-contained lubricating oil system for supplying oil to the turbine and generator bearings and also to the generator seal oil system. The lubricating oil will be cooled by closed circuit cooling water system utilising passivated demineralized water as cooling medium.

The unit will be capable of generating at MCR condition continuously with Condenser cooling water temperature of 33°C and specified make-up to heat cycle. It will also be capable of operating continuously under HP heaters out of service condition generating rated output. The design of the turbine will be based on the maximum pressure and temperature it is subjected to. The rotors will be dynamically balanced and heat stabilized with thermal deflection within prescribed limits of relevant codes. The Steam Turbine and Generator will include suitable emergency stop valve, reheat stop valve, interceptor valve, turbine control valves, HPLP steam turbine bypass system, piping, all special insulation, paints etc. Other protective devices i.e., emergency governor, emergency trip, unloading gears, vacuum breaker etc. as required for a modern utility plant will be provided. The sets will be complete with self-contained governing fluid, lube oil, seal oil, hydrogen filling, purging and pressure/purity monitoring/control system etc. as required for continuous safe and trouble-free operation. Besides these, a fully automatic gland steam sealing system will be provided. The electric generator will be three-phase, directly coupled, two-pole machine capable of generating 800 MW at generator terminals after meeting power requirement for excitation at a power factor 0.85 (lag) Peak loading of Generator will be considered as 105% of 800 MW but with improved PF (approx. 0.89) to remain within MVA capability limit. The generator will deliver power at 21~24 kV (As per Manufacturer's proven practice), 3 Ph, 50 Hz with short circuit ratio not less than 0.48. The rotor and the stator windings will be hydrogen and DM water cooled respectively. The generator will be suitable for connection by means of isolated phase bus duct to the low voltage winding of the step- up transformer. The generator will have Class-F insulation but rated for Class-B temperature rise.

The Turbine-Generator set will be capable of delivering continuously the rated power of 800 MW at 0.85 (lag) rated power factor when the voltage variation is within (-) 5% to (+) 5% of rated value and also when frequency variation is within (-) 5% to (+) 3% that is 47.5 Hz and 51.5 Hz. Generator will have static/brushless excitation system and be capable of maintaining steady generator terminal voltage under variable load conditions and also ensure generator stability under transient conditions.

2.7.1.2 Condensing Equipment & Accessories:

For increasing the turbine cycle efficiency, two (2) nos. single pass condensers having different back pressures have been proposed per turbine. Cooling water flows from one Condenser to another Condenser in-series manner.

The condensers will be of divided flow, single pass, horizontal, surface type. The condenser unit(s) will be transverse mounted and will condense exhaust steam by circulation of clarified water (design inlet temperature 33°C) in a re-circulating cooling water system using wet type cooling tower. Condenser outlet water temperature will be maintained within 41.5°C at TMCR condition. Clarified water will be the cooling medium in the condenser and in other auxiliary coolers. Condenser with Stainless Steel heat exchanger tubes, with steel tube sheet, baffle plates, etc. are envisaged for clarified water application. The condenser will be designed as per HEI code or equivalent. The design heat load of the condenser will consider the turbine operating condition at VWO having 105% MCR steam flow, maximum expected make-up, 90% tube cleanliness factor and a condenser cooling water inlet temperature of 33°C to maintain rated condenser pressure(s) For maintenance of degree of cleanliness of the condenser tubes, On-load ball re-circulation type tube cleaning system would be employed. The condenser will also be capable of accepting full HP-LP bypass steam flow (60% BMCR) safely without undue pressure rise, vibration, noise or other detrimental effects. Oxygen content of condensate leaving condenser hot well will be less than 0.015 CC/ litre over the entire load range.

Since the two Condensers of each unit have different back-pressures, separate air evacuation system will be provided for each condenser Two vacuum pumps (2x100%) are provided for each condenser to remove non-condensable gases and maintain vacuum in the condenser at the desired level during normal operation. For start-up both the pumps will be operated simultaneously. The condenser will be spring mounted with rigid connection to the turbine exhaust.

Condensate Extraction Pumps:

For each 800 MW unit, the condensate cycle will comprise three nos. (2W + 1S) 50% capacity motor-driven VFD controlled, vertical condensate extraction pumps of CAN-type construction. Connection between condenser and each pump suction will be through a block valve and removable strainer. The pumps will discharge through check valve and motor operated stop valves into a common discharge header.

Connection for condensate supply to the following major services will be tapped off from this condensate discharge header.

- LP bypass de-superheating spray.
- Turbine exhaust hood spray.

- Gland sealing system de-superheating.

Condensate will then pass in series through the condensate polishing system, gland steam condenser and drain cooler before being passed through the low-pressure feed water heaters. Condensate polishing system will have 4x33.3% mixed bed polishers for each 800 MW unit.

2.7.1.3 Steam Generators

Ultra-Super Critical Pressure ("USCP") power plant is envisaged with a view to capture better plant efficiency, minimizing basic fuel coal consumption and most important criteria being the drastic reduction of emission quantities of SO_2, NOx, CO_2 and particulate matters etc. as per MOEF & CC norms.

The USCP technology have been presently accepted & operational in India in various TPPs and adopted by NTPC for their 660MW Khargone plant and Adani in their 800 MW Godda TPP in Jharkhand State.

The steam generator units proposed for the station will be ultra-supercritical, once through, outdoor, pulverized coal fired, balanced draft, single reheat, dry bottom type with two pass or tower type arrangement as per manufacturer's standard practice. For improved efficiency at part loads and flexible operability, boiler, capable of sliding pressure operation, is favored. An added advantage is that this type of boilers features Boiler circulation pumps which shorten the start-up time and heat loss during start-up period.

The capacity of each steam generating unit will have adequate margin over the requirement of turbine at VWO condition in order to cater to:

- Auxiliary steam requirement for soot blowing operation
- Fuel oil heating and atomization.
- De-aerating of the steam generating unit during start-up and low load operation.
- Gland steam supply to turbine during start-up and low load operation.

The steam generators will be designed to operate with the HP heaters out of service condition (resulting in lower feed water temperature at economizer inlet) and deliver steam to meet the turbo- generator requirement at base load. Economizer section of the boiler will be non-steaming type with provision for recirculation during start-up, chemical cleaning etc.

Superheater section will be divided in convection and radiant zones and designed so as to maintain rated steam temperature of around 603°C (± 5°C) at the outlet over a control range of 50% TMCR to 100% BMCR load. The reheater section will be designed to maintain rated steam temperature of around 603°C/613°C (± 5°C) at the outlet over a control range of 50% TMCR to 100% BMCR load. Main steam de-superheating station will be provided with arrangement for spraying water tapped off from feed water piping. The steam generator will be conservatively designed for satisfactory, continuous and reliable operation at high efficiency with the range of coal expected for this station with minimum requirement of auxiliary fuel oil for flame stabilization etc. within its control range. Furnace will be conservatively designed to allow adequate residence time for the fuel to burn completely. The design air and flue gas velocities will be carefully selected to minimize erosion of pressure parts and other vital components. The pressure parts will be designed as per ISO/ASME Sec.1 and will conform to the current Indian Boiler Regulation. Each boiler will be provided with a set of automatic sequential electrically operated type steam soot blowers with provision of manual retraction in emergency for on-load cleaning of the heat transfer surfaces. Air preheaters of rotary trisector regenerative type of 2x60% capacity will be provided for the boiler. The regenerative type air heaters will be designed for minimum leakage and be practically maintenance-free with provision of air bypass. Cold start-up operation using steam coil air pre-heater (SCAPH) will be provided. The boiler furnace and flue gas passages will be designed for low gas velocities in order to minimize erosion or slagging.

The Steam Generator Control will include Burner Management System (BMS), Master Fuel Trip, Secondary Air Damper Control, Soot Blower System etc. Flame monitoring systems and field instruments including process switches & transmitters will be provided for the above controls. Final control elements for modulating and on-off duty control valves and dampers will also be provided to achieve remote control of the steam generating unit from central control room.

Draft System and Primary Air System Type

Draft system is envisaged to have two (2) sets each of Forced Draft (FD) fans, Combined ID Fans [CID] and Primary air (PA) fans, each set rated for 60% of BMCR capacity. The FD fans and PA fans will be of variable blade pitch control axial flow type with silencer at air inlet. The CID fans will also be axial type with variable blade pitch control. The equipment will be complete with lube oil, hydraulic regulations and all other accessories required for continuous operation. All equipment will be suitable for outdoor installation.

Pulverized Fuel Preparation System

The Steam Generator unit will be equipped with suitable pulverized coal firing arrangement comprising coal bunkers, gravimetric raw coal feeders, pulverizing mills, primary air fans and seal air fans, fuel and air pipes, burners etc. as necessary. When the unit is operating at TMCR with worst coal, one mill will remain as standby. Coal feed size is assumed to be (-) 25 mm. The feed control for coal will be done through selector switch either on manual mode or automatic mode and controlled as per the plant load and composition of the fuel. The firing system will employ latest low NO_X burners and permit load variation from 40-100% BMCR without auxiliary stabilizing fuel.

Light diesel oil (LDO) / High Speed Diesel oil (HSD) is envisaged to be used for cold start-up and for coal flame stabilization at low loads for supporting purposes. LDO/HSD system will be designed to cater up to 30 % BMCR of the Steam Generator and will comprise of oil storage tanks, unloading pumps, pressurizing pumps, strainers, piping, controls etc. 3x100% (each capable of meeting requirement one boiler) LDO/HSD pressurizing pumps (each capable of meeting requirement one boiler) have been considered for feeding the burners of two steam generators. Oil from the Storage tank will go to the inlet of fuel oil pressurizing pumps passing through suction strainer and there from be pumped to the burners. Excess oil from burners will be re-circulated back to the storage tanks. Oil burners will be complete with tips, extension pipes, atomizers, burner shut-off valve, flexible hoses and accessories. A good turn down ratio for the fuel oil system will be possible through burner turn down and selective use of a number of guns in steps.

The complete boiler will be top supported type and will be provided with all supporting steel structures, platforms, galleries, elevator and stairways for easy approach and maintenance of the unit. Adequate weather protection will be provided for instruments and operating personnel. Necessary lining and insulation along with fixing materials to limit outside surface temperature to a safe level will be provided. Monorails and hoists required for handling heavy equipment, motors, fans etc. will be supplied along with the steam-generating unit for ease of maintenance.

The Plant will be designed to comply with the current emission limits in flue gas promulgated by MoEF&CC vide notification dated 07.12.2015 and its subsequent amendments and as per the CPCB/SPCB norms.

Each steam-generating unit will be provided with Electrostatic Precipitators (ESP) having minimum four (4) independently operating gas streams/casings. Each gas stream/ casing shall be provided in twin section (compartments) each section of individual stream of ESP shall be provided with isolation dampers at inlet and outlet for carrying out maintenance work while the remaining streams of ESP are in service by completely isolating it electrically and grounding it. The design of ESP will be such that the outlet dust-burden does not exceed 30 mg/Nm^3 at 100% BMCR with worst coal firing and one field remaining as operational standby. The ESP will have adequate number of ash hoppers provided with electric heaters. The control of ESP will be based on microprocessor using semi-pulse device. To reduce the NOx emission from the Steam Generator, Selective Catalytic Reduction (SCR)/ Separated Overfire Air (SOFA) systems will be provided to reduce NOx emission from the unit below as per MoEF&CC stipulated standard with worst coal firing. The measures to be taken for NOx emission will include combination of the following methodologies – Low NOx Burners, Over-Fire Air, Fuel Biasing, Combustion Optimization and Selective Catalytic Reduction.

2.7.1.4 Coal Handling System

The Coal handling system will be common for 4x800MW. Coal from mines located in Chhattisgarh and Madhya Pradesh is considered as the primary fuel for the proposed green field project. For the project crushed coal (-300 mm) will be supplied from the mine end by railway wagons and will be unloaded into three (3) wagon tipplers.

Twin 100% capacity stream of conveying system is installed to ensure high availability. Bunkers would have a storage capacity of about 12 hours' coal requirement for the boiler. Necessary belt weighing at bunker level conveyors, electronic type level indicators, coal sampling units, reversible conveyors, flap gates, suspended magnetic separator, metal detector etc. would be provided in the system as required.

Coal in BOX-N wagons will be unloaded through wagon tipplers and conveyed to the boiler bunker through crusher house and a number of transfer houses. Provision has been kept for stacking crushed coal in coal stockyard from where coal will be reclaimed as and when the same will be required in coal bunkers.

The Coal handling plant includes receiving, stacking and conveying equipment up to the bunkers in coal mill building. Twin stream conveying system (2x100% capacity) is proposed for the system to ensure availability. Bunkers will have a storage capacity of about 12 hours' coal requirement for the boilers. The bunkers will be provided with rod and slide gates, arch breakers, etc. to facilitate operation. Necessary belt weighing at bunker level conveyors, electronic type level indicators, coal sampling units, reversible conveyors, flap gates etc. will be provided in the system as required.

Special precautions will be taken for pollution control by providing dust extraction and dust suppression systems in different transfer points and ventilation systems for the tunnels. In addition, roof extraction fans will be provided in key areas like boiler bunker floors. Pressurized ventilation systems with unitary air filtration unit will be provided for control room and MCC buildings.

A necessary water distribution network for drinking and service water with pumps, piping, tanks, valves, etc. will be provided for distributing water at all transfer points, control rooms etc.

A control room with microprocessor-based control system is envisaged for the operation of the Coal Handling Plant. Except locally controlled equipment like dust extraction/dust suppression/ventilation equipment, sump pumps, water distribution systems etc. all other in-line equipment will have provision of remote control. However, provision of local control will also be provided. All necessary interlocks, control panels, MCCs, mimic diagrams, etc.

will be provided in the control room for safe and reliable operation of the Coal Handling Plant.

The major equipment for coal handling system is listed below:

1. Wagon Tippler, Shifter & Pusher
2. Side Arm Charger
3. Apron Feeder
4. Belt Conveyors
5. Belt feeders
6. Stacker cum Reclaimer
7. In-line magnetic separators
8. Metal detectors
9. Cross-belt magnetic separators
10. In-line conveyor scales
11. Flow divider
12. Coal sampling unit
13. Flap gates, rod gates, slide gates
14. Bunker Level indicators: 3D acoustic type.
15. Motorized V-plough tripper
16. Bunker Sealing arrangement
17. Roof Extractors
18. Rack & Pinion Type Elevator
19. Electrical & Manual Hoist
20. Dry fog dust suppression system
21. Plain water dust suppression system

22. Dust extraction system
23. Compressors, Air Dryers, Air receivers
24. Chute liners and chute supporting structures
25. V- Plough Discharger
26. Belt Vulcanizer

The following are the salient points of design basis of the Coal Handling Plant for the proposed expansion 4x800 MW units are given in **Table 2.9.**

Table 2.9: Salient Features of Coal Handling System

S. No.	Considering	Unit	Coal Consumption (design) for 4x800 MW
1	Gross Calorific Value	kCal/kg	3200-4300
3	Annual Coal requirement for all 04 units considering 85% PLF	Million MTPA	**12.90**
		MT Per Annum	1,29,00,000
4	Daily coal consumption for all 04 units considering 85% PLF	TPD	35,340
5	Hourly coal consumption for all 04 units considering 85% PLF	TPH for 4 units	1472
6	Hourly coal consumption for per unit considering 85% PLF	TPH for 1 unit	368
7	Maximum size of Coal received at site	mm	(-)100
8	Mode of Coal Transportation	-	Through Rail

2.7.1.5 CONVEYING SYSTEM

In the primary route, coal will be directly taken to the powerhouse via crusher house bypassing the coal yard. This arrangement will be operational under normal conditions during daylight hours till the bunkers are full. Excess quantity will thereafter be stacked in the yard.

In the secondary route, the unloaded coal will be taken to the coal yard and stacked by stacker/reclaimer. The reversible type of stacker-cum-reclaimer will be rail-mounted, self-propelled unit with 41m boom length having adequate slewing and fluffing provision to stack coal upto a height of 10 m and reclaiming the same afterwards. For the proposed station two (2) stacker-cum-reclaimers are planned.

The design capacity of Coal Handling System for receiving will be 2500 TPH. Further, 2 nos. coal stockpiles, 1 no. stacker reclaimer and conveyor system for stacking & reclaiming are also envisaged.

2.7.1.6 CRUSHING & SCREENING

Suitable coal crushing equipment shall be included. This shall crush the delivered coal to a suitable size (25mm) for use by the boiler coal milling plant.

Coal from mines (-) 300 mm will be directly conveyed to the crusher house where four 60% crusher will crush coal to (-) 25mm size. The output of the crusher house will either go to the raw coal bunker of each unit or to the coal yard as per requirement.

Dust suppression equipment shall be included to ensure a safe working environment and to limit the release of dust to the external environment to acceptable levels. In-line magnetic separators shall be provided to protect the crushing equipment, the main boiler bunkers and coal milling plant from damage or poor operation due to any tramp metal. Screening equipment shall be included to ensure that only correctly sized coal is fed to the main boiler bunkers and coal milling plant.

2.7.1.7 STACKING AND RECLAIMING

In the secondary route, the unloaded coal will be taken to the coal yard and stacked by stacker/reclaimer. The reversible type of stacker-cum-reclaimer will be rail-mounted, self-propelled unit with 41m boom length having adequate slewing and fluffing provision to stack coal upto a height of 10 m and reclaiming the same afterwards. For the proposed station two (2) stacker-cum-reclaimers are planned.

A complete, fully operational and safe working coal storage stockyard with all associated equipment and environmental controls shall be provided to meet the functional requirements of the power station. The facilities of the coal storage stockyard shall include:

- Fully automatic stacking and reclaiming facilities.
- Bulldozers
- All environmental controls including dust suppression sprays and wastewater treatment.
- Auxiliaries like Dust extraction system, ventilation system, metal detector, Inline magnetic separator, Belt scale, Coal sampling unit, Elevator, Material handling system, Bunker ventilation system, Bunker sealing system, V-plough tripper, service water & drinking water shall be included.

The coal handling system shall be designed based on the following parameters:

- GCV of coal 3200-4300 kCal/kg
- Hours of operation considered -16 hrs
- Rated/Design capacity required -3870/4250 TPH

2.7.1.8 Ash Handling System

For each unit, Bottom ash will be collected in wet form; while fly ash will be collected in dry form to facilitate utilization. Fly ash and bottom ash shall be disposed via lean slurry /High Concentration Slurry disposal (HCSD) system to Ash dyke in case of exigencies; Ash extraction system is unitized basis and ash disposal systems will be common for 4x800MW. Provision for truck disposal of both bottom and fly ash is provided.

For the design of the Ash Handling System, the following data has been considered for each Unit. Necessary design margin shall be considered while selecting the equipment capacity.

Table 2.10: Quantum of Ash Generation

Parameter	4x800MW
Hourly coal (3,200-4300 kCal/kg GCV) firing rate at TMCR condition based on 85% PLF, per Unit (Approx.)	368.15 TPH
Total ash content	40%
Bottom ash (BA + Eco. Ash) generation @ 20% (T/day)	2,828

Fly ash (ESP + APH Ash) generation @ 80% (T/day)	11,308
Total Ash generation (T/day)	14,136
Annual ash generation @ 85% PLF (MMTPA)	5.16

Ash will be utilized for Cement Industries, Road Construction, filling abandoned Mines & low-lying area, Manufacturing of Bricks, aggregate replacement in concrete, etc. as per MoEFCC, Fly Ash Notification, 31.12.2021 and amendments. Provision will be made for disposal of un-utilized ash in high concentration slurry form to ash dyke.

An MoU has been signed between APL and Ashtech (India) Private Limited, Mumbai, India for utilization of Fly ash for the proposed 3200 (4x800) MW.

Bottom Ash handling system

It is envisaged that the bottom ash will be collected in wet. Efforts will be made to utilize 100% bottom ash as per MoEF guidelines. Unutilized bottom ash if any shall be disposed to the ash pond/ low lying area filling. Ash collected in Bottom ash hopper (B.A + Eco Ash) shall be transported to hydro bins through jet pumps and slurry pumps. Inside the hydro-bins, water shall be removed from the slurry & bottom ash from Hydrobins shall be disposed through trucks for further disposal to low lying area filling.

BA evacuation from BA hopper shall be done for 1.0 hour (per Unit) for every 4 hours (total 2 hours per Unit per shift of 8 hours). At a time only one Unit BA evacuation shall be done (i.e. Unit-1 BA evacuation followed by Unit-2 BA evacuation). 6 nos. Hydrobins shall be provided for four (04) Units.

a. Fly Ash handling system

The fly ash handling system shall be provided to remove fly ash from ESP hoppers and APH hoppers to transport fly ash to fly ash silos (main fly ash silos / MCSD fly ash silo) via pneumatic ash pipe conveying system. From the fly ash silos, fly ash shall be transported in dry form through bulkers truck / rail wagons for possible utilisation. The fly ash conveying system will be sized such that fly ash collected in 8 hours shall be evacuated in 5.5 hours.

For dry ash conveying to storage silos, 5 nos. (4W+1S) centrifugal type compressors shall be provided common for four (04) units. To facilitate easy flow of dry fly ash, 5 nos. (4W+1S) fluidizing blowers with heaters shall be provided common for all 4 nos. fly ash silos; Dry ash will be transported to 3 nos. main storage silos of RCC construction having combined capacity of 16 hrs storage, common for four (04) units. Each main fly ash silo shall be equipped with two outlet for loading of ash in conditioned form in to open truck / open rail wagons and two outlets for dry unloading in to closed tankers/trucks / closed rail wagons for utilization and two outlets for future use.

1 no. HCSD fly ash silo of suitable capacity shall be provided to cater to feed the fly ash to HCSD system for disposal of fly ash (along with bottom ash) in slurry form to Ash Dyke or in semi-wet form to load the trucks for further transportation to low lying area filling/possible utilization. HCSD fly ash silo shall be equipped with four (04) outlets for feeding fly ash to HCSD system, One (1) outlet for loading of ash in conditioned form to open truck, one outlet for loading of ash in dry form to closed truck for utilization and one outlet for future use.

b. Ash Water Recovery System

Ash water system shall be common for two units. Ash water system consists of Ash water tank and pump house to house 5 nos. (4W+1S) HCSD LP water pumps, 3 nos. (2W+1S) HP water pumps, 5 nos. (4W+1S) LP water pumps, 3 nos. (2W+1S) Economizer water Pumps, 3 nos. (2W+1S) HP seal water pumps, 5nos. (4W+1S) LP Seal water pumps and 1 no. HCSD emergency water pumps. Settling and Surge Tank shall be provided for recirculation of water (i.e. BA hopper overflow water, decanted water from Hydrobins) for use in the Ash Handling system.

c. Ash Pond

All efforts shall be made to promote utilization of ash to the fullest extent. However, in case of exigencies, unutilized ash will be disposed in to Ash dyke. Ash dyke shall be provided with lining and green belt. Ash dyke envisaged would be raised in stages. A suitable Ash water recovery system shall be provided to recover and re-use the Ash water collected in Ash dyke.

With a focus to utilize ash from start of operation phase, it is proposed to utilise existing Ash Dyke for proposed 4 x 800 MW units for exigency.

d. Mill Reject System

Pressure pneumatic conveying system shall be provided for conveying mill rejects (pyrites) from Coal Mills to Mill reject Silo. 5 Nos. (4W+1S) Conveying Air Compressors shall be provided common for four (4) Units. 1 No. Mill Reject Silo with 16 hours storage capacity shall be provided for each Unit for collection of mill rejects. Mill rejects from Mill reject Silo shall loaded in to tucks for further disposal. Mill reject system shall be designed considering 1% mill rejects in the coal consumption by each Unit.

2.7.1.9 Start-up Fuel System:

The fuel oil handling systems for the proposed 4x800MW Power Project would include unloading, storage, pressurizing of Light Diesel Oil / High speed diesel (LDO/HSD). The same would be required for light up and for load carrying purpose and also for flame stabilization up to 30% BMCR load.

System shall be designed meeting the requirements of Pollution Control/Petroleum/Explosive rules of Central and State Governments.

HSD / LDO will be brought to the plant by rail from nearby depots. The unloading area will have facilities to receive and unload oil from tankers to the headers. Three number (2W + 1S) Horizontal, twin-screw type unloading pumps shall be provided. Pump shall be sized for one (1) hour unloading time. Simplex strainer will be provided at each unloading pump suction.

Existing HFO tanks will be converted to LDO/HSD tanks to store LDO/HSD.

Five numbers (4W+1S) screw / centrifugal type HSD / LDO pressuring pumps shall be designed to supply the HSD / LDO flow requirement for each boiler simultaneously.

The HSD / LDO pressuring pumps shall be selected at 110% of the actual required design flow to account for the wear over the operating life. Configuration shall have individual pumps for each unit with at least one standby. Duplex strainer shall be provided at forwarding pump suction and discharge common header. Design flow capacity of each fuel oil pump for two boilers: Catering to 30% of the BMCR capacity. HSD / LDO pressuring Pumps Recirculation Control Valves shall be designed to the maximum flow capacity of Full pump discharge flow and minimum flow capacity of 10% of pump discharge flow.

All instrumentation and control facilities including tank level controllers, pressure/temperature gauges, control valves etc. along with a local control panel in the fuel oil pump house will be provided for safe and reliable operation of the system.

The Auxiliary Oil System and its facilities will be designed as per Pollution Control/Petroleum Rules/Explosion Acts/Fire Rules of Govt. of India.

2.7.1.10 Ventilation System

Adequate ventilation system has been considered for the powerhouse building, Central Control Building, ESP control building, Air Compressor House, Blower room for Ash Silo & Vacuum Fly Ash System, Switch Yard Control Building and other areas like A/C plant room, Switch gear room for Cooling Towers, DM plant building, CW Treatment Building, Chemical House, DG Building, Hydrogen Generation Plant, Elevator Machine rooms and various pump houses like Ash Slurry pump house, Clarified Water pump house, Fuel Oil Unloading and Pressurizing pump house etc. with their associated Electrical rooms, Workshop and Store, Fire Station Building, Kitchen/ Pantry and Toilet areas of Canteen Building, Service building and Administrative Building etc. to achieve the following :-

i. Dust-free comfortable working environment.
ii. Scavenging out structural heat gain and heat load from various equipment, hot pipes, lighting etc.
iii. Dilution of air polluted due to generation of obnoxious & hazardous gaseous/aerosol contaminants like acid/chemical fumes, dusts etc.

Ventilation system proposed for important areas are described below:

a. Powerhouse and Central Control Building

Supply/exhaust ventilation system with evaporative cooling has been recommended for the powerhouse building. Inside temperature shall be 3°C lesser than outside and +3mm WC positive pressure above atmospheric Ambient air would be drawn through air inlet louver, automatically cleanable water flooded type SS mesh filters, water wetted fill deck and moisture eliminator and will be supplied by means of centrifugal fans to powerhouse through ducting and grilles to achieve proper distribution. The sprayed water over the SS mesh filter will be re-circulated by means of centrifugal pumps, piping, valves and other accessories. Similarly, water dripped over the Fill Deck will also be re-circulated by means of centrifugal pumps, piping, valves and other accessories.

'Exhaust' system consists of axial flow wall/roof-mounted exhaust fans with rain protection cowl/ hood, short ductwork, etc. Part of the supplied air will be exhausted and the rest will ex-filtrate through the various openings in the structure, preventing infiltration of dusty air.

Various non-air-conditioned rooms in the Central Control Building e.g., cable spreader room, switchgear & MCC rooms, SWAS wet panel rooms and Battery Charger rooms etc. will be ventilated by means of the same Evaporative Cooling units for Power House.

Exhaust ventilation system will be provided for the Battery Rooms to evacuate acid fumes and hydrogen. Bifurcated type explosion proof exhaust fans will be employed for this purpose.

Coal tripper floors are proposed to be provided with exhaust system to eliminate building-up of hazardous gases like carbon monoxide, methane etc.

Pressurized Ventilation system will be affected for the Elevator Machine rooms by means of wall mounted Fan-Filter units and back draft dampers.

All toilets will be ventilated by providing wall mounted exhaust fans.

b. ESP and AHP Control Buildings

For ventilation of these building (except the control room), Sheet metal type Unitary Air Filtration unit (UAF) of suitable capacity shall be envisaged for each unit of ESP Building non-AC areas. Inside temperature shall be 3°C lesser than outside and +3mm WC positive pressure above atmospheric. A dedicated plant room shall be provided for UAF unit.

Ambient air will be drawn through unitary air filtration unit comprising fresh air intake louvers, automatically cleanable SS mesh filters (with water spray) and moisture eliminator and supplied to the space by means of centrifugal fans. Water sprayed over the filter will be re-circulated by means of centrifugal pumps.

In addition to filter cleaning, the water spray will have an evaporative cooling effect too. This will produce some cooling effect as an additional advantage.

The supplied air will be exhausted through wall mounted gravity operated dampers (Back Draft Dampers) to maintain an overpressure of +3mm of water column to reduce dust ingress.

c. Other Buildings

Other buildings like Air Compressor House, A/C plant room, DM plant building, CW Treatment Building, Chemical House, DG Building, MCC/ Switch gear room of Switch Yard Control Building, Hydrogen Generation Plant Building, Aeration Blower room for Ash Silo and Blower Room for Vacuum Fly Ash System, Various pump houses, like CW/ACW pump house, Raw Water pump house, Ash Water pump house, Ash Slurry pump house, Clarified Water pump house, Fuel Oil Unloading and Pressurizing pump house etc. with their associated Electrical rooms, Workshop and Store, Kitchen/ Pantry and Toilet areas of Canteen Building , Service building and Administrative Building etc. will be ventilated by means of dry system comprising axial flow fans, dry filter (wherever required), cowls, ducting (wherever required), gravity dampers (wherever required) etc. Inside dry bulb temperature (DBT) is expected to be higher than ambient by about 3°C.

2.7.1.11 Air Conditioning System

Various control rooms in power Project, housing a group of sophisticated and precision control panels and desks call for controlled environment for proper functioning and for personnel comfort.

Some other facilities like Administrative Building, Service Building, Canteen Dining Hall etc. will also call for comfortable environment for the occupants.

The following areas are proposed to be air conditioned:-

i. Control room, control equipment room, Shift Charge Engineers' rooms, computer room, Printer room, Record room, UPS room SWAS dry panel room, CPU Control room, Laboratory room, Central Control Building/Turbine Building.

ii. Electrostatic precipitator control room

iii. AHP Control Room

- **a.** Coal Handling Plant control room
- **b.** DM plant control room, office and Laboratory area
- **c.** CW control room
- **d.** Raw water pump house control room
- **e.** Cooling tower control room
- **f.** ETP/STP control room
- **g.** Compressor control room
- **h.** Stores- Maintenance office room
- **i.** Stack emission monitoring system control room
- **j.** Fuel oil unloading/forwarding pump house control room
- **k.** Electro chlorination control room
- **l.** Office areas, lecture rooms etc. in the service building
- **m.** Switchyard control room
- **n.** Weighbridge Control room
- **o.** Fire Station Control room
- **p.** AC Plant Control room
- **q.** Hydrogen Generation Plant Control room
- **r.** Other Control rooms housing PLC panels
- **s.** Different floors of the Administrative Building
- **t.** Dining Hall of Canteen Building

To cater to the above requirements, the following systems are proposed**: -**

i. A central chilled water plant to cater to the air conditioning requirement for the Central

Control Building, ESP control building, VFD room and Service Building, comprising Vapour Absorption Chiller and stand-by Screw Chillers, condenser cooling water circulating pumps, cooling towers, chilled water circulating pumps, cooling water and Chilled water piping with valves, accessories, fittings, supports, insulation as applicable, steam piping with fittings, supports, insulation, PRDS and associated Electrical items etc. has been envisaged. The chilled water produced in this central Chilled water plant will be circulated through the coils of individual air handling units for the respective air conditioned rooms /areas. This Central Air Conditioning System will be operated and controlled from the AC plant Control room DDC panels and two nos. Workstation PCs.

ii. Individual Water Cooled Precision Air Conditioners (PAC) will be provided for AHP Control room and DM plant Control Room, Office and Laboratory. Condenser Cooling water will be supplied to such PAC units from the Plant ACW system. Such PAC units will be operated and controlled from their built-in Microprocessor based Control console.

iii. Individual Air Cooled Precision Air Conditioners (PAC)/VRF based will be provided for Switch Yard Control Room and CHP Control room. Such PAC/VRF units will be operated and controlled from their built-in Microprocessor based Control console.

iv. Air Cooled Duct-able Split/ Packaged Air Conditioners/VRF system will be provided for Dining Hall of the Canteen Building and Administrative Building. These Air Conditioners will be operated and controlled from their built-in Microprocessor based Control Console/ hand operated Remote Control Panels.

v. Air Cooled Non Duct-able Split Air Conditioners will cater to the AC requirement of Weighbridge Control room, Fire Station Building Control room, Hydrogen Generation Plant Control room, AC plant Control room and other small control rooms housing PLC panels. These Air Conditioners will be operated and controlled from their individual hand operated Remote Control Panels.

2.7.1.12 Compressed Air System

Six (06) nos. of centrifugal type instrument air & service air compressors shall be provided for the 4x800 MW power Project to take care of continuous and intermittent demand. Normally four (4) compressors will continuously run to meet the sustained demand and will also serve on automatic mode and will run to meet the intermittent peak demand. Other two compressors will be kept as operation and maintenance standby. Common four (4) number of air receivers of capacity min.30 Cu.m shall be provided to absorb pressure pulsations and for acting as reserve supply of compressed air to permit continued operation following failure of the operating compressor until the standby one comes into service.

Five (5) numbers (4 Working + 1 Maintenance standby) Heat of Compression (HOC) type regeneration air dryers to match instrument air compressor capacity along with all accessories including control panel, flow meter, online digital dew point meter at the outlet of each dryer, etc.

Plant Air Quality will comply with ISO 8573.1, quality class 2.2.1. For air dryer, Atmospheric dew point shall be -40° C.

One (1) Control valve with manual bypass arrangement provided at the service air distribution header which will close (below a pre-set value) to maintain sufficient pressure at the IA distribution side.

The service air requirement for normal cleaning purposes, atomizing air medium for warm-up guns and ignitors, motive power for burner drive mechanism etc. of air pre-heaters will be met from plant-air compressors.

Service air system will have suitable inter-connection with the instrument air header for augmenting instrument air supply in emergency.

2.7.1.13 Fire Protection System

A comprehensive fire detection and protection system is envisaged for the complete power Project. This system will generally conform to the recommendations of TAC guidelines, IS standard and NFPA.

Fire protection system includes following:

- Hydrant system
- Automatic high velocity & medium velocity water spray system
- Automatic fixed foam system for fuel oil storage tank

- Automatic inert gas system
- Potable and mobile fire extinguishers
- Fire tender

Hydrant system:

Hydrant system for complete power plant covering the entire power Project including all the auxiliaries, buildings in the plant area. The system will be complete with piping, hydrants, valves, instrumentation, hoses, nozzles, hose boxes/stations etc.

Automatic high velocity & medium velocity water spray system

Automatic high velocity water spray system for all oil filled transformers located in transformer yard (oil capacity 2000 litre & above) and those of rating 10 MVA and above located within the boundary limits of plant, main and unit turbine oil tanks and purifier, lube oil piping (zoned) in turbine area, generator seal oil system, lube oil system for SG feed pumps, consisting of detectors, deluge valves, projectors, valves, piping, instrumentation etc.

Automatic medium velocity water spray system for cable vaults and cable galleries of the main plant, switchyard control room, CHP control room and ESP control room consisting of smoke detectors, linear heat sensing cable detectors, deluge valves, isolation valves, piping, instrumentation, etc.

Automatic medium velocity water spray system for conveyors, galleries, transfer points and crusher house consisting of linear heat sensing cables, IR detector, heat detectors deluge valves, nozzles, piping, instrumentation, etc.

Automatic medium velocity water spray system for un-insulated fuel oil tanks storing fuel oil having flash point 65 deg C and below consisting of QB detectors, deluge valves, nozzles, piping, instrumentation, etc.

Automatic fixed foam system for fuel oil storage tank

Foam injection system for fuel oil storage tanks consisting of foam concentrate tanks, foam pumps, in-line inductors, foam monitor, foam hydrant, valves, piping & instrumentation etc.

Automatic inert gas system

For protection of control room, equipment room, computer room and other electrical and electronic equipment rooms, suitable "Halon substitutes" such as "INERGEN" or "AGRONITE" system would be provided.

Potable and mobile fire extinguishers

Portable and mobile fire extinguishers, such as pressurized water type, carbon-dioxide type, foam type, dry chemical powder type, will be located at strategic locations throughout the plant.

Fire tender

Two no. fire tender of multipurpose type shall be provided in the fire station.

Fire detection and Alarm system – A computerized analogue, addressable type early warning system will be provided to cover the complete power plant with compatible detection systems.

An over ground fire water pump house will be constructed near these firewater storage tanks.

The Fire water supply system shall consist of the following major equipment:

- Two (2x100%) main electric motor driven hydrant pump
- One (1x100%) Diesel engine driven hydrant pump
- One (1x100%) electric motor driven spray water pump
- One (1x100%) diesel engine driven spray pump
- Two (2x100%) jockey pump electric motor driven & one number of hydro pneumatic tank with two (2x100%) reciprocating compressor shall be provided to maintain the constant pressure in complete system.
- One number (two compartment) aboveground RCC fire water storage tank shall be provided.

Firewater pumps will be installed in the pump house for hydrant and spray system and the same will be driven by electric motor and diesel engines as per TAC guidelines. The water for foam system will be tapped off from the hydrant system pumps.

The Fire Protection Water supply system shall be maintained at a static pressure of 10.5 Kg/cm^2 (g) by the pressure maintenance pump which shall start automatically when the pressure falls below a pre-set level.

For boiler area, Depending on the height of boiler & restriction in main pump static head, booster pumping station shall be provided to maintain the pressure of hydrant valve at boiler tope area,

One (1x100%) Diesel engine driven hydrant pump

One (1x100%) electric motor driven spray water pump

All necessary instrumentation & controls for the entire fire detection, alarm and protection system will be provided for safe operation of the system.

2.7.1.14 Piping, Valves, Fittings & Specialties

The scheme of various systems such as, steam of sub-critical and supercritical parameters, condensate, water, oil, air etc. have been explained above. Piping, valves, fittings, hangers, anchors, supports, guides etc. would be provided as required. All high pressure, medium pressure and low pressure lines will be of proven quality and suitable for conditions of operation encountered at the specific points. Pipelines running outside the powerhouse will be routed over trestles as far as practicable in order to avoid maintenance and other problems encountered with trench piping and buried piping. However, for rail culvert crossing piping inside trenches and for large diameter water lines buried pipes with proper coating and waterproofing would be adopted.

2.7.1.15 Miscellaneous Auxiliaries

Turbine oil purification system:

A suitable centrifuge or other type of turbine oil purification plant will be provided as an auxiliary of the turbo-generator to condition the turbine oil continuously, in order to remove the water and other impurities from the system to maintain the turbine oil at the optimum condition. In addition to the above unit system, a central turbine oil storage unit comprising one clean oil tank, one dirty oil tank, one purifier unit and necessary pumps, vent fans etc. will be kept. This would also receive the refill of turbine oil from outside. The purification plant to be provided with the unit system will be complete with oil purifiers, storage tanks, filters, necessary pumping sets, vent fans etc.

Condensate polishing system:

The proposed 4 x 800 MW Power Project will be provided with 100% capacity condensate polishing system per unit. Condensate polisher will comprise four (4) demineralisers per unit each operating in parallel. Any three (3) of these units will be capable of treating the full condensate flow at boiler MCR condition. Condensate polishing will ensure elimination of ammonia, silica, sodium or potassium from the condensate before being recycled to the feed water system. Condensate polishers will operate at 100% capacity during normal operation to maintain boiler water chemistry as required by OEM. Three (3) of the exchanger vessels will be working in parallel and the fourth one will remain isolated from the system. The fourth vessel will act as standby and will be brought into operation when regeneration is required or during any emergency period. The polishing unit would be located at the powerhouse building. The operation of the condensate polishing system will be semi-automatic, remote/manual.

The regeneration system will be external. For regeneration, the resins from the exhausted exchanger vessel will be transferred hydraulically to this facility located at DM plant and regenerated resin sent back in the same way.

Chemical feed system:

For maintaining ultra-supercritical steam parameters water chemistry assumes greatest importance. Oxygenated treatment (OT) program is adopted with 100% condensate polishing plant which has proven essential for once-through system. During start up and low load operation all volatile treatment (AVT) is followed with an oxygen scavenging chemical. Chemical feed system will be provided for feeding neutralizing amine for pH control and oxygen injection during OT (normal conditions) and neutralizing amine and hydrazine for

AVT (startup condition). The chemicals are injected in the condensate pump discharge with additional provision in the boiler feed suction line to maintain the chemical concentration in the feed water circuit within permissible limits for trouble-free operation of the plant.

Oxygenation system will consist of high pressure cylinder banks with standby, regulating station and mass flow control valve for injection.

The Low Pressure chemical dosing system (amine and hydrazine) of each unit will consist of: -

i. A mixing tank provided with stirrer and a metering tank
ii. Two (2) full capacity, variable volume metering pumps, complete with suction filters and other accessories and fittings as necessary. These LP pumps will inject hydrazine or other chemicals into the condensate pump discharge/boiler feed suction. Normally one pump will be running and the other will be standby.
iii. Necessary piping, valves, fittings and instruments.

In circulating cooling water system shock chlorination would be done to contain algae growth. Continuous chlorination will be required for the potable water system.

Hydrogen Generation Plant:

A hydrogen generation plant is being provided in the proposed expansion project to meet the requirement of hydrogen gas required for cooling the generator. Hydrogen generation plant capacity of 2 x 15 m^3/hr has been proposed. The plant would be located at a safe distance from other installation as per statutory requirements of the explosive act. Provision shall also be made to collect the by- product oxygen produced in compressed gas cylinders for medical use within the plant medical unit.

Plant Elevators:

One (1) goods-cum-passenger elevator will be installed for each boiler. In addition, one (1) passenger elevators will be installed in powerhouse building & one (1) passenger elevator will be installed in new service building.

Cranes & hoisting equipment:

Two EOT cranes of suitable capacity is proposed to be provided in the turbine hall and will be used for maintenance of the TG hall equipment. Temporary gantry crane is proposed for lifting generator stator and heavy equipment.

Conventional and special type of cranes required for maintenance of certain SG and TG equipment such as FD/PA/ID fans, condenser water box, ESP, transformer rectifier sets etc. will be supplied by the respective equipment supplier. For clarified water pump house a crane of suitable capacity (pendant operated) and for circulating water pump house a pendant operated of suitable capacity electric travelling crane have been considered. Two pendant-operated of suitable capacity of SG/DG EOT cranes are proposed for ash slurry pump house and store building.

Maintenance cranes/handling devices of suitable capacities have been considered for all other pump houses and other places such as coal handling plant transfer points, DM plant, etc. Monorails for lifting heavy motors and other equipment within the powerhouse not covered by EOT crane such as miscellaneous pumps, heat exchangers etc. will also be provided. Suitable rails will be provided, if necessary, on floor for bringing the horizontal feed water heaters under the approach of EOT crane.

2.7.1.16 Associated Facilities

Repair workshop:

For achieving higher availability of the plant, the plant maintenance would be done following a concept of unit exchange system for repair and maintenance.

Under this system, the defective components would be replaced immediately by sound ones from the stores. The defective components would thereafter be repaired in the workshop and sent back to the stores. Following this system, two types of activities namely maintenance and reconditioning would be physically separated thereby speeding up maintenance activity.

In order to carry out the repair activities, it is envisaged to provide the following shops:-

A. Main workshop near the main powerhouse building.

B. Electrical and Instrument repair shop housed within the powerhouse building or in the workshop.

C. A repair shop for mobile equipment would be located near the coal storage yard.

D. Motor vehicle repair shop.

Necessary machinery, tools and tackle required for the nature of repair involved would be provided at all the above shops.

Workshop shall be provided for repair & maintenance purpose & shall be decided during detailed engineering.

<u>General stores:</u>

Both covered and open space will be required for storage of various materials required for construction as well as operation and maintenance of the plant. While the construction stores will be temporary, the other stores will be permanent. Consumables, tools and tackle and other relevant items required for the 800 MW Unit size will also be kept in the stores.

The stores will broadly have the following divisions to house material of different categories:

1. Heavy materials store will house boiler tubes of various sizes, boiler and auxiliary parts, turbine heavy parts, stainless steel plates, conveyor belt and other coal handling equipment spares, dumper and dozer spares, motors, transformer windings, firefighting equipment, insulators and hardware connectors, copper and aluminium conductors and similar heavy items.
2. Mechanical, electrical and instrument stores will accommodate small spare parts for mechanical and electrical equipment and instruments respectively.
3. Fast moving spares store will house electrodes and welding materials, blow lamps, bulbs and light fittings, grease, soap, battery, cotton waste and cloth, brooms, motor vehicle spares, gas cylinders, gloves, aprons, safety belts, goggles, ropes, refill for the firefighting equipment etc.
4. Chemical stores will house alum, lime, morpholine/hydrazine resin, spirit and other

chemicals required for steam, feed water and condensate system and chemical laboratory.

5. Civil engineering store will accommodate cement, sanitary materials, filtering sand and filters, pipe and pipe fittings etc. for water supply.
6. Refractories and lubricants will be stored under separate covered sheds.

Open storage-yard will be provided to store structural steel, rail, sleeper, heavy castings, cable reels etc.

Suitable enclosures will be provided for storing the insurance spares. Arrangements will be made for storing items like relays, motors, and instruments under controlled atmospheric conditions.

Chemical laboratory & testing facilities:

A central chemical laboratory in the service building is envisaged for the Project. This will have necessary equipment and facilities to test and analyse steam, water, oil, fuel etc. required to ensure satisfactory operation and maintenance of the Power Plant. The testing and calibration laboratories for C&I and relay-metering will also be housed in the same building, with necessary equipment and standard instruments for chemical analysis of various items, testing of electrical items and testing/calibration of instruments.

For all practical purposes, the chemical laboratory and testing facilities shall be provided.

Thermal insulation:

Adequate insulation will be provided to reduce heat losses from the equipment, piping and ducts and to ensure adequate personnel protection in critical areas. Insulation would be so selected that the covering jacket surface temperature does not exceed the surroundings ambient temperature by more than 15 °C.

2.7.1.17 Pollution monitoring system:

Monitoring of various environmental aspects is of prime relevance in setting-up the proposed unit. The following aspects would be critically monitored:-

- To keep watch on the state of pollution
- To generate data for predictive and corrective measures
- To quantify environmental impacts

The important area requiring periodic/conditions monitoring are:-

- Stack emission
- Ambient air quality
- Disposed water quality (if any)

Electronic smoke density analyser and gas analyser equipment is proposed to be provided for continuous monitoring of particulate matters at the outlet of ESP. Sample analysis of NOx, ammonia slip, SO_2 and other pollutants from chimney would be carried out. Wastewater would be checked for any harmful pollutants before discharging to outfall (if applicable).

An oil/water separation unit has been envisaged near fuel oil day tank/pump house area in order to keep plant drains free of oil and to reclaim waste oil as far as practicable. Oil thus separated would be returned to the fuel oil tank and used or disposed of by incineration.

Coal Handling and Ash Handling Plants will be equipped with dust extraction/suppression system to combat fugitive dust.

2.7.1.18 Electrical System & Equipment

Power from the proposed power station will be available at 400kV level at the bus bars of the EHV switchyard of the power plant. Power from this switchyard would be evacuated through one 400 kV double circuit line to the nearest grid sub-station.

The 400 kV switchyard of the generating station will be located in front of the transformer yard.

Design Parameters

Following criteria/data will be used in engineering the electrical system and equipment for 4x800 MW power plant.

System Configuration

The system configuration is based on the concept of single contingency of operation i.e. failure of any auxiliary transformer or supply feeder pertaining to any subsystem will not affect the full load operation or start- up/shut down operation of any unit.

400 kV System Data:

a. Maximum short circuit level : 63 kA for 1 sec.

b. Maximum system voltage : 420 kV

Voltage at Load Terminal

a. At full unit load, the voltage will not drop below 90% of the rated voltage.

b. At light unit load, the voltage will not exceed 110% of the rated voltage.

c. During starting of large motor, the voltage will not drop below 80% of the rated voltage.

System Parameters & Variations

System parameters for utility systems are detailed below:-

Table 2.11: System parameters for utility systems

S. No.	System Voltage & Frequency	Fault level	Grounding
a.	11000 V ± 10%, 3Ph, 3-wire, 50 Hz - 5% to +3%	50 KA (1 sec)	Non effectively earthed
b.	6600 V ± 10%, 3Ph, 3-wire, 50 Hz - 5% to +3%	50 KA (1 sec.)	Non effectively earthed
c.	415 V ± 10%, 3Ph, 4-wire, 50 Hz - 5% to +3%	50 KA (1 sec)	Effectively earthed
d.	240 V ± 10%, 1Ph, 2-wire, 50 Hz - 5% to +3%	25 KA (1 sec)	Effectively earthed
Combined voltage and frequency variation 10% (Absolute sum)			
d.	220 V DC (–) 15% to (+) 10%, 2-wire	25 kA (1 sec)	Unearthed

2.7.1.19 ENVIRONMENTAL CONDITION

Electrical equipment will be installed in a hot, humid, and tropical atmosphere, heavily polluted at places with coal dust and/or fly ash and will be designed accordingly.

The equipment will be capable of continuous full load operation under the following site conditions :-

- Finished Grade Level : 181.0 M above MSL
- Annual Ambient

  Air Temperature : (+) 44.8°C (Max.)

  (+) 4.0°C (Min.)
- Relative Humidity : 85% (Max.)

  18% (Min.)
- Wind Velocity : 27 km/hr. in accordance with I.S.: 875
- Seismic Zone : Zone II as per IS- 1893
- Sensitive electrical and electronic devices will be placed in controlled environment such as control room, electronic equipment room, etc. as required.

All electrical equipment are to be designed for ambient temperature of 50ºC and relative humidity of 95%. Sensitive electrical and electronic devices will be placed in controlled environment such as control room, electronic equipment room, etc. as required.

2.7.1.20 CODES AND STANDARDS

Electrical equipment will be designed in accordance with the latest applicable Indian Standards (IS), International Electro-Technical Commission (IEC) standards, CEA guidelines and publications of Central Board of Irrigation & Power (CBIP).

Electrical installation work will conform to the provisions of Indian Electricity Act/Rules, CEA guidelines relevant I.S. Codes of practice and also comply with other statutory rules and regulations, as applicable.

2.7.1.21 ELECTRICAL SYSTEM

GENERATION SYSTEM & POWER EVACUATION

Proposed power station will have 4x800 MW STG units generating power at 27 kV or as per manufacturer standard. These units will be connected to 400 kV switchyard in the plant for evacuation of generated power. The switchyard will be contained in a fenced area separated from the generation building. The bus bar configuration will be suitable for one and half circuit breaker arrangement for better reliability, comprising four (4) bays.

- Four (04) – 400 kV circuits for generator transformers bay
- Two (02) – 400 kV circuits for station maintenance transformers bay
- Four (04) – 400 kV circuits for outgoing lines with switchable line reactor.
- One (01) – 400 kV circuit for Bus Reactor

A control room will be located in the switchyard premises to house switchyard control, metering and protective equipment. For reliable communication and carrier aided distance protection of 400 kV remote end breakers, power line carrier communication equipment (PLCC) and Fibre Optic Telecommunication Equipment (FOTE) will be installed in the switchyard in consultation with Utility.

In the Power House, each generator will be directly coupled to the respective steam turbine and will have a nominal rating of 800 MW at 0.85 p.f. (lag). Generation voltage will be 3-phase, 27 kV with variation of ±5%, at frequency 50 Hz with variation of + 3% to - 5%. The excitation system will be brushless or static type as per manufacturer's standard and will be selected for an ideal rate of response, accuracy and sensitivity during normal as well as transient state of operation. The generating unit will be connected to 400 kV switchyard through the Generator Circuit Breaker (GCB) and three-phase bank of three (3) single phase, 27/(400/√3) kV step-up generator transformers (GT) of 315 MVA each, having the total capacity of GT as 945 MVA. Connection between generator, GCB and generator transformer low voltage terminals will be through isolated phase generator bus duct and that between the high voltage terminals and the switchyard by outdoor overhead ACSR conductors.

POWER DISTRIBUTION SYSTEM

Three voltage levels viz. 11KV, 6.6KV and 415V have been envisaged to supply power to the unit and station auxiliaries in the power plant. According to the kW rating of motor, its rated voltage will be as follows:

Table 2.12: Motor rating details

kW rating of AC Motor	Rated Voltage
Motor kW <0.2 kW	230V , 1 phase
0.2 kW < Motor kW ≤ 200kW	415V, 3 phase
200 kW > Motor kW ≤ 2000 kW	6.6KV, 3 phase
Motor kW > 2000 kW	11KV, 3 phase

During starting of the unit the start-up power will be drawn from 400 kV bus through 400/27 kV Generator transformer. The generator will then be synchronized through GCB at 27 kV system. In the event of unit trip, power will be drawn from the 400 kV bus through Generator transformer for coasting down of the unit. As the system is a GCB scheme 2X50% unit transformer per unit and 1X100% Station transformer will be provided to feed the Unit and station auxiliaries and unit start-up / shutdown facilities. The 400 / 34.5 kV station maintenance transformers and 33/11.5 kV power transformer shall be used as back up to station/unit transformer and also used to take unit maintenance power in case of GT shutdown. During complete blackout, emergency DG set will be automatically started and will provide power to essential loads for carrying out safe shutdown of the unit.

11 kV System

11 kV station power will be derived from the 11.5 kV windings of 27/11.5 kV unit/station transformers and 400/11.5 KV station maintenance transformer. The 11.5 kV terminals of the transformers will be connected to 11 kV station/unit/maintenance switchgears through 11 kV segregated phase bus ducts. 11kV Unit switchgears will feed power to motor driven boiler feed pumps.

The dam-side Intake Pump House located within 2 km away will get two feeders from the 11 kV station switchgears. Those feeders will be upgraded to a higher voltage level if required to maintain allowable minimum voltage for the pump motors at starting. This aspect will be examined at the detail development stage.

In addition 11 kV Unit and Station switchgears will act as power source to 11/6.9 kV auxiliary power transformers. Two such transformers will be in the transformer yard of Power House for feeding the station/Unit loads of Power House area. A set of another two 11/6.9 kV auxiliary power transformers will be at CHP/AHP area to feed the loads of CHP/AHP. 11 kV switchgears will also act as power source to 11/0.433KV LV service transformers, which will feed the station loads for auxiliaries of Switchyard, auxiliaries of compressed air system, A/C & ventilation system, Plant Illumination System, welding boards and other station service loads through a number of 415V switchgears. 11 kV station switchgears/Unit Switchgear/Station maintenance will be interconnected by full capacity tie by means of 11 kV segregated phase bus ducts.

During normal running of the Unit, its auxiliaries like ID fan, PA Fan, FD Fans etc. will be fed from unit transformers. Two nos 27/11.5 kV transformers and 1 (ONE) 27/11.5 kV station transformer fed by each generator will cater the unit /Station auxiliaries of each 800 MW Unit through two (2) nos. unit 11 kV switchgears and one (1) station switchgear. Each 11 kV unit/station switchgear will be interconnected to 11 kV station maintenance switchgear by separate circuit breakers and segregated phase bus duct. During normal operation of the unit each 11 kV unit/station switchgear receives power through 27/11.5 kV unit transformer and 27/11.5 kV station transformer.

Construction power:

The peak demand of construction power is estimated as 7500 kVA, assuming certain quantity of site fabrication of steel structures and piping. The required construction power supply will be obtained either from the grid, depending upon feasibility.

6.6 kV System

6.6 kV power system will be derived from 11 kV system through 11/6.9 kV auxiliary power transformers and will be used mainly for feeding 6.6 kV motor loads and 6.6/0.433 kV auxiliary transformers. To cater the 6.6 kV motor loads/transformer load Unit/AHP/CHP there will be separate set of transformers and switchgears. There will be one (1) 6.6 kV switchgear for each unit and AHP/CHP loads. This unit switchgear will be in the Power House and will be fed from transformers located in Transformer Yard adjacent to Power House. 6.6 KV switchgears being located at respective load centre, will also be used to cater the 415V loads of respective area through 6.6/0.433kV transformers and 415V switchgears.

In order to cater 6.6 kV loads of CHP/AHP, 11/6.9 kV transformers and 6.6 kV switchgear will be installed in CHP/AHP area and 6.6/0.433kV transformers and 415V switchgears will be also there to cater 415V loads of AHP/CHP.

415 V System

415 V distribution system will supply power to 415 V loads during normal operation and under emergency condition of the plant. Unit and station loads will be powered from 6.6/0.433kV & 11/0.433kV service transformers connected to their respective 415V unit and station switchgears (MCCs/PMCCs). Connection between auxiliary transformer and 6.6kV & 11kV switchgear will be through cable and that between the transformer and 415V PCC/PMCC will be through non-segregated phase bus ducts. 415V PCC/PMCC will feed power to breaker-operated motors, lighting transformers and 415V MCCs.

Local Starter Panels/Local Panels and other auxiliary loads will be powered from respective 415V MCCs/DBs.

415 V Emergency System

Emergency AC power will be required to permit a safe shut down of the units as well as safety to personnel and plant (e.g. aviation obstruction lighting of the chimney) in the event of a plant blackout. Suitably rated Diesel Generator sets will provide the emergency power to the 415V emergency switchboard that will have normal supply from unit auxiliary system. This switchboard will feed important AC motors like AC turbine auxiliary oil pump, AC jacking oil pump, etc. It will feed power to Turbine as well as Boiler valve MCC etc. It will also meet the AC power requirement of loads such as battery chargers, UPS, AC emergency lighting loads etc. There will be three (03) DG Sets of identical rating - plus a common standby – to cater to the AC emergency loads.

220 V DC System

a. Battery backed DC supplies will be provided for critical loads such as emergency oil pump, seal oil pump, jacking oil pump, scanner air fan, etc. and for protection, control, indication and annunciation supply of switchgear and control panels including emergency lighting. Battery will supply these loads during complete black out condition and will be sized for 1 hour back up time subsequent to tripping of the generating units.

b. Four sets of batteries will be provided in Power House for the two generating units, each rated to carry the DC loads of one unit as well as common station loads. Each set of battery will be accompanied with a float-cum-boost charger. Further distribution of DC power will be through DC distribution boards/fuse boards.

c. Switchyard, Plant Water System, coal handling plant etc. which are away from Power House will have its own independent DC source derived from battery bank located in respective areas. Each set of battery will be connected to float charger and float cum boost charger. DC power will be further distributed to various locations through DC distribution boards/fuse boards.

UPS System

UPS will be provided for regulated, filtered and uninterrupted 240 V, 50 Hz, single-phase power to critical AC loads during normal as well as emergency conditions. The system will comprise 2X100% parallel redundant chargers and inverters, 2x100% battery bank for main plant, and power evacuation switchyard 1X100% battery bank for offsite area, bypass line transformers and voltage stabiliser, static switch, manual bypass switch, distribution board, etc.

System Control

The Generator will be controlled from Power House unit control room through DCS. The DCS will be utilized to perform control, interlock, indication, metering and annunciation related to the above equipment including equipment pertaining to Generator auxiliary system. All controls as supplementary to the proprietary system of boiler, turbine and generator package (BTG) including auto synchronization of generator with 400kV bus will also be performed from DCS.

Control, interlock, metering of Generator Transformer (GT)/Generator circuit breaker (GCB) breakers including its alarm/indication will be provided in DCS. Control of GT breaker will be possible from switchyard control room but limited to maintenance operation only, however

GCB shall be controlled from central control room DCS only. Important status indication will be duplicated in switchyard control room. The switchyard control room will also be the control point for all other 400 kV breakers and will house control, metering and protective relay panels, SAS/SCADA, 415 V AC and 220 V DC system equipment pertaining to the switchyard.

Control, indication, metering, monitoring of electrical power distribution system in the power block will be performed from DCS in unit control room. Electrical system of various sub systems (e.g. coal handling system, ash handling system, Plant water system, etc.) will be controlled from DCS/PLC, located in respective control room.

Control of diesel generator will be from AMF panel in DG room. Remote control provision will also be provided in DCS through CRT operator interface in unit control room.

Metering

Plant electrical parameters will be metered to the extent required for proper operation and monitoring of plant conditions. The same will be provided as per requirement.

For import and export of power, tariff meters shall be provided separately and the same shall be as per latest CEA regulations.

Protection System

For protection of equipment against abnormal system conditions, adequate protective devices will be installed in respective switchgears and/or control and relay panels located in switchgear room/control room. A group of such protective devices will be utilised to protect the equipment under different abnormal conditions arising out in the electrical system. Multifunction, numerical protective devices will be used for protection of electrical system equipment.

2x100% protection will be provided for each of the generators. For transformer, separate protection relays will be used for main & back-up protection. For line protection and bus bar protection having duplicated redundant protection, relays with different algorithm will be provided as main-1 & main-2 protection. Following protections will generally be provided for various electrical equipment in the electrical system:

Generator

a. Differential (87G)

b. Stator inter turn fault (95)

c. 100% Stator earth fault (64S)

d. 95% Stator earth fault (59N)

e. Over fluxing (24)

f. Inverse time over current (51) for alarm

g. Negative phase sequence (46)

h. Loss of excitation (40)

i. Reverse power (32)

j. Rotor earth fault (64R) (2 stage)

k. Back-up Impedance (21)

l. Pole slipping (78)

m. Thermal overload (49)

n. Low forward Power (37)

o. Over voltage (59)

p. Under voltage (27)

q. Over frequency (81O)

r. Under frequency (81U)

a. Voltage balance (60)

s. Check Synchronisation V.T. supervision (25)

t. Dead Machine (51,27)

The generator will also be provided with surge protection equipment comprising surge capacitor and lightning arrestor.

Generator Transformer

a. Overall differential (87GT)

b. Generator transformer differential (87T)

c. Buchholtz/Winding/Oil temperature/PRV operated (63)

d. HV restricted earth fault (64)

e. Volts/Hz. over fluxing (24)

f. Inverse time HV back-up over current (51)

g. Inverse time HV back-up earth fault (51N)

h. Breaker failure (50Z)

Unit / Station Transformer / Aux. Power Transformer / Station Maintenance Transformer

a. Transformer differential (87T)

b. Buchholtz/Winding/Oil temperature/PRV operated (63)

c. Restricted earth fault except for HV winding of Unit Transformer (64)

d. HV Back-up over current with high set instantaneous unit (50/51)

e. Directional earth fault for Aux. Power Transformer (67N)

f. HV back-up inverse time earth fault for Station Transformer (51N)

g. HV standby inverse time earth fault for Aux. Power and Station Transformer (51N)

h. LV standby earth fault (51N)

i. Breaker failure (50Z) for station transformer feeder

400 kV Line Feeder (main1 and Main2 shall be from different manufacturer)

a. Non-switched Distance Main – 1 with inbuilt directional earth fault (21,67N)

b. Non-switched Distance Main – 2 with inbuilt directional earth fault (21,67N)

c. Breaker failure (50Z)

d. Check synchronization (25)

e. Auto re-closing (79)

f. Overvoltage protection

Duplicated Bus bar differential protection (87BB) shall be provided for 400 kV bus in the switchyard.

LT Auxiliary Transformers

a. LV over current / earth fault (51/51N)

b. HV over current with high set instantaneous unit (50/51)

c. Buchholtz/Winding/Oil temperature/PRV operated (63)

11 kV Switchgear

Incomer/Bus-coupler-

a. Inverse time over current for phase fault (51)

b. Inverse time over current for earth fault (51N)

c. Check synchronization (25)

d. Under voltage (27) (wherever applicable)

Outgoing Line Feeders

a. Inverse time over current for phase fault (51)

b. Inverse time over current for earth fault (51N)

c. Under voltage (27) (wherever applicable)

Motor Feeders-

a. Integrated motor protection relay comprising of following functions:-

- Ø Thermal overload
- Ø Phase fault (short circuit)

Ø Unbalance (Negative Sequence)

Ø Locked rotor

- Earth fault through core balance CT
- Prolonged start

b. Differential protection for motor rated above 1000 KW (87)

c. Winding/Bearing temperature (49)

d. Under voltage (27) (wherever applicable)

6.6 kV Switchgear

Incomer/Bus-coupler-

a. Inverse time over current for phase fault (51)

b. Inverse time over current for earth fault (51N)

c. Check synchronization (25)

d. Under voltage (27) (wherever applicable)

Outgoing Line Feeders

a. Inverse time over current for phase fault (51)

b. Inverse time over current for earth fault (51N)

Motor Feeders

a. Integrated motor protection relay comprising of following functions: -

Ø Thermal overload

Ø Phase fault (short circuit)

Ø Unbalance (Negative Sequence)

Ø Locked rotor

- Earth fault through core balance CT
- Prolonged start

b. Differential protection for motor rated above 1000 KW (87)

c. Winding/Bearing temperature (49)

d. Under voltage (27) (wherever applicable)

415V Switchgear/PMCC

Incomer / Bus-coupler

a. Inverse time over current for phase fault (51)

b. Inverse time over current for earth fault (51N)

c. Check synchronization (25)

d. Under voltage (27) (wherever applicable)

Outgoing Feeders

a. Inverse time over current for phase fault (51)

b. Inverse time over current for earth fault (51N)

415V Breaker Controlled Motor Feeders (above110kW)-

a. Integrated motor protection relay (99) for the following functions:

- Ø Thermal overload
- Ø Phase fault (short circuit)
- Ø Unbalance (Negative Sequence)
- Ø Locked rotor
- Ø Earth fault
- Ø Prolonged Start

415V MCC

Incoming/Outgoing Feeders

a. Short circuit protection through fuse/MCCB

415V Contactor controlled Motor Feeders (upto and incl. 110kW)

a. Thermal overload with in-built single phasing protection.

b. Short circuit protection through fuse/MCCB

DC System

a. Short circuit protection with earth fault alarm.

Diesel Generator

a. Voltage restrained over-current (51VR)

b. Reverse power (32)

c. Negative phase sequence (46)

d. Under frequency (81)

e. Over voltage (59)

f. Under voltage (27)

In all cases, proper discrimination would be achieved so as to isolate the faulty **elements only, keeping the healthy part of the system in service.**

2.7.1.22 PLANT ILLUMINATION

Suitable illumination is necessary for general visibility in the plant as well as for operation and maintenance ensuring safe movement of working personnel. Power supply for the illumination system will be derived from the following sources:

- **Normal AC System**

Normal AC system would provide about 70 - 80% lighting in the power island and adjoining areas and 100% lighting in offsite areas, roads, other open areas including the switchyard. The power supply will be derived from station service switchgear through dry type lighting transformers, distribution boards and lighting panels distributed all over the plant.

- **Emergency AC System:**

This system provides 20 – 30% lighting in selected areas only in the power island. The supply will be derived from emergency switchgear through dry type lighting transformers, lighting distribution board and lighting panel. Lighting fixtures connected to this system will be normally ON along with normal AC system lighting. They will go off for few seconds in case of normal supply failure and will automatically be restored upon restoration of emergency AC supply through Diesel generator.

- **Emergency DC System**

At strategic locations, few lighting fixtures fed from 220 V DC supply will be provided to enable safe movement of operating personnel and access to important control points during an emergency when the complete station AC supply has failed. These lighting fixtures will be fed from DC lighting panels which in turn will be connected to DC distribution boards. The supply to DC lighting panels will be automatically switched ON in case of loss of AC supply at service switchgear as well as at emergency switchgear. The DC supply will be automatically switched off after few minutes following the restoration of supply to normal AC or emergency AC lighting system.

In auxiliary/off site buildings emergency DC lighting will be ensured through self-contained DC emergency fixtures. The fixtures will be switched ON automatically in case of failure of AC supply.

EXIT sign fixtures with built-in battery will be provided in strategic location.

Type of light source will be guided by the lumen output, operating life, colour appearance and area of application. Lighting fixtures recommended for different areas are given below.

Turbine Building -

a. General	:	LED
b. Turbine Hall	:	LED High bay.
c. Unit Control Room	:	LED Recessed Decorative type
d. Battery Room	:	LED Corrosion Proof.
e. Office Area	:	LED Decorative type

Boiler Area

a. Mill Bay	:	LED well glass/high bay fittings
b. Boiler Platform	:	LED highbay/well glass.
c. General Area	:	LED Flood lighting.

d. Stack : As per IOCA Aviation Warning Lights

Emergency Lighting

a. General Area : LED Bulkhead

b. Control Room : LED Decorative type

Other Areas

a. Fuel Oil : LED Flame-proof

b. Street Lights : LED Street

c. Miscellaneous : LED - depending upon area of application.

Street/Area Lighting

Lighting towers (lattice structure) will be employed for switchyard/stockpile/ outdoor area lighting. Street light poles (SWAGE type) will be used for approach road lighting. Photocell will be used for controlling chimney lighting/streetlights/yard lighting with provision for manual over ride.

Grounding & Lightning Protection

Grounding System:

The main objectives of grounding system are: -

a. To provide safety to personnel from contact of dangerous potential caused by ground fault.

b. To ensure sufficient grounding current for effective relaying.

c. To stabilize circuit potential with respect to ground.

In order to meet the above requirement, a ground mat/mesh will be provided for the main plant and switchyard complex. All electrical equipment, non current carrying metal parts, structures, building steel, lightning protection system, generator/transformer neutrals will be connected to the station ground mat. For grounding of electronic equipment such as DCS/PLC, separate arrangement will be provided for connection to electronic ground mat.

Equipment under different sub systems will be connected to the earth grid to be created for respective systems. The earth grid conductor under different systems will be finally connected to main plant ground mat.

Lightning Protection System

The main purpose of lightning protection system are :

a. Provide protection to structures from lightning strokes.

b. Provide a low resistance conducting path to lightning discharge.

Lightning protection is recommended for main plant building, chimney, cooling tower and other structures. Lightning protection will also be provided for building/structures as per latest IEC standard 63205. For metal structures, which are electrically continuous down to the ground level, no lightning protection is required except adequate grounding connections. Lightning arrestors (LA) will be installed in the HV side of generator transformers & station transformers for protection against lightning surges.

In –Plant Cabling

Cables provide means of carrying electrical power and also conveying signals for various control, protection and monitoring functions.

Type of Cables

All power cables in the distribution system will be of Cross linked Polythene (XLPE) insulated and control cables will be PVC insulated. All cables will be armoured. Armour of twine and multi-core cables will be of galvanized steel wire /tape and for single core cable it will be of non-magnetic material. Outer sheath of all cables will be of improved fire performance category C2 of FRLSH (Fire Retardant Low Smoke and Halogen evolution) Type.

Cable Routing

Cables will generally be laid on ladder type prefabricated GI cable trays either in trenches or overhead steel/structures supported from building. For inter plant connections, cables may be directly buried or routed through overhead cable bridge. Separate trays will be used for HV, LV, control and instrumentation cables. AC and DC circuit will not run in the same cable tray. For underground crossing of railways, roads, etc. protection will be provided in the form of hume pipe or concrete encased rigid steel conduits, depending on application.

2.7.1.23 INSTRUMENTATION & CONTROL (I&C)

The implementation of I&C system for the BTG unit would be based on a state-of-the-art Microprocessor based Distributed Digital Control, Monitoring & Information System (DDCMIS) with functional & geographical distribution of various function groups. Wherever required, Remote Inputs and Outputs (RIO) will be considered for the system & sub-system of the plant at different locations for optimization of the scope of cabling. The DDCMIS will be of Open Architecture type having high system availability and reliability with redundancies at various levels.

It is envisaged to have a unified DDCMIS system for Steam Generator Controls, Steam Turbine & Generator Control, Power cycle equipment, SCR, Plant Electrical Distribution System and BOP system controls through same family of hardware and software. All critical protection signals related to safety tripping shall be hardwired to DDCMIS.

Plant operation and control will be through the Operator Interface Units located on the Unit Control Desk (UCD) in the Central Control Room which will consist of colour graphic LED (TFT) monitor, keyboard / Mouse and also through Large Video Screen (LVS) driven by its driving server computer.

Offsite plants (BOP) will be DDCMIS / PLC based control system in hot redundant configuration. Major parameters of Offsite Plants like Raw Water facilities, DM Water facilities, Coal handling plant, Fuel Oil unloading & storage system, Ash Handling Plant etc. has also been considered in the CCR for remote operation / monitoring of the respective off-sites facilities in addition to their local operation and control from their respective local control rooms. PLC based proprietary control will be considered based on OEM recommendation.

PC based Operator Interface Units with LED (TFT) / KBD / Mouse will be provided for these offsite systems, which will be kept in the respective Local Control Areas. Some of the auxiliaries will have optional facility of operation from central control room as well as from local panels. 2 nos. 72’’LVS in each local control room of WTP, AHP, CHP will be provided.

Steam Generating Unit and Auxiliaries

I&C shall include major Boiler controls like Burner Management System (BMS) including Master fuel Trip (MFT), Secondary Air Damper (SADC), Soot Blower Control and other open/close loop controls like coal mills and coal mill feeders, seal Air fans, scanner air fans, Boiler circulation water pumps, Pressure reducing & de-super heating stations, ID / FD / PA fans, HP Bypass system, SCR etc. and other integral auxiliaries control. HP/LP Chemical Dosing System control shall be done directly from DDCMIS.

Turbine Generator and Auxiliaries

I&C shall include controls and protective trips functions like Electro Hydraulic Governor (EHG) control, Automatic Turbine Run up System, Turbine Testing, Turbine Stress Evaluator, Turbine Protective Trip System, Turbine supervisory Instrumentation (TSI), LP Bypass system and other open loop & closed loop controls of TG system and auxiliaries like Feed water system, Condensate system, Heater drain system etc. related to the integral performance and safety.

2.7.1.24 COMMON STATION C & I SYSTEM

This will Include the control & monitoring of all other balance controls in Power cycle such as, Service water pumps, CW & ACW system & Cooling Tower Fans, DMCW system, Fuel oil pressurizing, heating and forwarding system, Ammonia Unloading & Forwarding etc. along with all integral instruments.

CW/ACW & CT fan systems and Fuel oil pressurizing & heating system, Ammonia Unloading & Forwarding shall be controlled and operated from DDCMIS operator’s station as well as from Local operator’s station. Remote Terminal Units (RTUs) shall be provided for this purpose.

2.7.1.25 OFFSITE PLANT CONTROLS

DDCMIS / PLC based System

DDCMIS / PLC based controls with operator interface units will be provided for major offsite plant controls as mentioned below. DDCMIS / PLC & operator interfaces will be located at the respective area control rooms. DDCMIS / PLC systems for these offsite plants shall have interface with the Main Plant DDCMIS (either through soft-link communication or through hardwired link) for operation / monitoring and status indication of selected parameters in CCR. Considering the presence of electromagnetic interference prevailing in the plant, fibre optic cable would be provided for the above digital communication.

- In Plant Water Transportation & Pre-treatment Plant
- Demineralization Plant
- Coal Handling plant
- Ash Handling Plant
- Compressed Air Plant
- Mill Reject Handling System
- Condensate Polishing Unit
- Hydrogen Generation Plant
- Fuel Oil Unloading, Storage & Heating
- Condenser On-load tube cleaning system,
- Centralized Turbine Oil Purification system (PLC based as per OEM)
- Emergency Diesel Generator (Microprocessor based as per OEM)
- Raw water pumping system
- Effluent treatment system
- Fire Detection & Protection System (Microprocessor based as per OEM)
- Compressed Air Plant Compressors Integral Control (Microprocessor based as per OEM)

- Chlorination and CW Treatment plant
- Ammonia Unloading & Forwarding

Drives shall have start / stop, open / close facilities from the operator stations, at CCR. All drive shall have Emergency stop facilities through the Local Push Button stations.

Major Instrumentation & Control Systems

The following Control and Instrumentation Systems have been envisaged: -

- Distributed Digital Control & Management Information System (DDCMIS)
- Programmable Logic Control system (PLC)
- Field instruments
- Final Control Elements
- Vibration Monitoring & Analysis System
- Master and Slave Clock (GPS) system
- Alarm Annunciation System
- Steam and Water Analysis System (SWAS)
- Continuous Emission Monitoring System (CEMS)
- Boiler Tube Leak Detection System
- Hart Management System
- Plant Performance Analysis, Diagnosis & Optimization (PADO)
- Continuous Ambient Air Quality Monitoring stations (CAAQMS)

2.7.1.26 DISTRIBUTED DIGITAL CONTROL, MONITORING & INFORMATION SYSTEM (DDCMIS)

An integrated and functionally distributed hierarchical control (both binary and modulating) and data acquisition system synthesized from one common family of hardware and software has been envisaged for the plant.

The DDCMIS hardware like Controllers, modules / cards etc. shall be housed in cabinets located in Control Equipment Room (CER). HMI stations/operator interfaces shall be located in Unit Control Desk in Central Control Room (CCR) common for two units.

The DDCMIS shall be configured to perform the following basic functions:

- Automatic sequencing of start-up and shutdown of equipment and auxiliaries including group/plant level start-up to minimize Operator's intervention under normal operating conditions ensuring safety of man and machine as well as to ensure high plant availability.
- Automatic regulation of various valves and dampers to achieve guaranteed performance of various controlled variables and to achieve most fuel-efficient operating regime.
- Acquisition, display, report generation and archiving of plant data and maintain historical data.
- Performance calculations based on plant real time data and operator input data.
- Electrical Distribution Management System (EDMS) to provide control and monitoring of the unit in-plant electrical distribution system.
- Energy management of the plant and equipment by measuring consumption of power of all equipment in the plant, measurement of fuel, steam and all other relevant parameters.
- On-line self-surveillance, monitoring and diagnostic facility
- System programming & documentation facility
- Data communication system

The DCS shall broadly comprise the following sub-systems:

1. **Input / Output Signal Processing**

Input/Output process interface sub-system shall directly acquire process data from transmitters, thermocouples, resistance temperature detectors and other sensors.

Input/Output (I/O) modules shall be intelligent having the following features as minimum.

- Every channel shall be addressable during routine periodic diagnostic check.
- Any failure in the module, loss of signal (both analog & digital) or any signal input crossing the permissible range shall be immediately detected and displayed.
- Such failures shall lead to failsafe situations.

2. Closed Loop & Open Loop Control Subsystems (CLCS/OLCS)

Multi-loop Multi-function controllers shall be dual hot redundant and shall be capable of handling both Close and Open Loop Controls. Controllers shall connect to dual redundant network with a minimum bus speed of 100 MBPS.

The CLCS will perform modulating controls with optional auto-tuning facility that will act on valves, dampers or other regulating devices to achieve stable control with permissible variation in parameters.

The OLCS shall include sequence control, interlock & protection for various plant auxiliaries, valves, dampers, drives etc. The sequence control shall provide safe and automatic startup and shutdown of plant / associated plant items. The interlock and protection system shall ensure safe operation of plant / plant items at all times and shall automatically shut down plant / plant items when unsafe conditions arise.

Redundant multi-loop controllers logically grouped for optimum, effective and safe Performance will be provided.

It is envisaged that the controllers are uniformly loaded and have sufficient CPU spare capacity under worst data loading.

Redundant sensors (“2 out of 3” or “1 out of 2” philosophy) have been envisaged for critical measurements and control.

Boiler and Turbine protection will be conceived in either 2 or 3 channel configuration with adequate diagnostic.

Electro-pneumatic type final control elements are considered for the regulating duty. However, for critical applications where first response is required such as HP / LP Bypass etc., Electro-hydraulic actuators have been envisaged.

All actuators with fail-safe condition mode under abnormal conditions have been envisaged.

3. Data Acquisition System (DAS)

Bulk non-control-related data shall be acquired in similar Multi-loop Controllers and shall be processed and stored for monitoring purpose.

The data collected will be used for display, alarm, graphics, trends, logging, historical storage and performance calculation.

Historical Storage & Retrieval Subsystem

The Historical Storage Unit (HSU) will augment the Global Memory database in the system and will archive data and parameters for logs and historical records including trends, alarms and events. These will be used for analysis and performance calculation.

Historical Storage Facility shall be redundant so that any single failure of the storage medium or electronics will not lead to loss of historical data.

4. Performance Calculation

Plant performance calculations and other complex computations will be achieved by automatically retrieving plant data from highways. All these data will be displayed on Operator’s station. Performance calculation would be based on ASME PTC performance test code for the SG, TG and other equipment in the plant.

5. Engineering & Configuration Station

PC based Engineering and Configuration Stations per unit shall be provided for engineering, program development, customizing, configuring & modification jobs related to entire DDCMIS. Engineering station shall be located in the computer room.

6. HMI Subsystems

Adequate number of Operator’s stations configured with latest version of Pentium based PC, 32” industrial grade LED TFT colour monitors, keyboard, mouse etc. will be provided for

Human-machine interface. Any system / equipment of the unit can be operated and monitored from any Operator's Stations. In addition, engineering station, performance calculation & optimization package and shift supervisor station have been envisaged with PC based HMI.

Adequate number of color & B/W laser and dot matrix printers will also be provided as part of HMI systems for alarm, SOE, reports, logs, graphic print.

Over and above the Operator's consoles one terminal each shall be provided for, the Shift Charge Engineer, maintenance Management and Plant Performance Calculation.

For each 800 MW unit, four (4) high resolution 72'' Large Video Screen (LVS) from the state-of-the-art technology will be installed in the CCR to facilitate monitoring of the entire plant. The system will be interfaced with DDCMIS for Plant graphic & critical alarms.

7. Alarm Facility

Plant abnormal conditions will be alarmed and displayed in the Operator Stations with different levels of priority and colours to facilitate the type of action to be taken by the operator.

8. Data Highway & Gateway for interfacing with other Systems

The DCS shall be based on Open System Architecture system having globally distributed database and connectivity with third party systems following standard protocol. Redundant Fast Ethernet switches shall be utilised for connecting and routing of data. All active items on the network shall be identified by unique address as their location in the network.

All Controllers and HMI units shall be resident on a common redundant high-speed data highway for global distribution and access of data. Any data will be available at any point of the network as and when required unless protected or masked.

Communication gateway link between DDCMIS and other PLC based plant control system will be redundant.

Comprehensive self-diagnostic features have been envisaged to facilitate easy fault location and detection of hardware and software while the unit is in operation.

The data communication systems with following minimum features have been envisaged:

- Redundant communication controllers have been envisaged to handle the communication between each functional group of controllers of Control System with the Main data highway. The design shall be such as to minimize interruption of signals. It shall ensure that a single failure anywhere in the media shall cause no more than a single message to be disrupted and that message shall automatically be retransmitted. Any failure or physical removal of any station/module connected to the Data highway / control network shall not result in loss of any communication function to and from any other station / module.
- Built-in diagnostics shall be provided for easy fault detection. Communication error detection and correction facility (ECC) shall be provided at all levels of communication. Failure of one network and changeover to the standby network shall be automatic and completely bump less and the same shall be suitably alarmed / logged.
- Sufficient Data transmitting speed has been envisaged to meet the responses of the system in terms of displays, control etc. Spare capacity has been also considered.

9. Sequence of Event Recording System (SER)

A high-resolution Sequence of Event Monitoring System shall be an integral part of Distributed Control System.

All SOE inputs shall be sourced directly from the primary switches and primary relay/contactors for "real time-stamping" based on GPS master clock following any tripping of major equipment, sub-systems and the plant as a whole.

The system shall be capable to discriminate inputs with a resolution of one millisecond.

10. Scan Time & Response Time

As a guideline, the maximum permissible response time of DDCMIS for various functions are as follows:

- CLCS function - 200 – 250 msec.
- Critical loops - 100 msec.
- OLCS function – 100 msec
- DAS function - 500 msec or more.

11. Displays

Following displays on the monitor have been envisaged:

- Plant Graphics
- Control Faceplate Display
- Individual and Group Display
- Real Time and Historical Trend Display
- Alarms Display
- SOE display
- Diagnostic Display of the Process and Control System

12. Logs and Reports

The following logs and reports have been envisaged:

- Hourly, daily & monthly logs with freely assignable option of any parameter.
- Trip logs related to the unit and electrical system including pre-trip and post-trip.
- Alarm and SOE logs

13. System Software

The latest user-friendly version of all necessary software will be provided for the system. The software platform will permit interface with third party systems.

14. Programmable Logic Control System

PLC based control system shall consist of measurement system, interlock, protection and sequential logic control system, integrated annunciation system and data bus system for control and communication with the process. The microprocessor based PLC system shall consist of redundant power supply modules, redundant (hot standby) processor modules and redundant communication modules for communicating with operator station, Engineering station, DDCMIS (at CCR) and remote I/O panels with I/O card.

The system shall provide for sequencing of automatic start-up / shutdown of equipment/drives into operation as well as start/stop of standby equipment on failure of main equipment and manual intervention facility for all the equipment.

The PLC shall have all the standard facilities like dynamic graphics, alarm / event recording, real time and historical trending, control groups, overview pages, logging (hourly, shift, daily, weekly, monthly), Pre-trip, post trip reports etc.,

15. Field Instruments & Systems

The transmitters and switch devices will be grouped together and will be placed in different local instrument enclosures in open and dust prone areas and in open type local instrument racks in covered areas at suitable locations. All field instrumentation items shall have IP 65 protection class as minimum. Instruments located in hazardous area shall have intrinsic safe circuit / Ex-proof enclosure.

The equipment shall be designed and constructed to withstand ambient temperature extremes and relative humidity conditions of the plant. The equipment shall meet all functional requirements and perform accurately and safely under the environmental and operating conditions without undue heating, vibration, wear, corrosion and aging.

Instruments will be of proven reliability, high accuracy & repeatability. They will comply with the acceptable international standards with following type and features:

- All field transmitters are envisaged with 4-20 mA DC signal output with high turndown ratio and with superimposed digital signal conforming to HART protocol.
- Instrument scale will be calibrated in engineering units and range will be selected in such a way that normal process parameter will lie in between 50-80% (approx.) of full scale.
- Instrument will have over pressure limit of about 150%.
- Accuracy of process transmitters is envisaged as +/- 0.075%. Accuracy of local gauges (PG, TG etc.) is envisaged as +/- 1% (approx.).
- All temperature elements (RTD / Thermocouple) will be duplex type. Thermocouples will be mineral insulated & ungrounded type.
- Flow nozzles will be considered for auxiliary steam and feed water flow. For other water

flow measurement orifice plates are proposed.

- Coriolis Type Mass Flow Meter will be used for oil flow measurement.
- Magnetic Flowmeter / Ultrasonic Flowmeter will be used for CW flow to each unit
- Radar or Ultrasonic type level transmitter will be used for measurement of level of underground large sump and over ground large tanks
- Guide wave Radar type levels Transmitters will be used for vacuum services such as for Condenser hot well & LP heaters under vacuum. DP type level transmitters will be used for all other level measurement.
- Conductivity types Electronic Water level for boiler water separator.
- Discriminating type Flame Scanners will be considered for flame monitoring & failure trip. Flame intensity display will be available in monitor.
- Local gauges will be provided wherever any local adjustment and maintenance is required.
- Process switches for temperature, pressure and level as per requirements shall be provided for alarms / Trips.

Pressure indicators, Pressure switches, Pressure transmitters, Level transmitters etc. will be connected with process piping through root valves having proper size instrument piping. The necessary root valves, impulse piping, drain valves, gauge-zeroing valve, valve manifolds and all the other accessories required for mounting/ erection of field instruments (i.e. PI, PS, PT, LT, etc) will be provided.

16. Final Control Elements

Control valves, dampers and other final control elements will in generally be provided with pneumatic type actuators. Hydraulic actuators have been envisaged for HP / LP bypass valves.

Regulating duty valve shall have smart electro pneumatic positioner, position transmitter and air lock relay. On off duty valve will have solenoid valve and end position limit switch. All control valves shall be provided with handwheel.

All severe service control valves shall conform to leakage class V with metal-to-metal seating. Other will have leakage Class –IV.

The sizing procedure will be as per latest edition of ANSI/ISA or equivalent standard.

17. Vibration Monitoring & Analysis System

Microprocessors based standalone vibration monitoring and analysis system have been envisaged for rotating machine condition monitoring, analysis & diagnostic. Uniform make of On-line Vibration Monitoring System will be provided for all BTG & BOP HT drives like ID fans, FD fans, PA fans, BFP, CEP, CW pump, Mills Drives etc. including Turbine Generator Supervisory Instrumentation (TSI). The Vibration measurement shall be carried out in X and Y direction for the equipment and also for motor bearing. Vibration monitoring system will consist of Vibration transducers, Key phasor probes, Vibration monitors, Power supplies. Vibration monitoring system will have interface with DDCMIS for centralized monitoring.

18. Master and Slave Clock (GPS) System

A common redundant master and slave clock system is envisaged and this would be time synchronized with the Global Positioning Satellite (GPS) system. The master clock will synchronize the entire BTG controls and other associated controls as required for uniform time stamping.

19. Alarm Annunciation System

All the alarm points of DDCMIS / PLC will be annunciate on the HMI.

20. Steam and Water Analysis System

Considering the criticality of the water chemistry of the Ultra Super critical unit, a centralized Steam and Water Analysis System (SWAS) has been envisaged for measurement of pH, Conductivity, Dissolved Oxygen, Sodium, Silica etc. contents in feed water, steam and condensate at various sections of the process. Measured values and health of the Analysers will also be monitored in plant DCS through hardwiring and will interface with the dozing system to control the dozing pumps. SWAS will consist of a Wet Section and a Dry Section. Wet Section shall condition the sample to bring the sample to reference temperature by cooling at the primary cooler/s with DMCW and at the secondary cooler by cooling with chilled water and also bring the sample to a pressure level acceptable to the analysers. Dry Section shall house the analysers and the sensors. All samples shall be conditioned at 20 °C temperature before entering any sensor assembly of the Analyzer under worst ambient condition.

Provisionally, the following measurements points are foreseen: -

i. Superheated Steam (Degasser Cation Conductivity, pH, Silica, Specific Conductivity)
ii. Feed Water at Economizer Inlet (Cation Conductivity, pH, Silica, Specific Conductivity, hydrazine, Dissolved Oxygen)
iii. Condensate after Polisher (Cation Conductivity, pH, Silica, Specific Conductivity)
iv. Demineralized Make-up Water (pH, Silica, Specific Conductivity)
v. Condensate Extraction Pumps Discharge (Cation Conductivity, pH, Specific Conductivity, Dissolved Oxygen, Sodium)
vi. Deaerator Outlet (pH, Dissolved Oxygen)
vii. Condenser Hotwell (right and left) (Specific Conductivity)
viii. Reheater Steam (Specific Conductivity)

2.7.1.27 Continuous Emission Monitoring System (CEMS)

In conformity with the local and state pollution control norm, Continuous Emission Monitoring System shall be installed in the chimney to analyze the constituents of the combustion products. Link shall be established between CEMS and SPCB / CPCB for data reporting and central monitoring.

The system will consist of the following measurements:

- SOx, NOx, analyser at stack.
- Oxygen analyzer at stack
- Opacity monitors at stack.

- Flue gas velocity measurement at stack

2.7.1.28 Boiler Tube Leak Detection System

Acoustic type Steam leakage system to detect steam leaks from boiler tubes at different zones shall be provided. Whenever steam leaks from a tube, large amount of sound shall be produced. This shall be analysed and used for detection of tube leakage. The system shall be complete with acoustic signal generator, signal receiver, signal processing unit and controller, operator interface etc.

2.7.1.29 Hart Management System (HMS)

HMS has been envisaged for centralized configuration, calibration, maintenance, diagnostic and record keeping of electronic smart transmitters from remote location. Smart electronic transmitter signals will be wired to DDCMIS termination cabinet. The 4-20 mA signal shall be used for control and monitoring in DDCMIS whereas digital signal will be used by HMS.

2.7.1.30 Plant Performance Analysis, Diagnosis & Optimization (Pado) Software

PC based on-line plant performance analysis, diagnosis & optimization (PADO) system for the station has been envisaged. The PADO system shall incorporate the complete thermal design model of each unit. The model of each unit shall work together from the same PC for the complete plant.

The system shall use the measured data from the DDCMIS through appropriate interface. Instruments, which are specifically required for implementation of PADO shall also be provided.

2.7.1.31 Control Room / Equipment Room Desk & Panel

One Central Control Room (CCR) common for two units of the plant, located adjacent to the turbine hall at the operating floor level of powerhouse building has been envisaged.

Centralized control of the plant has been envisaged from LED (TFT) based Operator's station located in the common Central Control Room. DDCMIS Electronic Cabinets, VMS cabinets, Master clock panel, Relay Cabinets and other system cabinets will be housed in the Electronic Equipment Rooms. Computer Room in general will house the Engineering Consoles, Video copiers, historical storage units, network cabinets etc. All necessary computer furniture will be provided.

Operator Stations and Emergency shutdown push buttons will be installed on the Unit Control Desk (UCD). Control desk will be having aesthetically & ergonomically designed.

Emergency Push button stations as recommended by the manufacturer for safe shutdown of plant will be provided on unit control desk.

Separate Operator work station with monitor, Keyboard and Printer will be provided in Shift In charge engineer’s Room.

2.7.1.32 Power Supply System

A dual redundant single phase Uninterrupted Power Supply System (UPS) with 240V ± 1% AC supply having redundant 2 x 100% inverters and separate chargers with battery banks is envisaged for powering of the AC consumers in the C&I System, fire detection system, relevant C&I laboratory instruments and plant communication system etc. UPS system shall be designed for 60 minutes back up.

Batteries shall be sealed lead acid type or Ni-Cd type.

DC power distribution for DDCMIS and loop-powered field instruments shall be derived from the UPS supply and the required DC distribution boards shall be located within DDCMIS cabinets. Any other DC power supply required for the plant shall also be suitably derived and distributed.

Power supply to all other DDCMIS / PLC based control systems in the major offsite plants has been envisaged from their own packaged UPS system.

2.7.1.33 Instrument Air Supply

I&C Systems will be supplied with adequate Instrument air supply from compressor, Air dryer Assembly. Moisture and oil free Instrument air at 6 Kg/cm² and minus (-) 40°C dew point will be used.

Instrumentation & Control Cables & Accessories

Instrumentation cables shall be stranded, electrolytic grade tinned copper conductor, screened, armoured, FRLS outer sheath type. Junction boxes shall be provided within transmitter racks and other locations to group sensor and transmitter signal cables. Signal cables from Individual Instruments/sensors to field junction box, wherever applicable, shall be with conductor size of 1.5 mm^2. From the junction boxes multi-core overall screened signal cables shall be used for extending binary signals, multi-pair twisted cable shall be used for analog signals and multi-triads shall be used for extending RTDs to the control room area. Multi-core/ multi-pair/multi-triad cables from field junction box or transmitter rack to control room shall be of conductor size of 0.5 mm^2.

Extension cables shall be used to connect thermocouples. Similarly, thermocouples shall also be brought to junction boxes to facilitate the use of multi-pair cables. Single or Multi Pair, solid conductor, 20 AWG, overall screened & armoured extension cables will be provided for carrying millivolt signals.

For low voltage power cables stranded annealed plain copper conductors of cross-section 2.5 mm^2 with PVC insulation, armoured and with FRLS PVC outer sheath will be used.

All interconnecting cables between cabinets will preferably be prefabricated with connectors at both ends.

Cables shall be glanded at each point of entry with watertight glands. Screens shall be grounded at Control Room end only. For long parallel runs, separation of 300 mm will be maintained between low level signal cables and LT power/control cables. The separation of 600 mm shall be maintained with HT cable. Junction boxes shall be IP-65 enclosures with knock-out holes.

Erection Hardware

Erection hardware including all process connection and piping materials like impulse pipe, manifolds, fittings, condensate pots, siphons, isolation valves, pneumatic line tubes and pipes along with necessary fittings, instrument racks and enclosures, junction boxes, pull boxes, cable accessories like glands, flexible/rigid conduits, lugs, trays, supports etc. are envisaged. All erection hardware shall be of proper rating (in line with process piping class) and sizes.

Tools & Tackle and I&C Laboratory Instruments

Special tools and tackle shall be provided for the maintenance of the plant and machineries. A set of laboratory instruments consisting of standard measuring & calibrating instruments has been envisaged. Electronic test bench and pneumatic test bench equipped with all necessary meters, portable vibration monitoring equipment, etc. have been envisaged.

Spares & Consumable

All electronic cabinets shall have installed spares to allow expansion and modifications. Spare capacity shall be envisaged in the form of rack space for augmentation and spares channels would be judiciously distributed.

All mandatory spares, commissioning spares and consumable shall be included.

2.7.1.34 Fire Detection & Protection System

a. A fire detection system as per National Fire Protection Association (NFPA) standards / Tariff Advisory Committee (TAC) guideline would be provided. A Main fire alarm control panel located in the central control room will provide the alarm annunciation for the plant in case of fire.

b. Manifestation of fire shall be sensed by the following methods:

i. Multi criteria type / photoelectric type detectors.

ii. Thermal / heat detectors. Both the type of detectors shall be addressable from the panel and operator interface.

2.7.1.35 Plant Communication System

A Plant Communication System will be provided to facilitate plant operations by establishing quick communication among operating personnel at various locations of the plant. The Plant Communication System will consist of the following:

- Telephone System
- Public Address (PA) system

Electronic Private Automatic Exchange, with paging and intercom facility will be located in the administrative area and will have number of outgoing trunk lines. Wall mounted, rugged type field phones with paging button will be provided in various plant areas at strategic locations to make plant-wide announcements to draw attention of roaming operators to important developments in the plant. There will be provision for audio volume adjustment in the sets to circumvent ambient noise in plant areas. Intercom & Paging facilities will be provided at the Operator’s desk as well as in the Engineer’s table.

Speaking in ‘Paging’ mode will be heard all over the plant while the ‘Private’ mode will facilitate conversation between two or more stations through close talk channel.

2.7.1.36 Closed Circuit Television System (CCTV)

IP based Closed Circuit Television System (CCTV) with all cameras, CCTV components and accessories shall be provided for the purpose of surveillance of major Electrical Drives & equipment e.g. Boiler Feed Pumps, ID Fans, FD and PA Fans, Mills, Condensate Extraction Pumps and critical areas like Turbine hall, CW pump house, CHP, Ash Plant areas etc. so that, by and large, all important areas and equipment can be brought under surveillance. Also, cameras for security surveillance shall be installed at the Main Gate, Material Gate, fencing, admin building, service building, store and other common auxiliary plants.

Industrial TV for furnace flame monitoring system (Furnace Flame TV) is envisaged

2.7.2 WATER DEMAND

Water consumption for thermal power plants as per MoEF&CC vide Notification S.O. 3305 (E) dated 07.12.2015 for all existing CT based plants reduce specific water consumption up to maximum of 3.5 m^3/MWh and as per MoEF&CC stipulated norms vide Notification GSR 593 (E) dated 28.06.2018 water allocated to the thermal power plant is 3 m^3/MWh for new plants installed after the 1st January, 2017.

The total water requirement for the proposed expansion project is 6400 m^3/hr (56 MCM/Year) i.e. 2 m^3/MWh, which is well within the stipulated norms of Notification dated 28.06.2018. The water will be sourced from Parwan River/ Dam through existing water pipeline at a distance of about 30 Km.

The water drawl permission from WRD Rajasthan for 34 MCM/Year vide letter no. CEWR/TA (W)/1482 dated 11.08.2009 has already been obtained for 2x660 MW TPP.

The Plant is based on Zero Liquid Discharge (ZLD) concept.

Circulating cooling water system using Induced Draft Cooling Tower is considered for condenser and auxiliary cooling by a separate set of ACW pumps.

In a conventional fossil fuel-fired thermal power Project, water is used to meet the following basic consumptive requirements: -

a) To meet cooling requirement for steam condenser which acts as a heat sink for the thermodynamic cycle and other auxiliary cooling such as, bearing/lube oil coolers, compressors, generator stator, etc.

b) To meet the heat cycle make-up and other process requirements.

c) Selective Catalyst Reduction (SCR)/ Separated Overfire Air (SOFA) systems as per new MoEF&CC guidelines

d) For miscellaneous services viz.

- Firefighting.
- General services viz. A/C and ventilation, floor washing etc.
- Sealing and cooling water for equipment of ash handling system.

- Dust extraction and dust suppression for coal handling system.
- Potable use in the Project and housing complex.
- Transport media for ash in case of wet disposal of ash (under exigency condition).
- Horticulture/landscaping.

Plant water System:

A recirculating cooling water system using wet type evaporative cooling tower would be deployed for the proposed Project. It would be used for the condenser and auxiliary equipment cooling in a semi-open cooling water circuit. The choice of cooling water system is guided pre-dominantly by the GOI guidelines on use of sweet water for cooling purposes. Natural draft (ND) cooling tower has overall advantage, but considering initial investment and installation timeframe required, Induced Draft (ID) cooling tower is preferred for this Project.

During detailed engineering stage year round water analysis data will be available for establishing appropriate design basis for finalizing the plant water system. For the purpose of the present study a water balance diagram is presented in Drawing No. KAW2-E-EPC-SPE-TM-T-I-002.

For the proposed 4 x 800 MW Project the total raw water requirement is estimated on the basis of 1% heat cycle make-up (ultra-supercritical units), make-up to cooling towers usually associated with average daily plant load apportioned on hourly basis and other consumptive requirements like potable water, make-up water requirements for air-conditioning and ventilation etc. It is proposed to utilise cooling tower blow down in flue gas desulfurization system, ash handling and coal handling plant dust suppression system to the extent possible and remaining quantity shall be feed to the blow down recycling plant for achieving maximum possible water utilization.

A new intake pump house shall be provided in Parwan River / Dam. 3 nos. of 50% capacity intake pumps (two working + one standby) shall be installed inside the new intake pump house and a new pipeline shall be provided for catering makeup water for the proposed 4x800 MW project.

To ensure redundancy to the system, a new raw water reservoir with seven (7) days' raw water storage capacity has been considered in the plant water schemes.

The reservoir in the raw water system would also functionally assist in removal of substantial portion of suspended solids and will provide adequate redundancy to the system. Raw water will be clarified to remove suspended solids and colloids in clariflocculators. Four (4) clariflocculator units each having 60% capacity is considered for the CW make and service water system with Lime, alum and other coagulant aids dosing system. Separate four (4) clariflocculator units each having 60% capacity is considered for the RO-MB (DM Plant) feed water system with Lime, $FeCl_3$ and other coagulant aids dosing system.

Clarified water would, thereafter, be stored in a twin chamber semi-underground RCC reservoir having a capacity of 2-hours of clarified water requirement for the proposed Project. Separate Clarified water storage tank for DM feed is to be provided. Clarified water would be supplied as make-up in the cooling tower basin by gravity.

Clarified water will also cater to the requirement of ventilation plant and requirement of filtration plant.

For pre-treatment plant of the RO-MB system filtration system will be provided after clarifier. In the filtration plant, clarified water would be passed through sand bed filters where adequately sized filter beds with redundancy in number as well as capacity shall be provided. The water quality at the outlet of the filtration units shall be maintained within 10 NTU/10 ppm TSS. Filtered water would be stored in an RCC tank. With storage capacity of 4-hours filter water requirement for the Power Project. Filtered water will be required for potable use and DM plant feed. Filtered water will feed to Ultrafiltration system (UF). UF treated water will be stored in UF water storage tank. UF treated water will feed to RO plant through micron cartridge filter and anti-scalant, SMBS chemical dosing. RO-High pressure pump will feed water to RO plant (2x50% capacity) and get RO treated water. RO treated water will be stored in product water storage tank having 2 hrs storage capacity.RO reject water will be used in the coal dust suppression, ASH slurry preparation etc. RO product water will feed to DM plant (3x50% capacity MB vessel). DM water will be stored in 2 nos of DM water storage tanks.

DM water will be used for heat cycle make-up, chemical feed system, hydrogen generation plant, SCR and as primary coolant in heat exchangers for the auxiliary cooling system of boiler, TG auxiliaries and other common auxiliaries. The heated DM water in closed cooling loop would be subsequently cooled in SET of four 3 plate type heat exchangers, one per unit of (TG, Boiler Aux.) & one common for BOP auxiliaries using clarified water from cooling tower basin through a set of auxiliary cooling water pumps in the secondary circuit.

a. Demineralisation Plant & Heat Cycle Make-up System:

The basic scheme of Demineralised Water System shall be clarifier-PSF-UF-ROMB. DM plant equipment sizing shall be with 3% heat cycle make-up to ensure adequate redundancy and start-up requirement. Assuming an average of 3% makeup for the heat cycle, 2x50% RO and 3x50% MB vessel scheme is considered. Total DM water generation capacity (output) shall be 2x90 cu.m/hr. RO single pass or double pass will be decided during detailed engineering.DM Plant will supply heat cycle make-up, the make-up requirement for primary water circuit of stator cooling system, chemical feed system, air-conditioning system makeup and DM water requirement for the hydrogen generation plant, make up requirement for primary coolant in heat exchanger for the auxiliary cooling system for Boiler, TG and other common auxiliaries.

Filtered water would be pumped to the DM Plant for demineralisation. In the DM Plant, the water would be first filtered through pressure sand filter units & UF units to be installed within the DM Plant building. Filtered water will subsequently be passed through BWRO and mixed bed exchangers and the demineralised water will be stored in DM water storage tanks. Acid and alkali handling, storage and feeding system will be installed for the MB resin regeneration. The DM water produced in the plant would then be taken to two (2) DM water storage tanks, each of 3000 m^3 capacity to meet the total requirement including start up and any exigency. DM water from the storage tanks would be transferred to the unit condensate storage tanks by 3x50% capacity DM transfer pumps. Each pump will have capacity to meet the requirement of one unit. The plant would be equipped with 100% unitized condensate polishing unit for ensuring required water quality for operation of once through steam generator with steam parameter in ultra-supercritical range as mentioned earlier.

b. Waste Water Treatment System:

Floor wash and other service water wastes will be led to an ETP where they shall be treated through clarifiers and led to CMB. The treated water shall meet the PCB norms for effluent discharge. Oily wastes shall be treated using oil water separators and the treated effluent led to CMB. Water from CMB shall be used for horticulture. pH corrections shall be made as required for chemical wastes. RO reject shall either be brought to CMB or used for gardening directly.

CW system shall operate at a COC of 5 and the blow down water shall be recycled directly in Ash Handling systems. Any excess blow down water shall be treated by installing pre-treatment, ultrafiltration and reverse osmosis. Product water from recycle plant will be used as a make up to cooling tower and reject water will be used for CHP dust suppression AHP make up. Following recycle scheme/wastewater treatment schemes are adopted:

- CW Blow down recycle System
- Plant regeneration waste from Neutralizing Pit
- Boiler Blow down water as applicable.
- Water from Ash water recovery system
- STP Filtrate.

CW Blow down shall be treated in CW Blow down recycle plant. Product water from recycle plant will be used as a make up to cooling tower and reject water will be used for CHP dust suppression and AHP make up.

Mixed Bed unit and Condensate Polishing Units regeneration waste, RO Cleaning chemicals are collected in the neutralizing pit and pumped to the CMB after neutralization.

Boiler Blow down water if applicable (during start up) is received in a boiler blow down tank and pumped to CMB.

Recovered water from Ash dyke shall be circulated back to Ash water sump for makeup to Ash handling system.

Waste water from TPP, after neutralization and treatment shall be sent to ash handling system.

Filtrate from STP sludge drying bed will be recirculated back to Sewage collection sump.

Recovered water from filter press and miscellaneous non-chemical/floor washing drains will be collected in a common tank and pumped for utilization in horticulture & greenbelt.

Drains from fuel oil and lube oil storage areas & floor wash from maintenance areas shall be passed through oil water separator for treatment and reuse.

Plant is to be designed based on zero liquid discharge.

c. Sewerage and Sewage Treatment Plant:

The sewerage system shall be designed to provide cleansing conduit for speedy and efficient conveyance of foul water, such as wastewater from closets, urinals, bathrooms and pantries. An independent network of lines to carry the storm water drainage and sewerage shall be provided. Sewers shall be designed for desired minimum and maximum velocities.

The plant area shall be divided into different parts based on layout consideration. The sewerage flow shall be made by gravity. Routing of these shall ensure no interference with underground facilities. Manholes shall be provided at every 30 meters along the length of any pipe, at connection points and at every change of alignment, gradient or diameter of sewer pipeline.

A permanent sewage treatment plant (anaerobic treatment) shall be provided to ensure adequate cleaning of the sewerage discharge of the plant. The treated effluent shall be utilized for the irrigation of the landscaped areas. The treatment plant shall be designed to meet all requirements of applicable local bylaws/pollution standards, as well as the conditions stipulated by the State/Central agencies during the environmental clearance to the Project.

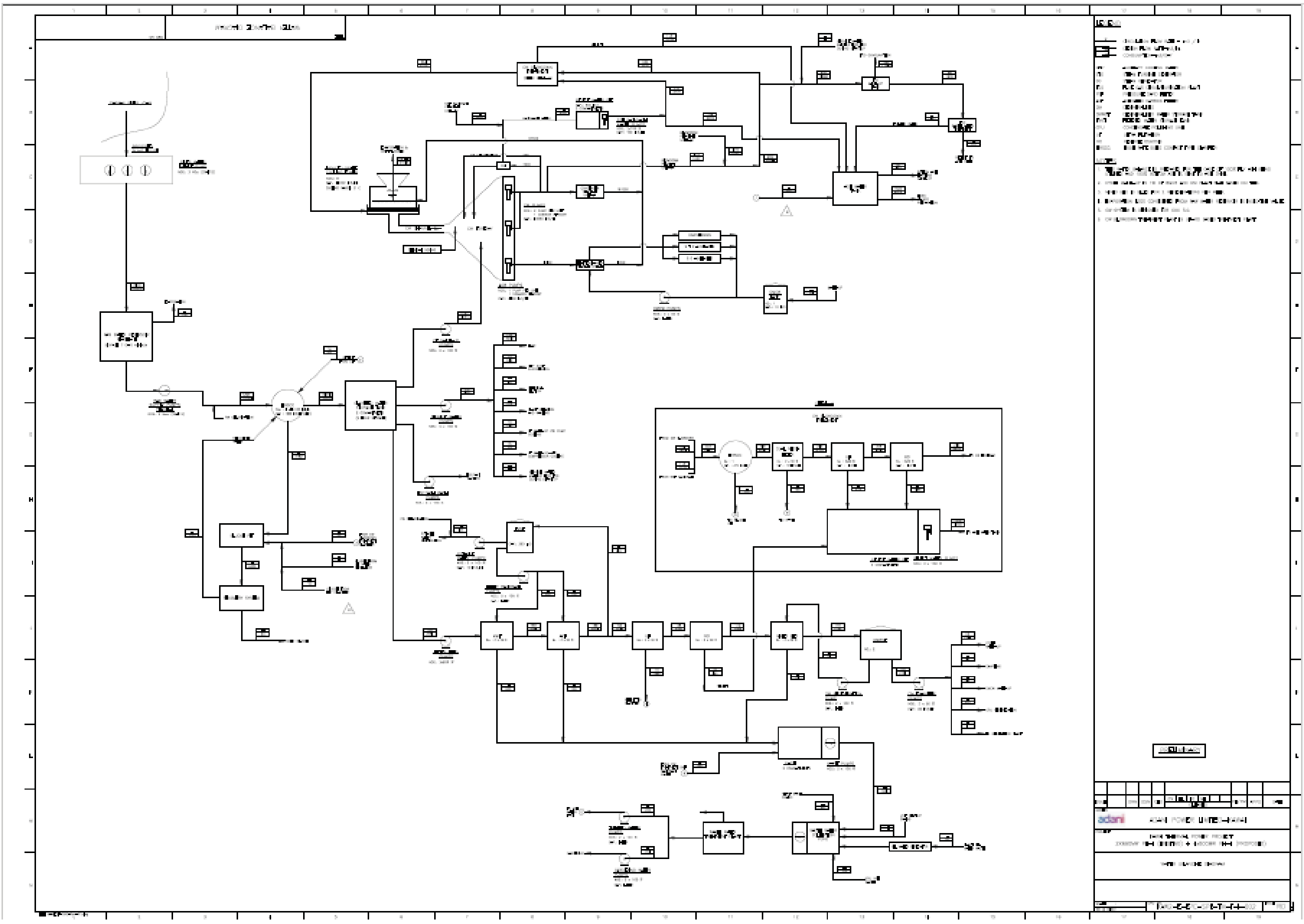

Fig. 2.3: Water Balance Diagram for Proposed Expansion Project

2.7.3 MANPOWER DEMAND

Employment during construction phase (4 x 800 MW) is estimated to be around 8000 Nos. (Direct employment approx. 500 Nos and approx. 7500 Nos Indirect). Employment required for operation of 4 x 800 MW Units in addition to existing O&M staff is estimated around Approx. 550 Nos Direct and 1500 Nos Indirect.

2.7.4 PROJECT COST

The total capital cost estimated for the proposed is Rs. 36,600 Crores.

2.8 DESCRIPTION OF MITIGATION MEASURES INCORPORATED TO COMPLY WITH THE ENVIRONMENTAL STANDARDS

Table 2.13: Mitigation Measures for Pollutants

Pollutions	Description of Mitigation Measures
Air Pollution	• Emission standards shall be as per MoEF notification S.O. 3305(E) dated 7.12.2015, & its amendments. • To control the emission of particulates, High Efficiency (99.99%) electrostatic precipitators (ESPs) will be provided. • To control NOx emission, Ultra-supercritical boilers having advanced low NOx generation system will be installed. In addition, Selective Catalytic Reduction (SCR) system will be installed. • For the control of fugitive dust emission within and around the coal handling plant, dust extraction system with pulse jet bag filter and suppression systems will be provided. • A stack height of 275 m will be provided with each unit.
Water Pollution	• Effluent management scheme will be implemented with the objective of optimization of various water systems so as to reduce intake water requirement. • Sewage Treatment facilities will be provided and treated sewage water will be utilized for purpose of greenbelt development & plantation. • Effluent will be treated in ETP. There will be no effluent discharge from the premises, hence the ZLD will be maintained. • The water from the cooling towers will be recirculated. • A state-of-the-art paved and green area rain water harvesting system will be provided to collect the run -off for storing in RWH Reservoirs for recharge the ground water.

Noise Pollution	• Ambient noise inside and outside the plant area will conform to the prescribed noise levels for various land use categories as per OSHA and National Standards for Ambient Noise respectively. • This will be ensured through proper designing of the equipment with adequate acoustics permitting the ambient noise levels without exceeding the specified criteria from the source. • Adequate green area has been/will be developed within the project premises. Suitable dense greenbelt of sufficient width will be developed all around the plant premises. • Earmuffs and / earplugs have been/will be provided to all the workers deployed at high noise generating sources. Acoustically insulated cubicles will be provided to operators working near high noise generation sources. • Effective preventive maintenance and vibration measurement of all equipment will be done which will help in improvising the plant life and reduce the noise.
Fly Ash Utilization & Management	• 100% ash utilization shall be taken up as per Fly Ash Notification, 31st December, 2021 and its amendments. • Ash will be utilised in Cement Industries, Road Construction, filling abandoned Mines & Stone quarry, Manufacturing of Bricks, aggregate replacement in concrete, etc. as per Fly Ash Notification, 31st December'2021 and amendments. • Dry ash handling system will be provided for Ash handling by pneumatic conveying systems and will be supplied to Cement indutries. • Wet ash will be handled using HCSD systems.
Waste Management	**Solid Waste:** **Hazardous Waste:** • The spent oil and used oil will be collected in drums and sent to authorized recycler as per Hazardous & other waste (management & transboundary movement) rules 2016 & its subsequent amendments. **E-Waste:** • E- Waste will be sent to authorized recycler as per E E-Waste (Management) Rules, 2016 & subsequent amendments. **Bio-Medical Waste:** • Bio-medical waste generated from medical unit will be stored separately & disposed off as per BMW management Rules, 2016 through MoU with nearest CBWTF or through nearest Health care facility having MOU with CBWTF. Non-hazardous/ Solid waste, Battery waste, shall be disposed off to the authorized vendors as per MoEF&CC /CPCB norms.

2.9 ASSESSMENT OF NEW & UNTESTED TECHNOLOGY FOR THE RISK OF TECHNOLOGICAL FAILURE

The technology involved in the proposed expansion project is well accepted and prevailing in recent times. Hence of risk of technological failure is not anticipated.

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CHAPTER: III
DESCRIPTION OF THE ENVIRONMENT

3.1 INTRODUCTION

The anthropogenic activities related to proposed exapsnion project causes impacts on environmental components in and around the project site. However, the intensity of environmental impacts vary from project to project, depends upon several factors like; Physical, Chemical, other etc., involved in the project, scale / size of the project, type and extent of pollution control measures, project location, surrounding geomorphology etc. To assess environmental impacts from proposed exapsnion project, it is essential to monitor the environmental quality prevailing in the surrounding area prior to implementation of the proposed exapsnion project. The environmental status (baseline status) within the study area is used for prediction of anticipated environmental impacts assessment study.

The project site is designated as the core zone, while the area within a 10 km radius from the plant boundary is identified as the 'buffer zone' for the baseline environmental study.

Relevant information and data, comprising both primary and secondary sources, were gathered within both the core and buffer zones (up to a 10 km distance from the plant boundary) during the post-monsoon season - October to December'2024, adhering to the guidelines for the preparation of Environmental Impact Assessment (EIA) studies.

This study aligns with the Terms of References (ToR) issued by the Ministry of Environment and Forest (MoEF&CC) vide TOR Identification No: TO24A0601RJ5203867N dated 29/07/2024 and it follows the guidelines provided by the Central Pollution Control Board (CPCB).

3.2 STUDY AREA

Study Area: An area of 10 km radius (aerial distance) from the plant boundary is marked as study area. The baseline data is collected for the study area, where the plant **site** is considered as the core zone and area within 10 km radius of the plant boundary is considered as buffer zone.

The project site is located in the Village Kawai, Tehsil Atru, District Baran, Rajasthan.

Toposheet (SOI OSM) showing project site boundary & environmental settings in 10 km radius of project site is given as Figure 1.1 in Chapter 1 of this EIA Report. Google Earth Imagery showing project site boundary & Geographical Co-ordinates of the project area is given as Figure 2.2 in Chapter 2 of this EIA/EMP Report.

3.3 BASELINE DATA COLLECTION

Baseline data generation for one season (Post -Monsoon Season) was carried out during October 2024 to December 2024 by **M/s Newcon Consultants & Laboratories, Uttar Pradesh.**

Table 3.1: Details of Environment Monitoring Laboratory

Name of the lab	**M/s Newcon Consultants & Laboratories, Uttar Pradesh.**
NABL Certificate Number & Validity	Certificate No.: TC-12621; Validity period: 17.11.2023 to 16.11.2025
CPCB Notification & validity	CPCB recognition letter dated 09.07.2024 valid upto 16.11.2025.

The details of the baseline parameters are tabulated as under:

Table 3.1 : Details of baseline parameters

Particulars	Number of locations	Location	Type of data
Climatological study (Micro-meteorological data generation)	1	Project Site	Primary data generation & Secondary data from Climatological data from IMD station Baran.
Ambient air monitoring	11	Project site & study area	Primary data generation
Ground water analysis	08	Project site & study area	Primary data generation

Particulars	Number of locations	Location	Type of data
Surface water analysis	07	Surface water bodies of the study area	Primary data generation
Soil analysis	10	Project site & study area	Primary data generation
Noise monitoring	11	Project site & study area	Primary data generation
Ecology & Biodiversity	10 km study area	Study area	Primary data generation (reconnaissance survey) as well as secondary data
Socio-economic environment study	10 km study area	Study area	Primary data generation as well as secondary data
Land use analysis	10 km study area	Study area	Satellite imagery: NRSC & confirmation from SOI OSM & field survey.
Geology & Hydrogeology	10 km study area	Study area	Primary survey as well as secondary sources

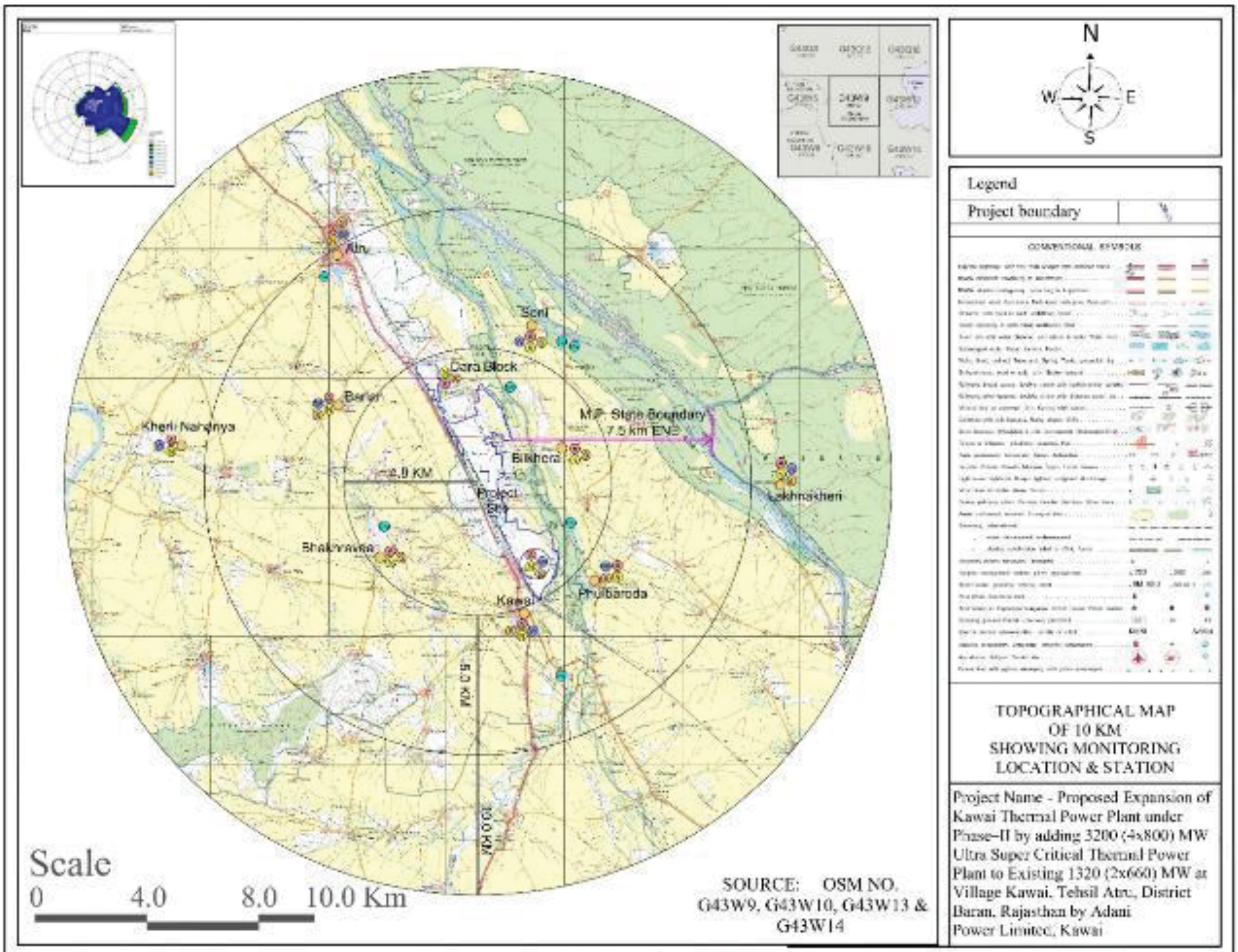
3.3.1 LOCATIONS OF MONITORING STATIONS

Eleven monitoring stations including a project site were selected for monitoring of Ambient Air and Noise analysis. Surface water sampling was carried out at seven locations, ground water sampling was carried out at eight locations and soil sampling was carried out at ten locations. The monitoring stations were selected on the basis of surface considerations, demographic influence and metrological conditions based on secondary sources. The details of monitoring locations along are given in table below:

Table 3.2: Details of monitoring stations

S. No.	Environmental Attribute	Parameters	Number of Locations	Frequency of monitoring
1.	Micro-meteorology	Temperature (deg C), Relative Humidity (%), Wind Speed (m/s), Rain fall (mm)	01 location Project Site	One season

S. No.	Environmental Attribute	Parameters	Number of Locations	Frequency of monitoring
2.	Ambient air quality	PM_{10}, $PM_{2.5}$, SO_2, NOx, CO & Hg	11 locations Site-Once	24 hourly samples Twice a week for 3 months
3.	Ground water	Physical, chemical & biological parameters As per IS: 10500	08 locations	Once during monitoring period;
4.	Surface water	Physical, chemical & biological parameters As per IS: 2296	07 Locations	Once during monitoring period;
5.	Ambient Noise Level	Noise levels monitoring dB(A)	11 locations	Once during monitoring period
6.	Soil quality	Physical & chemical parameters	10 locations; once during monitoring period.	Once during monitoring period



Location	Distance (km)	Direction	AQ (A)	Noise (N)	WQ		Soil (S)
					GW (W)	SW (W)	
Project Site	--	--	A	N	W	----	S
Phulbaroda (Up wind)	1.4	ESE	A	N	W	----	S
Bhakhravda (Dn wind)	4.2	W	A	N	----	----	S
Bilkhera (Second Up wind)	2.2	E	A	N	----	----	S
Barlan (Dn Wind)	2.2	WSW	A	N	W	----	S
Lakhnakheri (Up wind)	8.4	E	A	N	W	----	S
Kawai (Cross wind)	0.8	WSW	A	N	W	----	S
Soni (Cross wind)	2.8	NE	A	N	W	----	S
Atru (Habitation)	4.8	NW	A	N	W	----	S
Kherli Nahariya (Habitation)	8.8	WSW	A	N	W	----	
Dara Block (Sensitive)	0.01	E	A	N	----	----	S
Andheri Nadi (Up Stream)	0.5	E	----	----	----	W	----
Andheri Nadi (Dn Stream)	0.5	E	----	----	----	W	----
Bhupsi Nala	3.9	W	----	----	----	W	----
Lhasi Nadi	2.8	SSE	----	----	----	W	----
Atru (Water Body)	3.8	NW	----	----	----	W	----
Parbati River (Up Stream)	3.5	E	----	----	----	W	----
Parbati River (Dn Stream)	3.4	E	----	----	----	W	----

Fig. 3.1: Topographical Map showing Baseline Monitoring location/ stations

3.4 LAND USE LAND COVER STUDIES

Studies on land use aspects of eco-system play an important role in identifying susceptible issues and to take appropriate action by concerned subject specialist conducting the EIA studies.

3.4.1 Objectives

The objective of the present work is to prepare land use and land cover map, and land use land cover changes in the last 10 years with respect to the project site, using hybrid digital classification technique. The land use-land cover map will depict the state of land features and land use of the core and the buffer Zone (10 Km Radius from the project boundary). In addition, land use-land cover thematic map can be used in studying the spatial distribution of impacts due to the project and accordingly suggest mitigation measures.

3.4.2 Methodology

The details of study area, collection of relevant satellite images, ground-truth observation, and the use of software and analytical tools used in the current study.

3.4.3 Tools & Resources

The Land use Land cover study has been carried out using Digital Image Processing and Digital Image Interpretation techniques. The Image Processing and Geographical Information Systems software have been used for the Spatial Analysis. In order to meet the project requirements, Tecdatum has acquired the following satellite data of the study area from National Remote Sensing Centre (NRSC).

For 10km Buffer Zone:

Kharif Season

Satellite: IRS Resourcesat2

Sensor: LISS-IV FMX

Path: 96 Row: 054

Date of Pass: 28-October-2024

Spatial Resolution: 5.8m

The IRS-R2 L-IV FMX data of the buffer zone is presented in Fig.3.2.

For 10km Buffer Zone:

Rabi Season

Satellite: IRS Resourcesat2

Sensor: LISS-IV FMX

Path: 96 Row: 054

Date of Pass: 19-April-2024

Spatial Resolution: 5.8m

The IRS-R2 L-IV FMX data of the buffer zone is presented in Fig.3.3

For Core Zone:

Satellite: IRS Resourcesat2

Sensor: LISS-IV FMX

Path: 96 Row: 054

Date of Pass: 28-October-2024

Spatial Resolution: 5.8m

The IRS-R2 L-IV FMX data of core zone is shown in the Fig.3.4

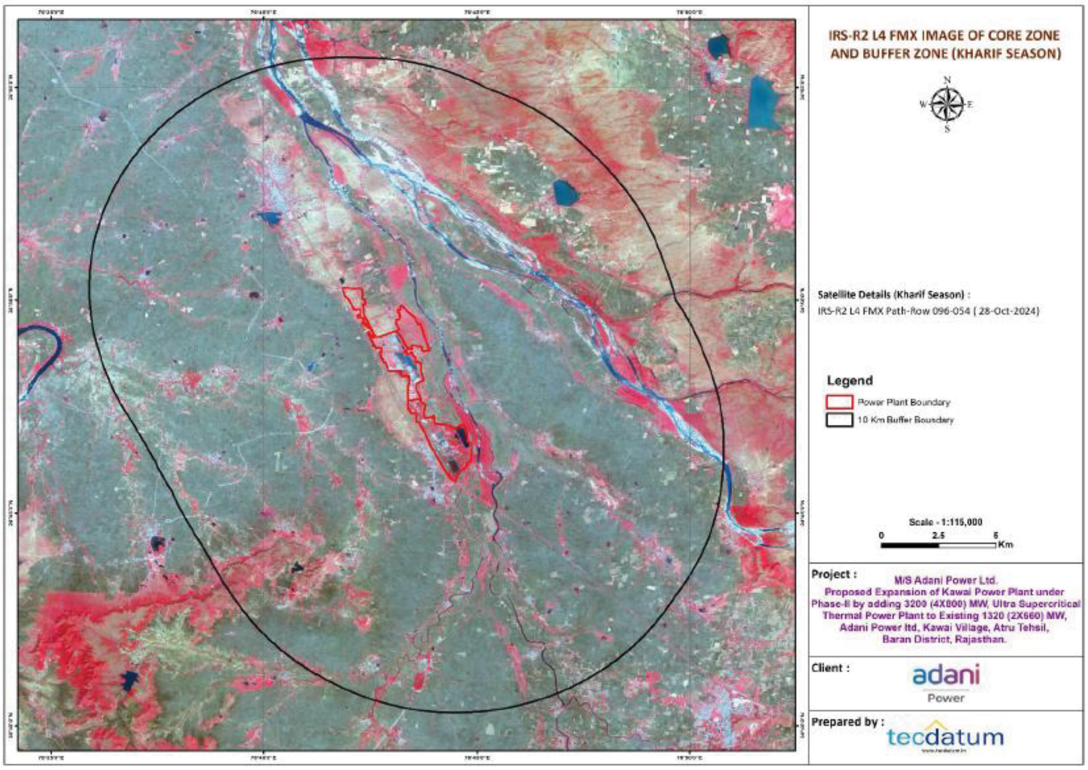


Figure 3.2: IRS-R2 LISS4FMX 28-Oct-2024 Satellite data (10km buffer zone) of kharif season

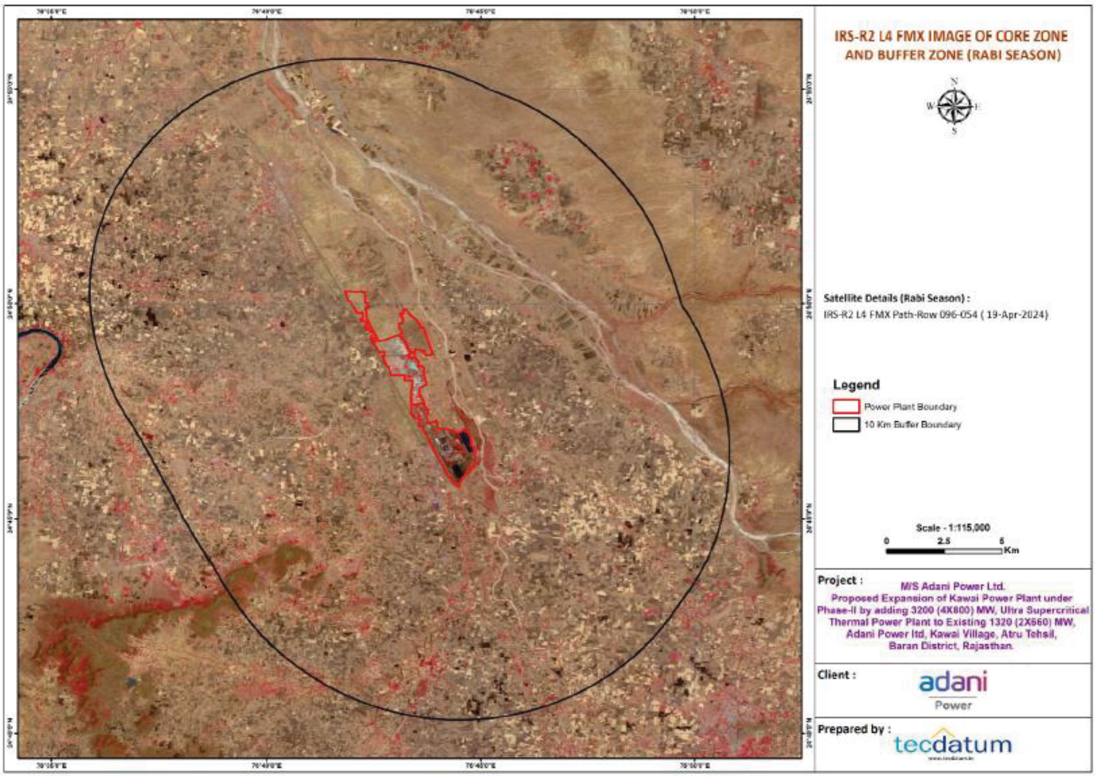


Figure 3.3: IRS-R2 LISS4FMX 19-Apr-2024 Satellite data (10km buffer zone) of Rabi season

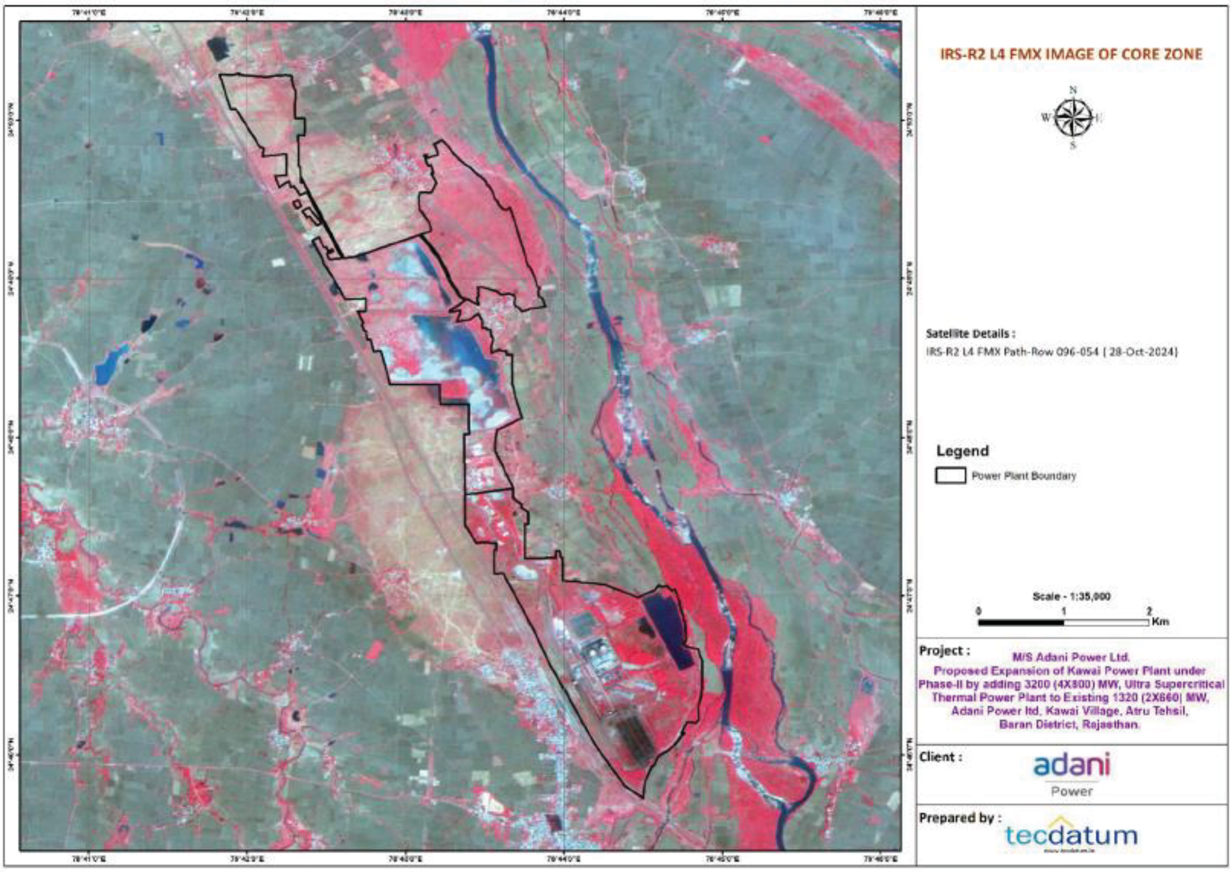


Figure 3.4: IRS-R2 LISS4FMX 19-Apr-2024 Satellite data (10km buffer zone) of Rabi season

3.4.4 Background Information

The advent of high resolution, multi-spectral satellite data has opened a new avenue in the field of mapping and monitoring of vegetation cover and changes that may have taken place over a period of time. The present study has been taken up to assess the changes in vegetation cover in two seasons. While assessing the Land use Land cover and vegetation cover in the power plant area and buffer areas, changes in different categories of vegetation cover are also analyzed to formulate the remedial measures, if any, required to be taken up to maintain the ecological balance in the region.

3.4.5 About Report

To assess the Land use Land Cover of the proposed Project, the primary data i.e Satellite Imageries have been procured from NRSC. Other data sets were derived from the secondary data namely SOI toposheets data. After carrying out respective studies, the same are presented in this report.

3.4.6 Pre-processing of Satellite Data for Land use Land cover Studies

The IRS R2 LISS-IV FMX data was geometrically corrected with respect to Survey of India toposheets. To carry out the Geo-referencing, Ground Control Points (GCPs) were identified on the maps and raw satellite data. The coefficients for two co-ordinate transformation equations were computed based on polynomial regression between GCPs on map and satellite data.

Alternate GCPs were generated till the Root Mean Square (RMS) error was less than 0.5 pixel and then both the images were co-registered.

The Digital Image Processing was performed using ERDAS Imagine software tools and Ground Truthing using handheld Garmin 64S & Oregon GPS (Global Position System).

Similarly for Core Zone, IRS R2 LISS-IV FMX was Geo-referenced with reference to the GCPs collected using GPS during the ground truthing phase.

The satellite image was analyzed digitally by the method of supervised classification system with necessary ground truthing using the reference map as well as GPS.

The topography of the buffer zone was studied using the Survey of India Toposheets and google earth data for obtaining the elevations and the drainage pattern including drainage orders.

The results of the land use studies were verified on the ground during the Ground truthing and the necessary corrections have been made according to the ground truthing observations.

3.4.7 Land use Land cover Classification for the study:

Based on the scale and the satellite resolution (5.8m) the Land use Land cover classification can be made in two levels. Since digital image processing was carried out to delineate various Land use Land cover categories viz. Open Forest, Degraded Forest, Forest blank, Waste lands such as land with or without scrub, barren/ rocky and stony waste, Double crop, Single crop areas, Water bodies, Power plant Infrastructures and mining / quarry areas. Necessary training sets were identified based on tone, texture, size, and shape pattern and location information. Further necessary care was taken to identify proper Land Use class, where there is conflict between the signatures of various classes.

However, since the project is intended to address the Land use analysis, Land use Land cover delineation is addressed with focus on the Land Use features which are influenced by this project activity.

Table 3.4: General Land Use Land cover classes in respective levels

S. No.	Level I	Level II
1.	Built-up land	1.1 Settlement
		1.2 Vacant land
2.	Agricultural Land	2.1 Double crop
		2.2 Single crop
		2.3 Fallow Land
		2.4 Agricultural Plantations
3.	Forest	3.1 Dense Forest
		3.2 Open Forest
		3.3 Degraded Forest
		3.4 Forest Blank
		3.5 Forest Plantations
4.	Waste Land	4.1 Land with Scrub
		4.2 Land without Scrub
		4.3 Marshy/ Swampy Area
5.	Water Bodies	5.1 River/Stream
		5.2 Tank/ Reservoir
6.	Others	6.1 Mining /Quarry Area

Various Land Use Classes considered:

The buffer zone can be broadly classified in to forest areas, built-up areas, agriculture areas and other land with or without scrubs.

Forest

All the areas are declared as reserve forest areas as shown in this class. The forests can be classified based on density into the following classes:

Closed Forest: Forests with tree canopy coverage above 70%.

Dense Forest: Forests with tree canopy coverage between 40%-70%.

Open Forest: Forests with tree canopy coverage between 10%-40%.

Degraded Forest: Forests with tree canopy coverage less than 10%, generally covered with scrubs/ altered land use areas.

Forest Blanks: Forests with tree canopy coverage less than 1%. Forest encroachments and illegal agriculture also are shown in this class.

Plantations: The plantations raised in the reserve forest boundaries are shown in these classes.

Agriculture

Double Crop: The areas where farmers practice cultivation in two seasons in a year.

Single Crop: The areas where farmers practice cultivation in one season in a year.

Fallow: The areas are not cultivated in current year/ years.

Plantations: The areas are with horticulture/ other plantations.

Waste Lands

Areas with/ without scrubs: Generally, waste lands non-agriculture and non-forest areas covered with or without scrubs.

Barren lands: Land without any usage and without scrubs and sometimes they are rock exposed areas.

Water Bodies

The oceans, rivers, streams, lakes, tanks, reservoirs, canals, etc. will be identified in this class.

Built-up

The villages/ colonies/ Industries are shown in this class.

Mining Areas

The areas, where the mining activity is performing/ performed are shown in this class.

Industrial Area

The industrial Establishments are shown in this class.

A. Land use Land Cover Details of the Buffer Zone:

The satellite imagery (IRS Resourcesat-2 Liss 4 FMX) of the study area around 10 km buffer zone from the project site (Power Plant boundary) captured by the satellite is presented in Fig.3.2. The land use Land cover in this study area is depicted in Fig.3.5.

In total 58.52% of the buffer zone is covered with Agriculture land under various categories, 16.13% of the buffer zone covered with waste land, 15.74% of the buffer zone covered with Forest land under various categories and about 9.61% with others.

Various classes and their respective areas with percentage of coverage are given in Table 3.5.

Table 3.5: Land use Land Cover Composition of Buffer Zone

Land Use cover class		Area of Subclass		Area of Class	
		Area (ha)	% of Usage	Area (ha)	% of Usage
Agriculture				**31294.99**	**58.52**
	Double crop	4440.5	8.30		
	Single crop	22402.08	41.89		
	Fallow land	4323.99	8.09		
	Plantation	128.42	0.24		
Forest cover				**8415.14**	**15.74**
	Open forest	1315.97	2.46		
	Degraded forest	3358.63	6.28		
	Forest bank	3740.54	7.00		
Waste land				**8625.09**	**16.13**
	Barren rock/ Land	2900.73	5.42		
	Land with/without scrub	5724.36	10.71		
Others					
	Settlements	1549.33	2.90		
	Power plant infrastructures	74.64	0.14		

Land Use cover class		Area of Subclass		Area of Class	
		Area (ha)	% of Usage	Area (ha)	% of Usage
	Ash pond	118.09	0.22		
	Mining/Quarry Area	37.17	0.07		
	River/ Water Body/Canal	3356.52	6.28		
Total		**53470.97**	**100.00**	**53470.97**	**100.00**

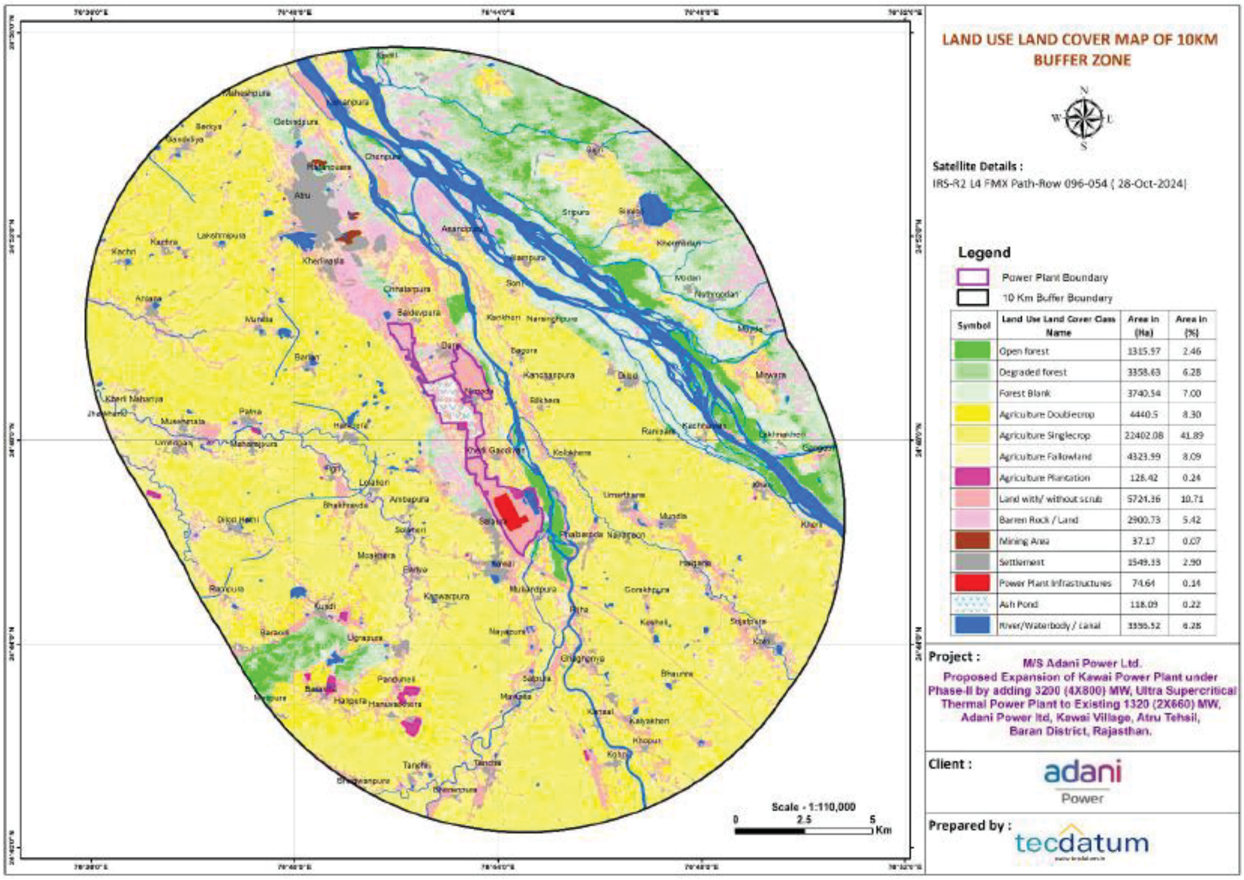


Figure 3.5 Land use Land cover map of the buffer zone

B. Land use Land Cover Details of the Core Zone:

The Satellite data of the core zone of 2032.54 Acre (822.541 Ha) is presented in Fig.3.4. The hybrid method of digital and visual interpretation procedures was followed for study area on the high resolution of IRS R2 LISS-4 FMX 28-Oct-2024 (Fig.3.4) data have been used for interpreted to delineate various Land use Land cover classes in the core zone i.e. plantations, land with and without scrubs, barren land, built up lands, infrastructure developments, runway, roads, ash pond, coal stock yard, Railway line, Reservoir and Water bodies etc. The Land use Land cover in the study area is depicted in Fig.3.6

In total 49.89% of the core zone is covered in waste lands with various categories, 29.58% of the core zone is covered Power Plant area under various categories, 17.90% of the core zone is covered with others under various categories and Agriculture land with various categories 2.63%. No common property resources (community land, woodland patches, grazing land etc.,) were observed in core zone.

The various classes of Land use Land cover and their respective areas with percentage of coverage are given in the Table 3.6.

Table 3.6 Land use Land cover composition of the Core Zone

Land Use/land Cover Class		Area of Sub class		Area of Class	
		Area (ha)	%of Usage	Area (ha)	%of Usage
Agriculture				**21.619**	**2.63**
	Crop land	13.362	1.62		
	Fallow land	8.257	1.01		
Plant Area				**243.293**	**29.58**
	Plantation	131.896	16.04		
	Built-up land	16.623	2.02		
	Plant Infrastructures	19.506	2.37		
	Roads	40.127	4.88		
	Railway Line	14.207	1.73		
	Coal stock yard	14.319	1.74		
	Substation	6.615	0.8		
Waste Land				**410.403**	**49.89**
	Barren land	71.311	8.67		
	Land with scrub	232.407	28.25		
	Land without scrub	106.685	12.97		
Others				**147.226**	**17.9**
	Runway	5.872	0.71		
	Ash Pond	71.998	8.75		
	Reservoir	23.724	2.88		
	Stream/Water Bodies	45.632	5.56		
Total		**822.541**	**100**	**822.541**	**100.00**

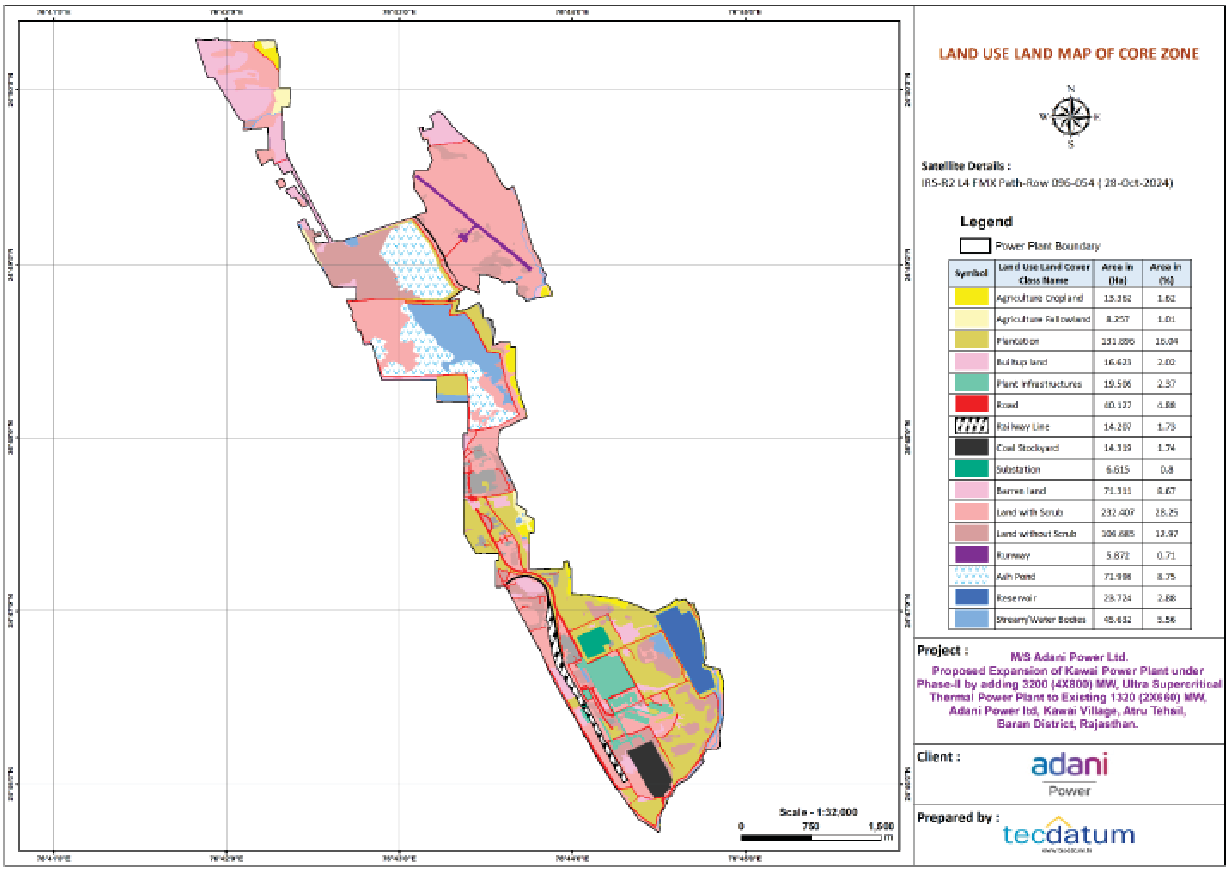


Figure 3.6: Land use land cover map of the core zone

3.4.8 Study Results:

As per the interpretation of Satellite Data through Image Processing techniques, Agricultural classes and Waste lands have been observed apart from the built up and water bodies in the buffer zone.

About 58.52% of the buffer zone is covered with Agriculture land under various categories, 16.13% of the buffer zone covered with waste land, 15.74% of the buffer zone covered with Forest land under various categories and others about 9.61%.

About 49.89% of the core zone is covered with various categories of waste lands, 29.58% of the core zone is covered under various categories of Power Plant area, 17.90% of the core zone is covered under various categories of other classes and Agriculture land with various categories 2.63%.

As per Survey of India Topographical Map, the minimum and maximum elevation of the buffer area ranges between 280m and 380m, above MSL and the core zone has the elevation Contour values in the range of 300m-310m above MSL.

3.5 SOIL QUALITY

For studying soil quality of the region, samples were collected to assess the existing soil conditions in and around the project site. The present study on soil quality establishes the baseline characteristics and identifies the incremental concentrations if any, due to the proposed project.

The soil samples were collected from three different depths viz. 30 cm, 60 cm and 90 cm. The samples were then packed in a polythene plastic bag and sealed. The samples from three different depths were homogenized and then were analyzed.

In order to study the impact of the proposed expansion project on agriculture and other activities in the 10 km radius of the project, soil sampling stations have been selected accordingly.

Table 3.7: Soil sampling locations

S. No.	Monitoring Locations	Station Code	Selection criteria	Distance (km)	Direction
1.	Project Site	S1	Core zone	--	--
2.	Phulbaroda	S2	Up wind	1.4	ESE
3.	Bhakhravda	S3	Down wind	4.2	W
4.	Bilkhera	S4	Second Up wind	2.2	E
5.	Barlan	S5	Down wind	2.2	WSW
6.	Lakhnakheri	S6	Up wind	8.4	E
7.	Kawai	S7	Cross wind	0.8	WSW
8.	Soni	S8	Cross wind	2.8	NE
9.	Atru	S9	Habitation	4.8	NW
10.	Dara Block	S10	Sensitive	0.01	E

3.5.1 BASELINE SOIL STATUS

Ten samples were collected from the study area including from the project site. The samples were packed in polyethylene bags and assigned a number. The collected samples were air dried at room temperature in the laboratory and lightly crushed with mortar-pastle and passed through a 2 mm sieve. The soil samples were analyzed for the physio-chemical properties by standard procedure as presented in Table 3.8.

Table 3.8: Analytical Technique for Soil Sample

S. No.	Parameters	Analytical Method	Reference
1	Texture	Sieve analysis & Hygro meter	-
2	Moisture Content	Gravimetric	Department of Agriculture & Co-operation, Govt of India Page No. 76-77:2011
3	pH	pH meter	IS 2720- Part 26, 1987 by pH meter
4	Conductivity (1:2)	Conductivity meter	Department of Agriculture & Co-operation, Govt of India Page No. 81-82:2011
5	Organic Matter	Black method	IS2720-(Part 22),1972, Reaffirmed 2001
6	Organic Carbon	Calculation	IS2720-(Part-22),1972, Reaffirmed 2001 (By calculation)
7	Potassium	Flame Photometric	TM-S/13
8	Phosphorus	Spectrophotometric	TM-S/11
9	Nitrogen	Distillation & Titration	TM-S/17
10	Infiltration Rate		TM-S/40
11	Bulk Density	Sand replacement, core cutter	TM-S/34
12	Porosity	-	TM-S/33

Standard Classification of Soil as per Indian Council of Agriculture Research, New Delhi is presented below in **Table 3.9.** The soil quality as analyzed from the collected samples is given in **Table 3.9 a & 3.9 b**.

Table 3.9: Standard Classification of Soil

S. No.	Soil Test	Classification

1.	pH	• <4.5 Extremely acidic, • 4.51- 5.50 Very strongly acidic, • 5.51-6.0 moderately acidic, • 6.01-6.50 slightly acidic, • 6.51-7.30 Neutral, • 7.31-7.80 slightly alkaline, • 7.81-8.50 moderately alkaline, • 8.51-9.0 strongly alkaline • 9.01 very strongly alkaline
2.	Salinity/ Electrical conductivity (umho/cm) (1 ppm = 640 umho/cm)	Up to 1.00 Average, 1.01-2.00 harmful to germination, 2.01-3.00 harmful to crops (sensitive to salts)
3.	Organic Carbon	Up to 0.2: very less, 0.21-0.4: less, 0.41-0.5 medium, 0.51-0.8: on an average sufficient, 0.81-1.00: sufficient and >1.0 more than sufficient
4	Nitrogen (kg/ha)	Up to 50 very less; 51-100 less; 101-150 good; 151-300 Better and >300 sufficient
5	Phosphorus (kg/ha)	Up to 15 very less, 16-30 less; 31-50 medium, 51-65 on an average sufficient 66-80 sufficient, >80 more than sufficient
6	Potash (kg/ha)	0 -120 very less; 120-180 less; 181-240 medium; 241-300 average; 301-360 better; >360 more than sufficient

Table 3.9a: Soil Analysis Results

S.No.	Parameter	Unit	Test Method	S1	S2	S3	S4	S5
1	Texture	-	NCL/STP/SOIL/04	Sandy Silt	Sandy Silt	Sandy Silt	Sandy Silt	Sandy Silt
2	Sand	%	NCL/STP/SOIL/04	66	76	71	70	66
3	Silt	%	NCL/STP/SOIL/04	25	16	20	23	24
4	Clay	%	NCL/STP/SOIL/04	9	8	9	7	10
5	pH	-	IS : 2720 (P-26)	7.41	7.61	7.41	7.51	7.58
6	Electrical Conductivity	µS/cm	IS : 14767	260	210	240	230	226
7	Cation Exchange Capacity	meq/100gm	IS : 2720 (P-24)	6.4	5.2	5.9	5.8	6.1
8	Potassium	kg/hect	IS : 11260	170	210	170	190	168
9	Sodium	mg/kg	STP/NCL/SOIL/02	106	108	92	80	104
10	Calcium	mg/kg	STP/NCL/SOIL/03	110	112	102	120	134
11	Phosphorus	kg/hect	ISO : 11262	10.8	12.9	12.4	11.6	14.8
12	Magnesium	mg/kg	STP/NCL/SOIL/10	41	42	38	38	45
13	Sodium Absorption Ratio	meq/L	STP/NCL/SOIL/09	2.61	1.80	1.75	1.72	2.81
14	Water Holding Capacity	%	IS : 14765	24	22	18	19	21
15	Porosity	%	STP/NCL/SOIL/08	40	38	42	43	39
16	Zinc (as Zn)	mg/kg	STP/NCL/SOIL/04	36.24	3.1	36.25	38.02	36.26
17	Lead (as Pb)	mg/kg	STP/NCL/SOIL/04	BDL(DL-0.05)	BDL(DL-0.05)	BDL(DL-0.05)	BDL(DL-0.05)	BDL(DL-0.05)
18	Mercury (as Hg)	mg/kg	STP/NCL/SOIL/04	BDL(DL-0.05)	BDL(DL-0.05)	BDL(DL-0.05)	BDL(DL-0.05)	BDL(DL-0.05)
19	Arsenic (as As)	mg/kg	STP/NCL/SOIL/04	BDL(DL-0.05)	BDL(DL-0.05)	BDL(DL-0.05)	BDL(DL-0.05)	BDL(DL-0.05)

20	Organic Matter	%	IS : 2720 (P-22)	0.91	0.85	0.94	0.91	0.86
21	Total Kjehdahl Nitrogen	kg/hect	IS : 14684	12.3	11.4	12.6	12.1	11.9

Table 3.9b: Soil Analysis Results

S.No.	Parameter	Unit	Test Method	S6	S7	S8	S9	S10
1	Texture	-	NCL/STP/SOIL/04	Sandy Silt	Sandy Silt	Sandy Silt	Sandy Silt	Sandy Silt
2	Sand	%	NCL/STP/SOIL/04	75	72	72	66	71
3	Silt	%	NCL/STP/SOIL/04	17	17	16	25	19
4	Clay	%	NCL/STP/SOIL/04	8	11	12	9	10
5	pH	-	IS : 2720 (P-26)	7.61	7.52	7.65	7.41	7.42
6	Electrical Conductivity	µS/cm	IS : 14767	218	250	260	260	219
7	Cation Exchange Capacity	meq/100gm	IS : 2720 (P-24)	3.9	6.1	6.3	6.4	5.4
8	Potassium	kg/hect	IS : 11260	191	170	160	170	164
9	Sodium	mg/kg	STP/NCL/SOIL/02	110	119	84	106	92
10	Calcium	mg/kg	STP/NCL/SOIL/03	140	115	195	110	88
11	Phosphorus	kg/hect	ISO : 11262	10.8	12.5	11.2	10.8	11.4
12	Magnesium	mg/kg	STP/NCL/SOIL/10	48	43	48	41	35
13	Sodium Absorption Ratio	meq/L	STP/NCL/SOIL/09	1.95	1.9	1.52	2.61	2.10
14	Water Holding Capacity	%	IS : 14765	23	20	23	24	22
15	Porosity	%	STP/NCL/SOIL/08	38	36	39	40	41
16	Zinc (as Zn)	mg/kg	STP/NCL/SOIL/04	39.62	43.62	40.66	36.24	36.62
17	Lead (as Pb)	mg/kg	STP/NCL/SOIL/04	BDL(DL-0.05)	BDL(DL-0.05)	BDL(DL-0.05)	BDL(DL-0.05)	BDL(DL-0.05)
18	Mercury (as Hg)	mg/kg	STP/NCL/SOIL/04	BDL(DL-0.05)	BDL(DL-0.05)	BDL(DL-0.05)	BDL(DL-0.05)	BDL(DL-0.05)
19	Arsenic (as As)	mg/kg	STP/NCL/SOIL/04	BDL(DL-0.05)	BDL(DL-0.05)	BDL(DL-0.05)	BDL(DL-0.05)	BDL(DL-0.05)
20	Organic Matter	%	IS : 2720 (P-22)	0.75	0.81	0.74	0.80	0.73

21	Total Kjehdahl Nitrogen	kg/hect	IS : 14684	12.2	11.9	11.2	10.4	12.4

3.5.2 OBSERVATIONS:

- pH: Ranges from 7.41 to 7.65, suitable for most crops.
- Water Holding Capacity 18 % to 24 %, suggesting good moisture retention.
- Electrical Conductivity: Ranges from 210 to 260 mS/cm, indicating a low to moderate salt concentration.
- Organic Matter: Varies from 0.73 % to 0.94%, contributing to soil fertility.
- The concentration of available Total Kjehdahl Nitrogen, Phosphorous and Potassium in the soil samples varies from 10.4 to 12.6 mg/kg, 10.8 to 14.8 mg/kg, and 160 to 210 mg/kg respectively.

3.6 CLIMATOLOGY AND MICROMETEOROLOGY

Micrometeorological data helps for appropriate understanding of the baseline micro climatic status of the study area as well as for input into prediction models to evaluate air dispersion phenomenon. Chronological data on meteorological parameters also helps identifying the general errors encountered during generation of micro meteorological data of the region. The year is broadly divided into four seasons as per IMD:

- Winter season : December to February
- Pre-monsoon season : March to May
- Monsoon season : June to September
- Post-monsoon season : October to November

3.6.1 METHODOLOGY

The methodology adopted for monitoring surface observations is as per the standard norms laid down by Bureau of Indian Standards (IS: 8829) and India Meteorological Department (IMD). Automatic micro meteorological station was installed at the project site with continuous data logger for the sampling period.

3.6.2 METEOROLOGICAL DATA

While selecting and finalizing the monitoring stations, secondary source (Envitrans) of wind rose was considered. However, Percentage frequencies of wind in 16 directions have been computed from the recorded data during the study period (Oct-Dec 2024) to plot wind rose. **Figure-3.7** represents the summary of the wind pattern.

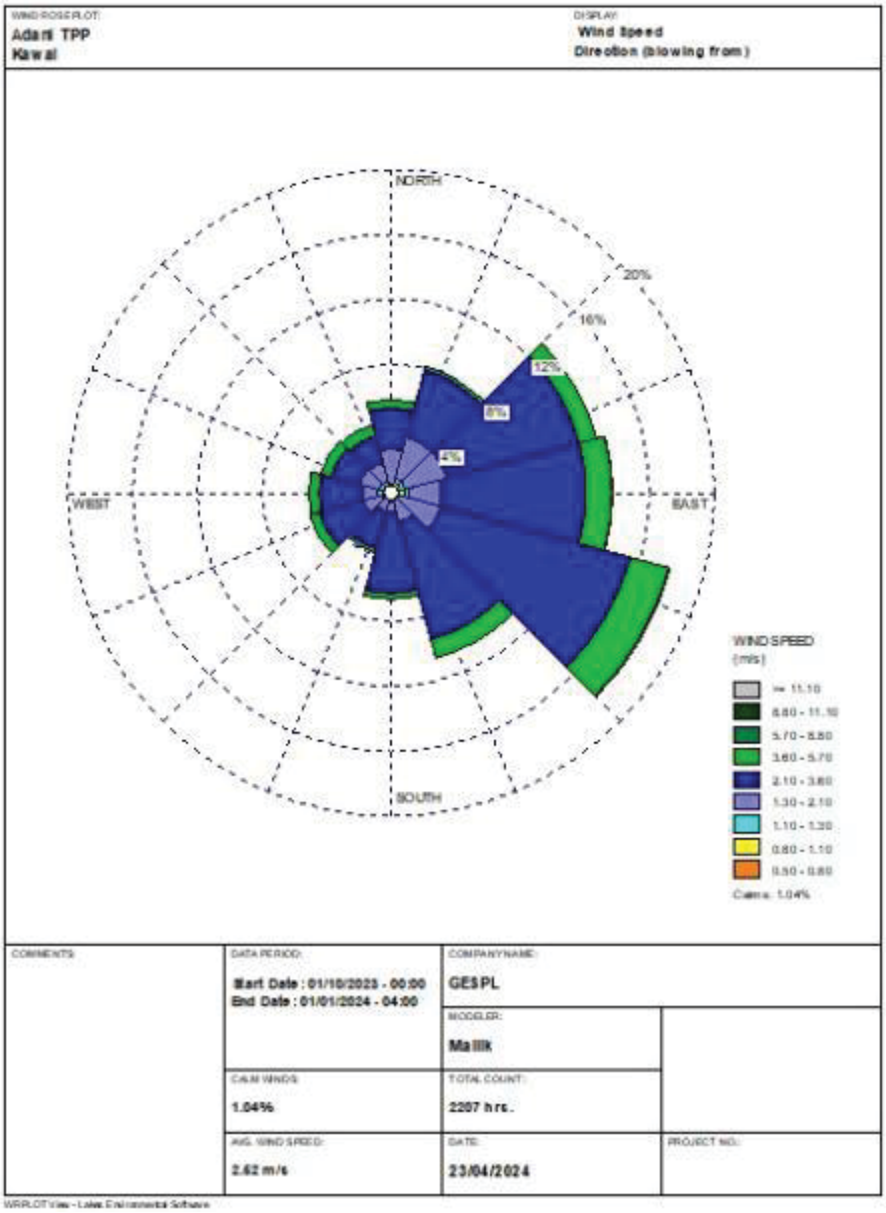


Figure 3.7: Wind Rose

The recorded micro meteorological data for the study period at project site is presented in Table 3.10.

Table 3.10: Summary of the Meteorological Data (October to Decemeber'2024)

Month	Temperature (deg C)		Relative Humidity (%)		Wind Speed (m/s)		Rainfall (mm)
	Max	Min	Max	Min	Max	Min	
Oct	35.3	18.8	94.8	16.0	7.3	0	2.6
Nov	33.9	10.2	65.9	18.3	7.6	0	0
Dec	29.4	6.5	97.1	13.2	8.5	0	4.1

3.7 AIR ENVIRONMENT

The objective of the baseline air monitoring was to evaluate the existing air quality of the area. This will also be useful for comparing and writing EMP for attaining conformity to standards of ambient air quality during the operation of the proposed expansion project.

This chapter describes the selection of sampling locations, methodology adopted for sampling, analytical techniques and frequency of sampling. The results of monitoring carried out for the study period Oct-Dec' 2024 is presented in this chapter.

3.7.1 Methodology adopted for Air Quality Survey

- **Selection of Sampling Locations**

  The baseline status of the air quality in the study area has been assessed through a scientifically designed ambient air quality monitoring network. Ambient Air Quality Monitoring (AAQM) stations were set up at eleven locations with due consideration to the above-mentioned points.

Table 3.11: Ambient air quality monitoring locations

S. No.	Monitoring Locations	Station Code	Selection criteria	Distance (km)	Direction
1.	Project Site	AAQ1	Core zone	--	--
2.	Phulbaroda	AAQ2	Up wind	1.4	ESE
3.	Bhakhravda	AAQ3	Down wind	4.2	W

S. No.	Monitoring Locations	Station Code	Selection criteria	Distance (km)	Direction
4.	Bilkhera	AAQ4	Second Up wind	2.2	E
5.	Barlan	AAQ5	Down wind	2.2	WSW
6.	Lakhnakheri	AAQ6	Up wind	8.4	E
7.	Kawai	AAQ7	Cross wind	0.8	WSW
8.	Soni	AAQ8	Cross wind	2.8	NE
9.	Atru	AAQ9	Habitation	4.8	NW
10.	Kherli Nahariya	AAQ10	Habitation	8.8	WSW
11.	Dara Block	AAQ11	Sensitive	0.01	E

3.7.2 Frequency and Parameters for Sampling

Ambient air quality monitoring has been carried out with a frequency of two days per week at eleven locations covering one complete season except monsoon (CPCB Guidelines). *Frequency and Parameters for Sampling.* The baseline was monitored for parameters mentioned below as per latest Gazette Notification of the Central Pollution Control Board (CPCB) on NAAQ standards dated 18th November 2009. The ambient air quality parameters along with their frequency of sampling are given in **Table-3.12.**

Table 3.12: Monitored Parameters and Frequency of Sampling

S. No.	Parameters	Sampling Frequency	Protocol
1.	Particulate Matter (PM_{10})	24 hourly sample twice a week for three months	IS: 5182 Part-23: 2006 (Reaffirmed 2017)
2.	Particulate Matter ($PM_{2.5}$)	24 hourly sample twice a week for three months	IS 5182 (Part 24): 2019
3.	Sulphur dioxide (SO_2)	24 hourly sample twice a week for three months	IS: 5182 (Part-2)-2001 (Reaffirmed 2017)
4.	Oxides of Nitrogen (NO_x)	24 hourly sample twice a week for three months	IS: 5182 (Part-6)-2006 (Reaffirmed 2017)

3.7.3 Instruments used for Sampling

Fine Particulate Samplers (FPS) has been used for $PM_{2.5}$ Sampling. Respirable Dust Samplers (RDS) with gaseous attachment have been used for PM_{10}, SO_2 & NOx, CO & Hg Sampling.

Table 3.13: Ambient Air Monitoring Instruments

Instrument	Make	Model
Fine Particulate Sampler	Envirotech	APM 550
Respirable Dust Sampler	Envirotech	APM 460
Gaseous attachments	Envirotech	APM 411

3.7.4 Presentation of Results

The analysis results for the study period are presented in detail**.** Various statistical parameters like 98th percentile, average, maximum and minimum values have been computed from the observed raw data for all the AAQ monitoring stations. The summary of these results for all the locations is presented in **Table-3.14(a) & 3.14(b).**

Table 3.14 (a): Summary of Ambient Air Quality for all the locations

Stations	PM_{10}				$PM_{2.5}$				NO_2			
	Max	Min	Average value	98th percentile	Max	Min	Average value	98th percentile	Max	Min	Average value	98th percentile
Project Site	59.3	42.5	50.19	58.96	44.3	28.1.	35.73	43.97	21.8	8.1	14.32	20.98
Phulbaroda	67.5	46.1	57.61	67.07	44.1	28.1	37.13	43.78	20.2	7.3	13.98	19.87
Bhakhravda	65.5	43.5	55.31	65.06	48.3	29.2	39.43	47.91	19.8	6.9	13.9	19.64
Bilkhera	66.5	45.1	56.54	66.07	46.2	29.2	38.26	45.86	20.4	7.5	14.2	20.07
Barlan	66.2	44.2	54.33	65.76	48.3	29.4	36.35	47.92	23.8	12.9	17.2	23.5
Lakhnakheri	69.5	54.4	63.22	69.19	46.4	24.2	37.16	45.95	17.8	5.9	12.5	17.64
Kawai	64.4	44.1	53.19	63.99	48.3	29.4	37.09	47.92	19.8	7.1	12.82	19.5
Soni	64.4	45.2	56.12	64.01	46.2	29.4	36.13	45.86	17.8	7.1	12.72	17.6
Atru	66.5	43.3	57.33	66.03	45.3	30.10	38.20	44.99	23.6	12.8	17.1	23.4
Kherli Nahariya	66.1	44.1	57.69	45.66	44.2	29.2	37.01	43.90	22	11.8	16	21.6
Dara Block	64.4	44.1	55.68	63.99	48.3	29.2	37.38	47.91	21.5	7.9	14.30	20.8
Test Method	**IS:5182 (P-23) 2006, RA2017**				**IS:5182(P-24)-2019**				**IS:5182(P-06) 2006 Sec.2, RA 2018**			
***NAAQS**	**100 µg/m³**				**60 µg/m³**				**80 µg/m³**			

Table 3.14 (b): Summary of Ambient Air Quality for all the locations

Stations	SO_2				CO				Hg
	Max	Min	Average value	98th percentile	Max	Min	Average value	98^{th} percentile	
Project Site	9.8	2.4	6.73	9.65	0.9	0.4	0.67	0.88	BDL(DL-1.0)
Phulbaroda	10.2	2.1	5.43	10.03	0.8	0.4	0.62	0.77	BDL(DL-1.0)
Bhakhravda	10.2	3.4	6.57	10.064	0.86	0.38	0.65	0.81	BDL(DL-1.0)
Bilkhera	10.6	2.9	6.59	10.44	0.78	0.38	0.61	0.75	BDL(DL-1.0)
Barlan	9.5	2.4	6.74	9.35	0.88	0.35	0.55	0.83	BDL(DL-1.0)
Lakhnakheri	10.6	2.4	6.24	10.43	0.72	0.35	0.56	0.70	BDL(DL-1.0)
Kawai	10.5	2.3	5.56	10.33	0.8	0.35	0.65	0.76	BDL(DL-1.0)
Soni	10.5	2.2	5.54	10.33	0.7	0.3	0.5	0.68	BDL(DL-1.0)
Atru	10.5	2.9	7.74	10.34	0.86	0.34	0.54	0.82	BDL(DL-1.0)
Kherli Nahariya	10.2	2.4	5.93	10.04	0.78	0.30	0.50	0.73	BDL(DL-1.0)
Dara Block	10.9	2.4	5.81	10.73	0.88	0.38	0.65	0.85	BDL(DL-1.0)
Test Method	IS:5182(P-2) 2001, Sec.1 RA 2018				IS:5182 Part 10				
***NAAQS Limits**	**80 µg/m³**				FOR 08 Hrs., = 02 For FOR 01 Hrs = 04 **mg/m³**				

3.7.4.1 Observations:

- PM_{10}: The maximum value for PM_{10} was 69.5 µg/m^3 and minimum value for PM_{10} was 42.5 µg/m^3.
- $PM_{2.5}$: The maximum value for $PM_{2.5}$ was 48.3 µg/m^3 and minimum value for $PM_{2.5}$ was 24.2 µg/m^3.
- SO_2: The maximum value for SO_2 was 10.9 µg/m^3 and minimum value for SO_2 was 2.1 µg/m^3.
- NOx: The maximum value for NOx was 23.8 µg/m^3 and minimum value for was 5.9 µg/m^3.
- CO: The maximum value for CO was 0.9 mg/m^3 and minimum value for CO was 0.3 mg/m^3.
- Hg: Mercury levels were below detection limit at all the locations.

3.7.5 AIR QUALITY INDEX (AQI)

In 2014, CPCB developed uniform air quality index for the Indian cities. The CPCB method utilizes the use of USEPA methodology for determination of the AQI with different breakpoint indices for Indian conditions (CPCB, 2014). The methodology involves the determination of sub-index and then agglomeration of this sub-index for final AQI. The breakpoint concentrations are calculated for different pollutants based on the NAAQS (National Ambient Air Quality Standards) standards and the potential health impacts of the criteria pollutants. The CPCB method of AQI also tells about the pollutant responsible for AQI. The health effects associated with different AQI Categories are given in below.

The sub-index (*Ip*) for a given pollutant concentration (*Cp*), as based on 'linear segmented principle' is calculated as:

$$I_p = \left[\left\{\left(\frac{I_{HI} - I_{LO}}{B_{HI} - B_{LO}}\right)\right\} \times (C_P - B_{LO})\right] + I_{LO}$$

B_{HI}= Breakpoint concentration greater or equal to given conc shown in table S4.

B_{LO}= Breakpoint concentration smaller or equal to given conc shown in table S4.

I_{HI} = AQI value corresponding to B_{HI}

I_{LO} = AQI value Corresponding to B_{LO}

Finally;

AQI = Max (*Ip*) (where; p= 1, 2,,n; denotes n pollutants)

Table 3.15: Health Statements for AQI Categories

AQI	Associated Health Impacts	Condition/Color
(0–50)	Minimal Impact.	**Good**
(51–100)	May cause minor breathing discomfort to sensitive people.	**Satisfactory**
(101–200)	May cause breathing discomfort to the people with lung disease such as asthma and discomfort to people with heart disease, children and older adults.	**Moderately polluted**
(201–300)	May cause breathing discomfort to people on prolonged exposure and discomfort to people with heart disease.	**Poor**
(301–400)	Maycauserespiratoryillnesstothepeopleonprolongedexposure.Effectmay bemore pronounced in people with lung and heart diseases.	**Very Poor**
(401-500)	May cause respiratory effects even on healthy people and serious health impacts on people with lung/heart diseases. The health impacts may be experienced even during light physical activity.	**Severe**

Table 3.16: Breakpoints for AQI Scale 0-500

AQI Category (Range)	**PM_{10} 24-hr µg/m^3**	**$PM_{2.5}$ 24-hr µg/m^3**	**NO_2 24-hr µg/m^3**	**O_3 8-hr µg/m^3**	**CO 8-hr (mg/ m^3)**	**SO_2 24-hr µg/m^3**	**NH_3 24-hr µg/m^3**	**Pb 24-hr µg/m^3**
Good (0-50)	0-50	0-30	0-40	0-50	0-1.0	0-40	0-200	0-0.5
Satisfactory (51-100)	51-100	31-60	41-80	51-100	1.1-2.0	41-80	201-400	0.5 –1.0
Moderately polluted (101-200)	101-250	61-90	81-180	101-168	2.1- 10	81-380	401-800	1.1-2.0
Poor (201-300)	251-350	91-120	181-280	169-208	10-17	381-800	801-1200	2.1-3.0
Very poor (301-400)	351-430	121-250	281-400	209-748	17-34	801-1600	1200-1800	3.1-3.5
Severe (401-500)	430 +	250+	400+	748+	34+	1600+	1800+	3.5+

Source: CPCB 2014

3.7.5.1 AIR QUALITY INDEX OF STUDY AREA

Overall AQI of the study area based upon data collected from selected monitoring locations is as below:

Table 3.16 (a): Air Quality Index of Monitoring Station-1

Project Site (A-1)				
Pollutants	Avg	Concentration in µg/m³ (except for CO)	Sub-Index	Air Quality Index
PM_{10}	24-hr avg	59.30	59.30	74 Satisfactory
$PM_{2.5}$	24-hr avg	44.30	74	
SO_2	24-hr avg	9.8	12	
NOx	24-hr avg	21.80	27	
CO (mg/m³)	max 8-hr	0.9	45	

Table 3.16 (b): Air Quality Index of Monitoring Station-2

PHOOL BARODA (A-2)				
Pollutants	Avg	Concentration in µg/m3 (except for CO)	Sub-Index	Air Quality Index
PM_{10}	24-hr avg	67.50	67.50	74 Satisfactory
$PM_{2.5}$	24-hr avg	44.1	74	
SO_2	24-hr avg	10.2	13	
NOx	24-hr avg	20.20	25	
CO (mg/m³)	max 8-hr	0.8	40	

Table 3.16 (c): Air Quality Index of Monitoring Station-3

Bhakrawada (A-3)				
Pollutants	Avg	Concentration in µg/m³ (except for CO)	Sub-Index	Air Quality Index
PM_{10}	24-hr avg	65.50	65.50	81 Satisfactory
$PM_{2.5}$	24-hr avg	48.30	81	
SO_2	24-hr avg	10.20	13	
NOx	24-hr avg	19.80	25	
CO (mg/m³)	max 8-hr	0.86	40	

Table 3.16 (d): Air Quality Index of Monitoring Station-4

Bilkhera (A-4)				
Pollutants	Avg	Concentration in µg/m³ (except for CO)	Sub-Index	Air Quality Index

PM_{10}	24-hr avg	66.50	66.50	**77 Satisfactory**
$PM_{2.5}$	24-hr avg	46.20	77	
SO_2	24-hr avg	10.60	13	
NOx	24-hr avg	20.40	26	
CO (mg/m^3)	max 8-hr	0.78	39	

Table 3.16 (e): Air Quality Index of Monitoring Station-5

Barlan (A-5)				
Pollutants	**Avg**	**Concentration in $\mu g/m^3$ (except for CO)**	**Sub-Index**	**Air Quality Index**
PM_{10}	24-hr avg	66.2	66.2	**81 Satisfactory**
$PM_{2.5}$	24-hr avg	48.3	81	
SO_2	24-hr avg	9.5	12	
NOx	24-hr avg	23.80	30	
CO (mg/m^3)	max 8-hr	0.88	44	

Table 3.16 (f): Air Quality Index of Monitoring Station-6

Lakhmakheri (A-6)				
Pollutants	**Avg**	**Concentration in $\mu g/m^3$ (except for CO)**	**Sub-Index**	**Air Quality Index**
PM_{10}	24-hr avg	69.50	69.50	**77 Satisfactory**
$PM_{2.5}$	24-hr avg	46.40	77	
SO_2	24-hr avg	10.60	13	
NOx	24-hr avg	17.80	22	
CO (mg/m^3)	max 8-hr	0.72	36	

Table 3.16 (g): Air Quality Index of Monitoring Station-7

KAWAI **(A-7)**				
Pollutants		**Concentration in $\mu g/m^3$ (except for CO)**	**Sub-Index**	**Air Quality Index**
PM_{10}	24-hr avg	64.40	64.40	**81 Satisfactory**
$PM_{2.5}$	24-hr avg	48.30	81	
SO_2	24-hr avg	10.50	13	

NO_2	24-hr avg	19.80	25	
CO (mg/m^3)	max 8-hr	0.80	40	

Table 3.16 (h): Air Quality Index of Monitoring Station-8

Soni **(A-8)**				
Pollutants		**Concentration in $\mu g/m^3$ (except for CO)**	**Sub-Index**	**Air Quality Index**
PM_{10}	24-hr avg	64.40	64.40	**77 Satisfactory**
$PM_{2.5}$	24-hr avg	46.20	77	
SO_2	24-hr avg	10.50	13	
NO_2	24-hr avg	17.80	22	
CO (mg/m^3)	max 8-hr	0.70	35	

Table 3.16 (i): Air Quality Index of Monitoring Station-9

Atru **(A-9)**				
Pollutants		**Concentration in $\mu g/m^3$ (except for CO)**	**Sub-Index**	**Air Quality Index**
PM_{10}	24-hr avg	66.50	66.50	**76 Satisfactory**
$PM_{2.5}$	24-hr avg	45.30	76	
SO_2	24-hr avg	10.50	13	
NOx	24-hr avg	23.60	30	
CO (mg/m^3)	max 8-hr	0.86	43	

Table 3.16 (j): Air Quality Index of Monitoring Station-10

Kherli Nahariya **(A-10)**				
Pollutants		**Concentration in $\mu g/m^3$ (except for CO)**	**Sub-Index**	**Air Quality Index**
PM_{10}	24-hr avg	66.1	66.1	**74 Satisfactory**
$PM_{2.5}$	24-hr avg	44.2	74	
SO_2	24-hr avg	10.2	13	
NOx	24-hr avg	22	28	
CO (mg/m^3)	max 8-hr	0.78	39	

Table 3.16 (k): Air Quality Index of Monitoring Station-11

Dara Block (A-11)				
Pollutants		**Concentration in µg/m³ (except for CO)**	**Sub-Index**	**Air Quality Index**
PM_{10}	24-hr avg	64.4	64.4	**81 Satisfactory**
$PM_{2.5}$	24-hr avg	48.3	81	
SO_2	24-hr avg	10.9	14	
NOx	24-hr avg	21.5	28	
CO (mg/m³)	max 8-hr	0.88	44	

Based on the above observations, the AQI of the project site is found to be **74** and is classified as moder **as** per CPCB.

3.7.6 Results and Conclusions:

The results of the monitored data indicate that the ambient air quality of the region in general is conformity with respect to norms of National Ambient Air Quality standards of CPCB, at all locations monitored.

3.8 HYDROGEOLOGY

The water requirements for the proposed expansion project are met through surface water sources, namely Parwan River/ Dam. The Water requirement for the proposed expansion project is optimized as 56 MCM/Year sourced from Parwan River to project site through existing pipeline of about 30 km in length. According to the CGWA the Atru block in Baran District is categorized as "Over exploited category" in terms of groundwater potential. The assignment involved conducting a detailed survey to assess the scope of geology, hydrogeology, and artificial recharge in the area.

3.8.1 OBJECTIVES:

- Conduct a thorough analysis of the physiographic conditions in the study area, utilizing field observations, GPS readings, and satellite imagery.
- Observe and evaluate the hydro-geological conditions prevalent in the area.

- Determine the groundwater flow direction within the study area.
- Assess and formulate the potential for rooftop within the proposed project premises, along with the design of suitable rainwater harvesting systems.
- Evaluate the impact of proposed recharge initiatives on the groundwater regime of the area.

3.8.2 METHODOLOGY:

Physiographic Studies:

Utilizing regional levels identified through spot levels in the latest Google imagery, site visits, GPS surveys, etc., an in-depth study of the physiographic conditions of the area and its surroundings was conducted to ascertain the physiographic gradient.

Hydrogeological Observations:

Observations were made during hydrogeological studies, focusing on geology, aquifer types, surface water bodies, drainage patterns, yields, quality, and relevant hydraulic parameters influencing the groundwater regime.

3.8.3 GEOMORPHOLOGY

The district is a part of "Hadoti Region", which is a distinct geomorphic region of Rajasthan state. The hill ranges of the Vindhyan in the northeast and low rounded hills of Malwa plateau in the south bound the region, while sedimentary rocks belonging to the Vindhyan super group occupy northwestern part.

The district's geomorphology can be broadly divided into four distinct units:

1. Fluvial Origin.
2. Denudation Origin.
3. Structural Origin.
4. Hill.

Landform Units	Lithology	Occurrence in District	Land Cover

Fluvial Origin	Alluvial Plain	Mainly undulating land scape formed due to fluvial activity, consisting of gravel, sand silt and clay. Terrain mainly undulating produced by extensive deposition of alluvium by rive system	Around Baran town	Double crop, single crop(Rabi). Fallow
	Valley fill	Formed by fluvial activity, usually at lower topographic locations, comprising of boulders, cobbles, pebbles gravels, sands, silt and clay. The unit has consolidated sediment deposits.	In south east and north east part	Single crop (Rabi), open scrub.
	Ravine	Small, narrow, deep, depression, smaller than gorges, larger than gulley, usually carved by running water.	Along Parwati, Kalisindh and Kaku rivers.	Single crop (Kharif), open scrub.
Denudation Origin	Pediment	Broad gently sloping rock flooring, erosional surface of low relief between hill and plain, comprised of varied lithology, criss crossed by fractures & faults.	Scattered in entire district, Main concentration in north east and south west.	Marginal double crop, single crop (Kharif). Open scrub, fallow land.
	Buried pediment	Pediment covered essential with relatively thicker alluvial, colluvial or weathered materials.	Scattered in entire district, Main concentration in north west central and south.	Marginal double crop, single crop (Rabi/ Kharif) fallow, open scrub
Structural Origin	Dissected Plateau	Plateau, criss-crossed by fractures forming deep valleys	South, south east and north east.	Land with or without scrub.
Hills	Structural Hill	Linear to arcuate hills showing definite trend-lines with varying lithology associated with faulting etc.	Near Ramgarh village	Forest, open scrub.

Geomorphologically, the study area comprises alluvial plains, flood plains, highly dissected plateaus, low dissected plateaus, moderately dissected plateaus, pediment-pediplain complexes, waterbodies, and rivers.

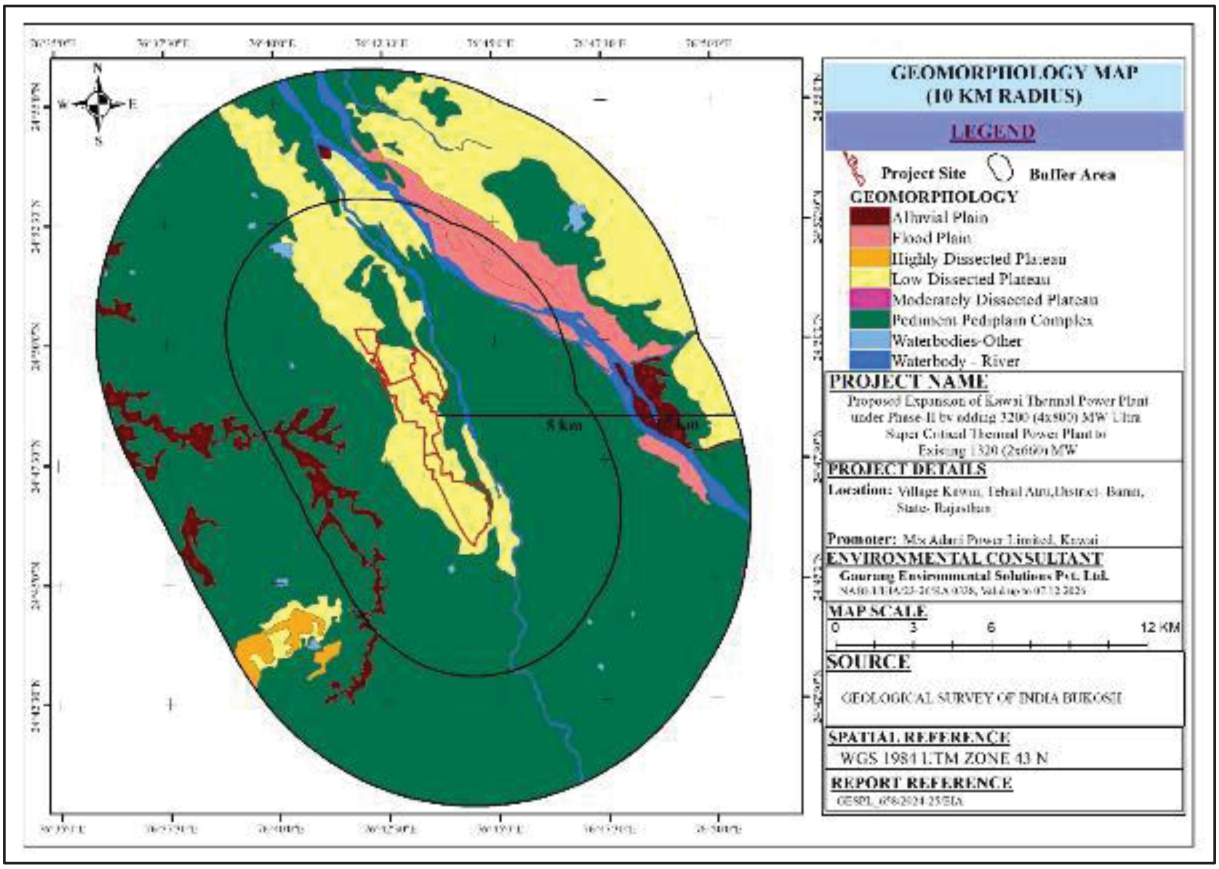


Fig 3.8: Geomorphological map of 10 km buffer zone

Drainage

The district is served by the sub-basins of Chambal River These sub-basins include Kali sindh, Parvati, Parwan and Kuno. Kalisindh, a tributary of Chambal, on being joined by Parwan river flows northward forming western boundary of Mangrol tahsil for about 40 kms. from Rajgarh to Dheepari and joins Chambal at pipalda in Kota district. The important villages en route are Palaitha, Nonera, Dip Singh Kotra, Barod and Patonda. Parvati, a tributary of Chambal originates from Vindhyan ranges. It enters the district in the south near village Karaihat. It first forms the district's boundary with Madhya Pradesh and then traverse through the central parts of the district. Parwan originates from Vindhyan ranges, enters the district near Harnawada Shahji and flowing through the central parts of the Atru Tehsil, joins Kali Sindh near Rajgarh. Kuno enters Shahhad tahsil in the south from Madhya Pradesh and after flowing northward and passing about 9 km east of Shahhbad, re-enters Madhya Pradesh. Andheri river enters Chhipabarod tahsil from Madhya Pradesh and joins Parvati, about 6 kms. east of Atru. Banganga river originates in the south of Baran somewhere from Bamla and Shrod and joins Parvati near Mithod. Other small rivers and Lhasi, Sukar, Ghadavat, Khadela, Kelwara, Bangardi, Bilas, Barni, Kori, Retri, Kol etc.

The drainage of the study area (10 km Buffer) depicts the presence of 1st, 2nd, 3rd and 4th stream order. The nearest rivers are Andheri Nadi which is located at 0.5 km (Eastern direction) away from the project site and also following nalla /nadi are noticed in the study area of 10 Km radius.

S.no	Name of Nadi/Nala	Distance from project Boundary	Direction from project site	Flow direction
1	Andheri Nadi	0.5	East	North Western
2	Parbati River	2.5	North	North western
3	Ghoghra Nala	6	North Western	Western
4	Rhupsi Nala	5	South West	Western

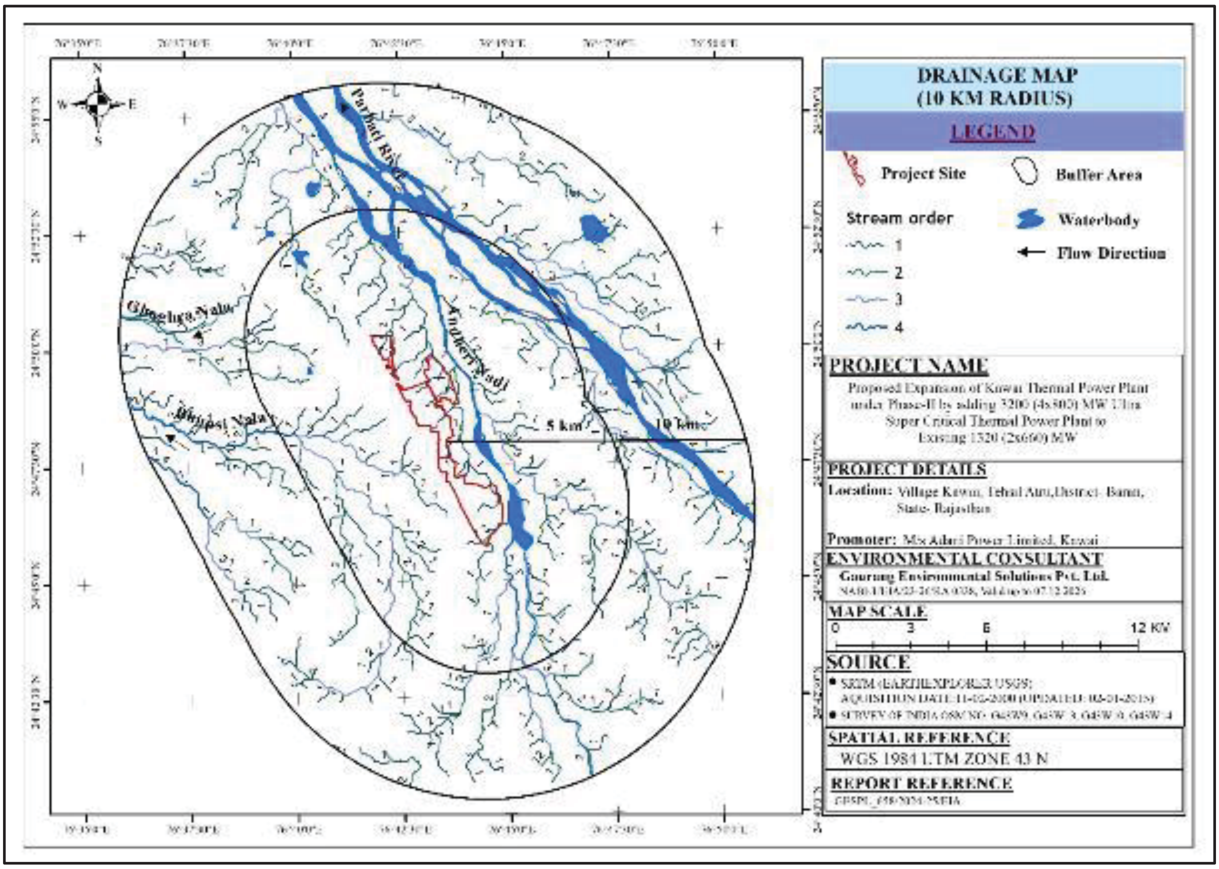


Fig 3.9: Drainage map of 10 km buffer zone

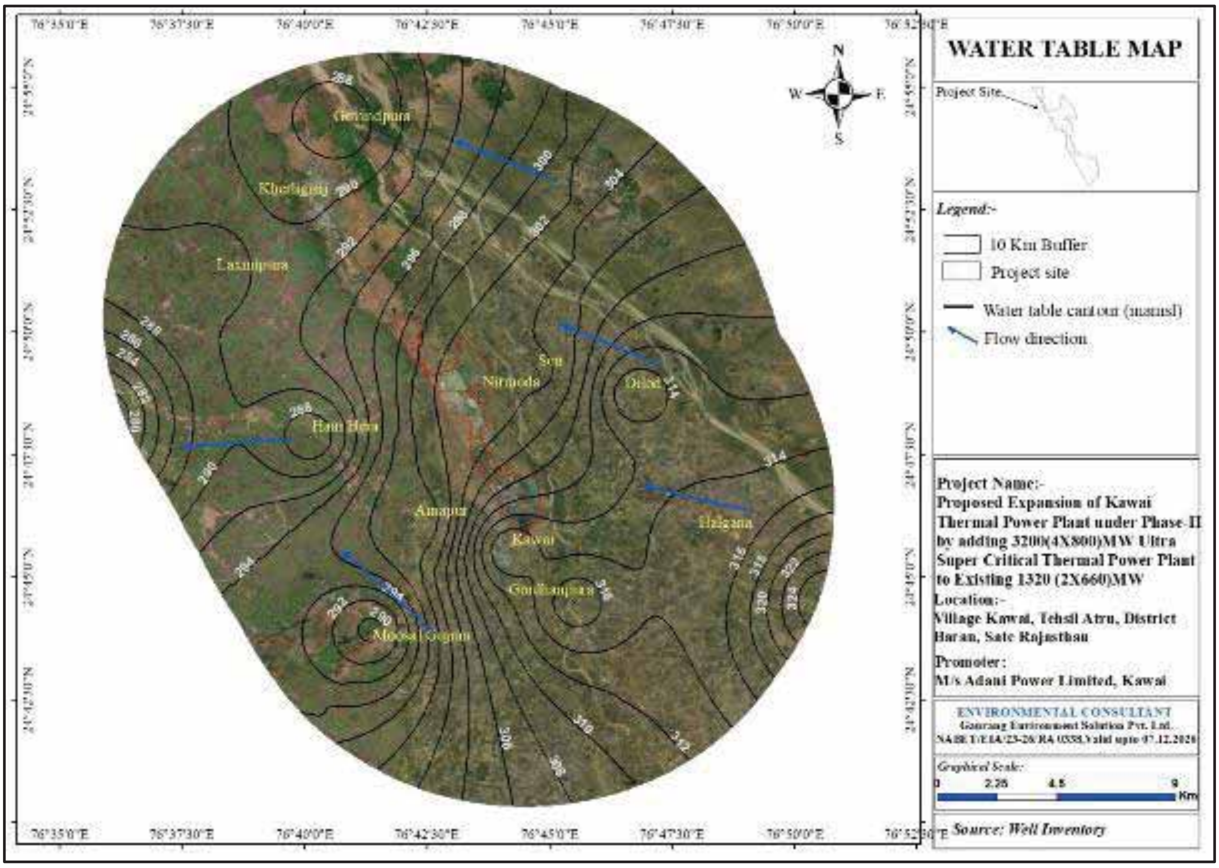


Fig 3.10: Water Table Contour map of 10 km buffer zone

According to the groundwater table analysis, groundwater generally flows from southeast to northwest direction

Soil Type

The soils of the district are alluvial in nature and are generally non-calcareous. Its colour varies from dark brown to black. This type of soil generally occurs in plains. Mainly black kachari soils are found in Baran and Mangrol tehsils, which is highly fertile. Red gravelly loam hilly soils are found in the southern and eastern parts of the district.

The study area of 10 Km Buffer area are Fine texture, medium texture, Coarse Texture and Rocky and non-soil.

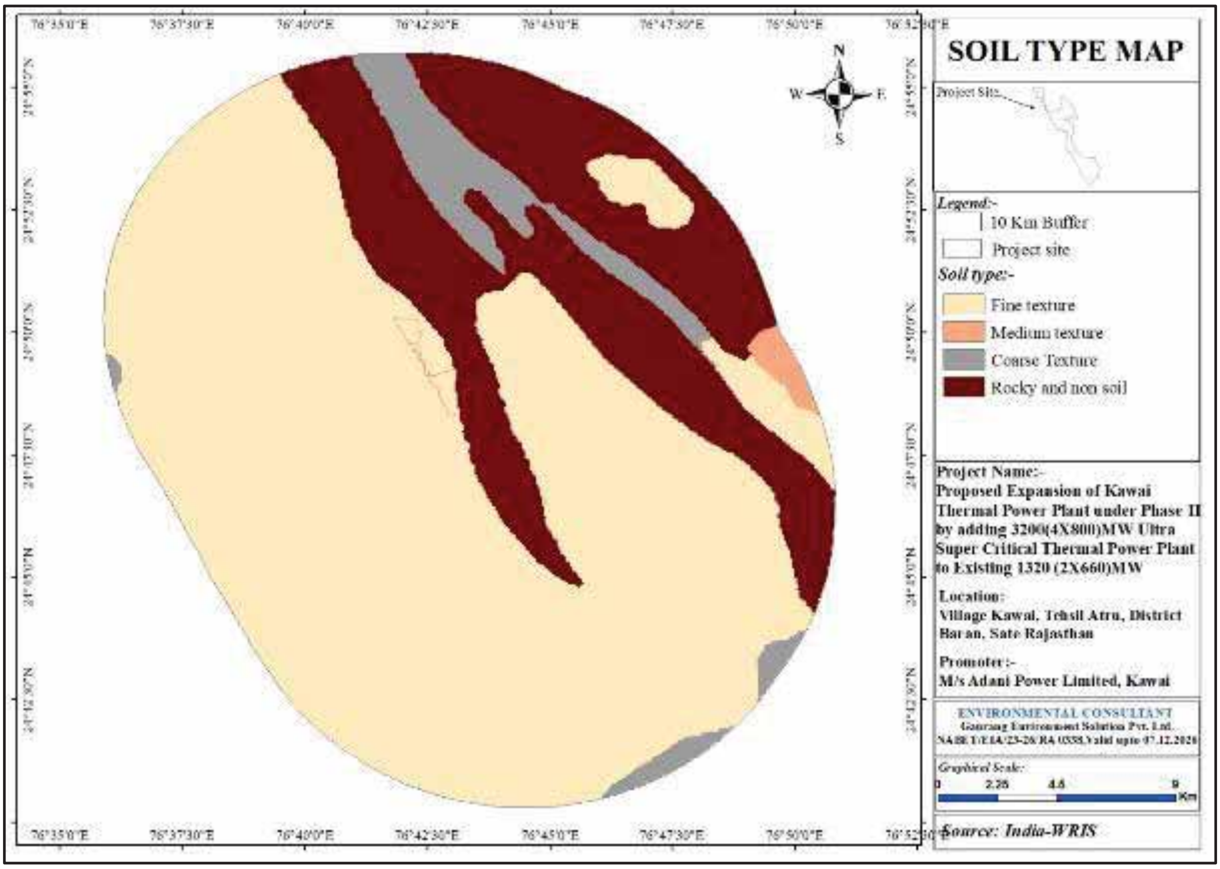


Figure 3.11: Soil texture map of 10 km buffer zone

Regional Geology

Geological framework of the Baran district is occupied by sandstone, limestone and shale of Bhander group of Vindhyan Super Group constitute the basement overlain by Deccan Trap basalt. At places a thin Alluvial cover is also found. The general stratigraphic setup of the Baran district is given below:-

Table 3.17: stratigraphic succession of geological formation

Age	Group	Sub-Group	Lithology
Recent			Alluvium and Soil
Upper Cretaceous		Deccan Traps	Basaltic flows with inter-trappean beds
Upper Vindhyan	Bhander Group	Lower Bhander Sandstone	Sandstone with shale intercalation
		Bhander Limestone	Impure argillaceous stromatolitic limestone
		Ganurgarh Shale	Variegated shale

Geologically Description.

Major Part of Baran district is occupied by shale- sandstone- limestone sequences belonging to the Vindhyan Supergroup (Middle to Upper Proterozoin) and the Deccan Traps and laterite (Cretaceous to Eocene). The oldest rock types belong to the Vindhyan Supergroup. These are classified into the Rewa and Bhander Groups. The Rewagroup is represented by the Govindgarh Sandstone (Upper Rewa Sandstone) and is well exposed north of Thanakasba in the north east. This is conformably overlain by the Bhander Group Comprising Ganurgarh Shale, Lakheri Limestone, Samria shale, Bundi Hill Sandstone and the Sirbu Shale formations in ascending order of succession. Bhander group occupies 84% of the area in north and northeastern parts of Anta, Atru, Baran, Kishanganj & Shahbad blocks. Of these the Bundi Hill Sandstone and the Sirbu Shale formations are most predominant and occupy almost the entire district. Southern part of the district is occupied by Deccan Trap flows and constitutes about 16% area of the district covering parts of Chhabra & Chhipabarod blocks. Small outcrops of basalt and laterite are also seen in the western part around Dhikwani and Thanakasba. Infra-trappean chert, sandstone and limestone occur around Thanaksba. Laterite occurs as capping over basalt. Quaternary deposits, about l million-year-old, occur as terraces and are extensively dissected to form ravines. Younger Alluvium, is found along the present-day flood plains of the rivers, supports extensive cultivation.

Geologically, the 10 km study area is predominantly covered by the Bander of Vindhyan Super Group & Malwa Group of the Deccan Trap.

Age	Super Group	Group	Formation	Lithology
Late Cretaceous	Deccan trap	Malwa	Kalisindh	Basalt
Neoproterozoic	Vindhyan	Bander	Budhi Hill	Sndstone with Shale Band
				Sandstone, Siltstone
			Sirbu	Shale with Limestone Band

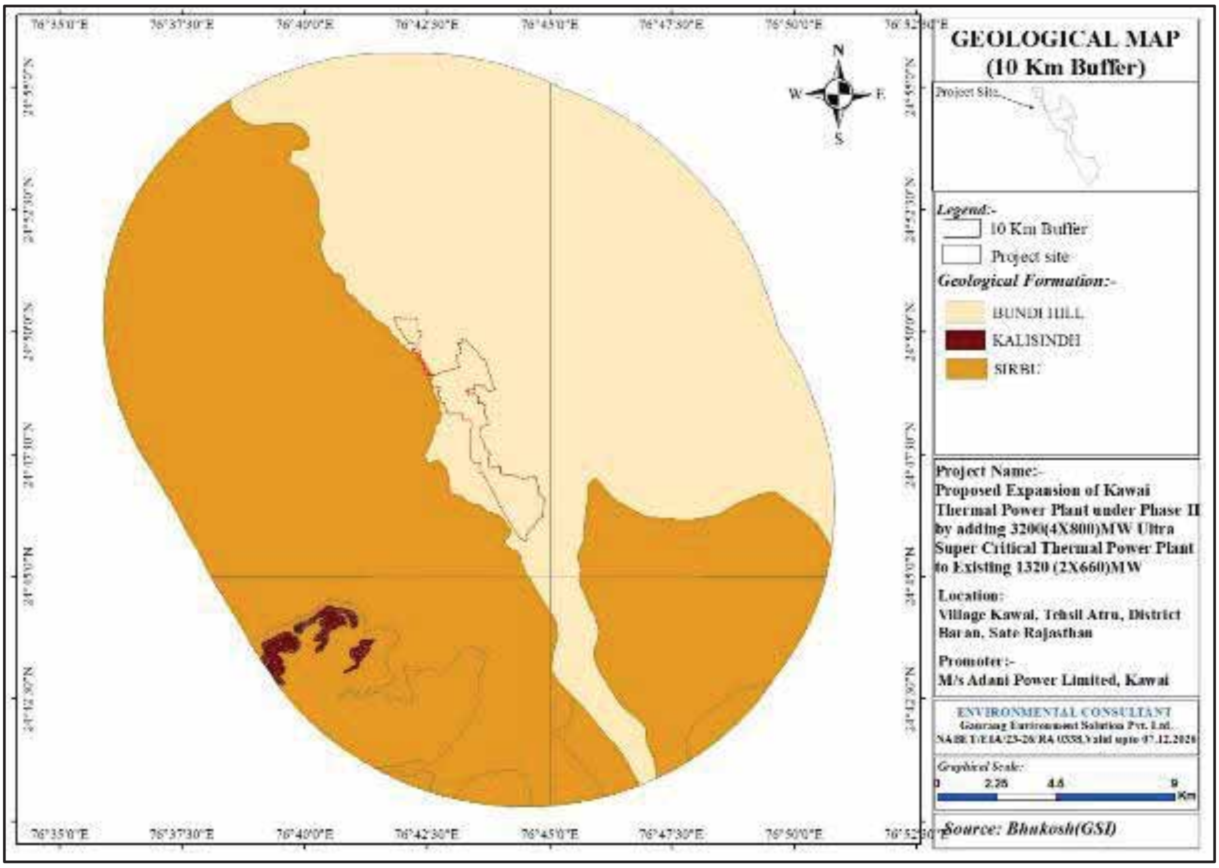


Fig 3.12: Geological map of 10 km buffer zone

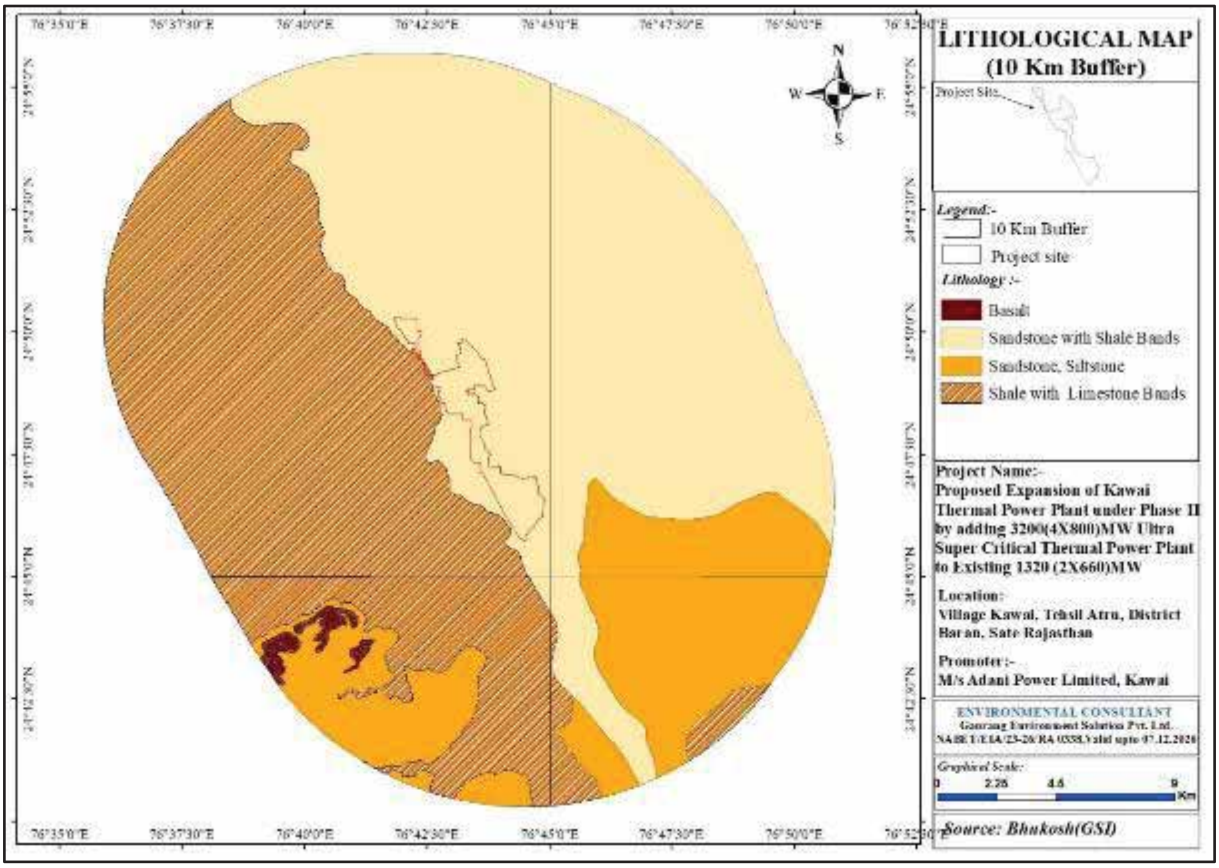


Fig 3.13: Lithological map of 10 km buffer zone

Natural Disaster

Seismic Study

As per Earthquake Hazard Map of Rajasthan, The Study area falls under the *Low Damage Risk Zone – II.* The Earthquake Hazard Map of Rajasthan is given in figure no 3.14

Study of landslide

The project site is present at no land slide active zone as per land slide incidence map of India. The landslide incidence map of India is given in figure no. 3.15

Flood Study

The study area does not belong to flooding prone zone. The Flood Hazard Map of India is given in figure no. 3.16.

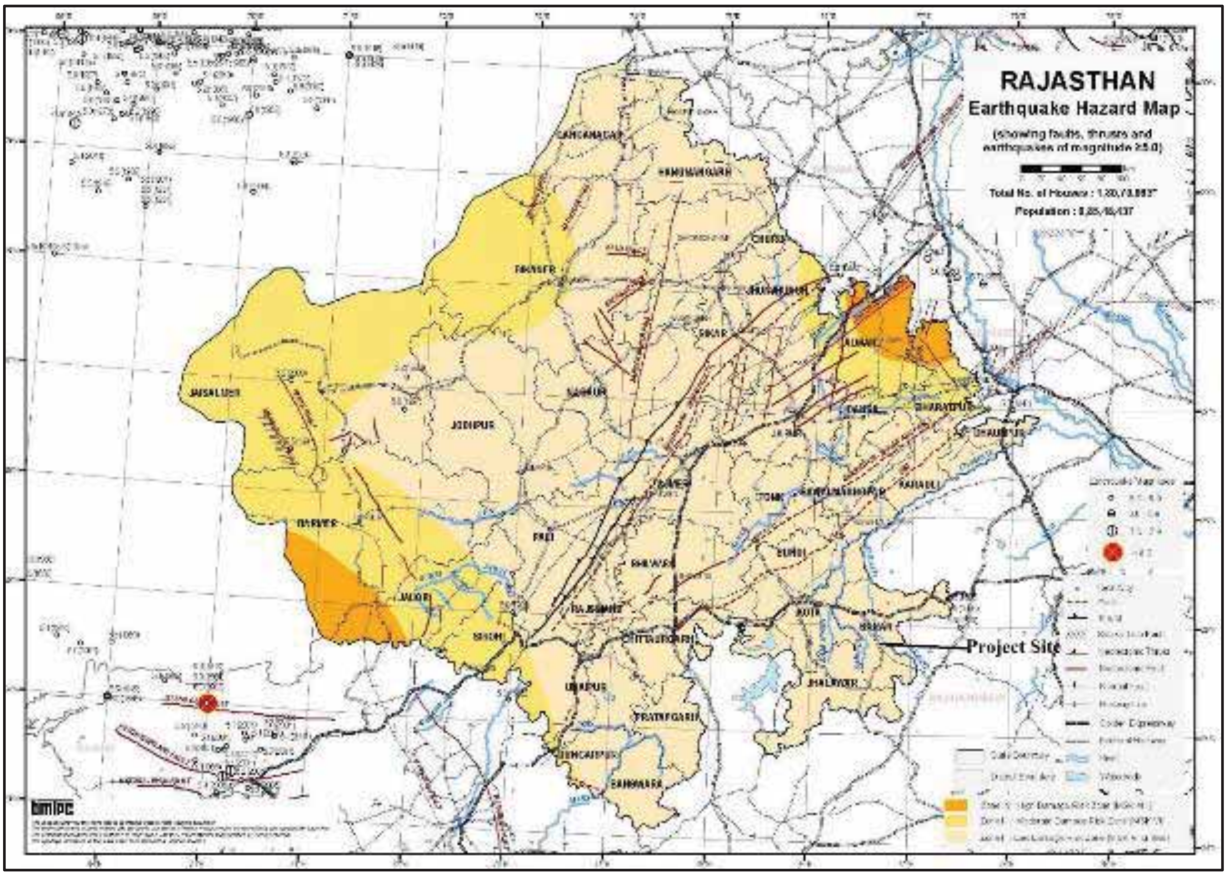


Fig 3.14: Earth Quick Hazard Map of Rajasthan (Source: BMTPC)

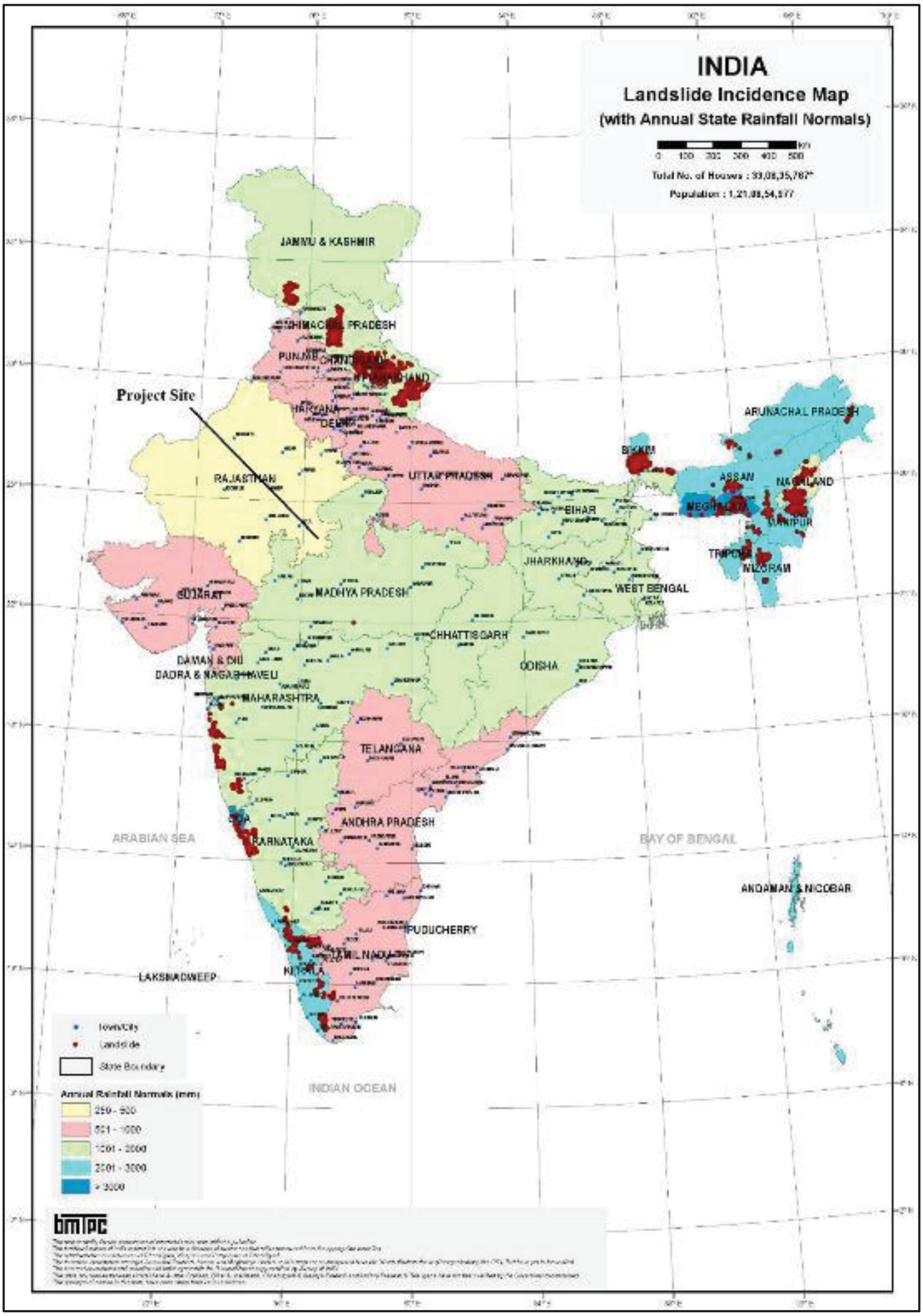


Fig 3.15: Landslide Map of India (Source: BMTPC)

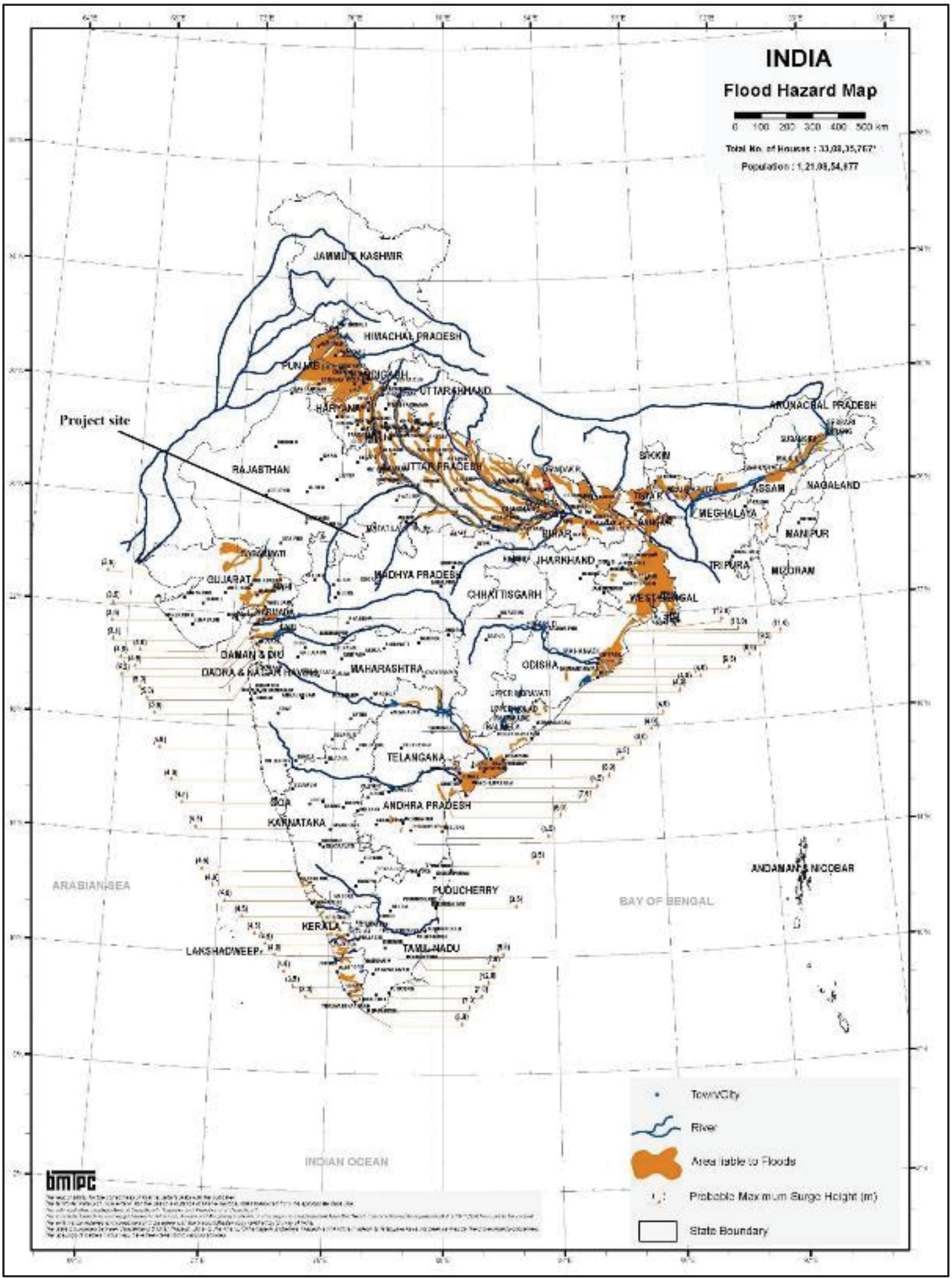


Figure 3.16: Flood map of India (Source: BMTPC)

3.8.3.1 Climate and Rainfall

The climate of Baran study area is mainly dry with very hot summer and cold winter except during monsoon season when moist air of oceanic origin penetrates into the district. There are four seasons in a year. The hot weather season starts from mid-March to last week of the June followed by the south-west monsoon which lasts upto September. The transition period from September to October forms the mild climate. The winter season starts late in November and remains up to first week of March. The normal annual rainfall of the Atru Station 1044 mm (10 years Normal). The Yearly rainfall for the period 2014-2023 is given in below figures - (*Source WRD, Rajasthan*).

Table 3.18: Rainfall data of Atru station of Baran

S. No.	Year	Rainfall (mm)	Annual rainy days
1	2014	1297	43
2	2015	1109	45
3	2016	1119	38
4	2017	615	37
5	2018	858	40
6	2019	1565	58
7	2020	547	36
8	2021	1382	42
9	2022	1211	54
10	2023	735	41
Average		**1044**	**44**

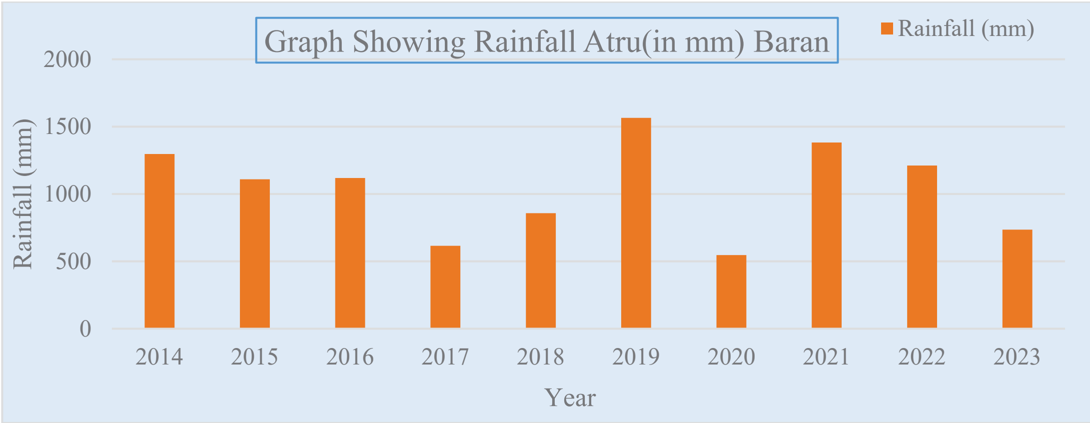


Figure 3.17: Rainfall graph of Atru station of Baran

3.8.3.2 Hydrogeology

The availability, occurrence and movement of ground water depends upon the rock formations present in the area. In Baran district, alluvium, limestone, sandstone, shale and inter trappeans are the main hydrolith units. Among these formations, alluvium is the most potential among different hydrogeological formations. The ground water in these formations occurs under water table conditions. At places, semi-confined conditions also exist. Ground water in hard rocks viz. Vindhyan limestone, sandstone, shale and Deccan basalt occurs in secondary porosity developed by weathering and/ or fracturing. The ground water potential of these rocks depends upon the intensity of joints and fracture systems and their interconnection. These formations are known to be water-bearing down to more than 100 mbgl. These deeper zones are tapped by bored wells mostly for irrigation purpose.

Aquifer of the district is divided in four types:

a. Alluvial Aquifer(Quaternary) Alluvium comprises unconsolidated to semi-consolidate, sand, silt and clays. Thickness of alluvium varies from few meters to about 40m. The litho unit occurs in a localized pocket confined to Baran block. It occupies nearly 4% potential area.

b. Basalt (Upper Cretaceous to Palaeocene) Basalt is dark green to steel grey, fine to medium grained and porphyritic at place. It varies from hard, massive to amygdaloidal and vesicular type. Intertrappeans are practically absent. Then litho unit encompasses southern part of the area and confined to Chhabra and Chhipabarod blocks. It covers nearly 14% potential area.

c. Sandstone (Vindhyan Super Group) Sandstone is buff to red colour, hard, compact and quartzitic. The litho unit covers most extensive area. It occupies Kishanganj and major part of

Atru and Shahbad blocks and spreads in peripheral part of the adjoining blocks. Sandstone, shale and sandstone occupy nearly 56% potential area.

d. Shale, Limestone (Vindhyan Super Group) Shale is fine to medium grained, grey, yellow, buff, red and chocolate colour. Grey and yellowish limestones, at places are siliceous, hard and less susceptible to weathering. Limestone is often interbedded with shales. Shale occupies eastern part of Shabad block. Limestone spreads in major part of Anta block with some peripheral area of adjoining Anta and Baran block.

Source: CGWB

Hydrogeological Impacts and its Mitigation Measure

Appropriate mitigation measures can enormously reduce the damage caused by Hydrogeology is given in below table

HYDRO-GEOLOGICAL IMPACTS	
Hydro-geological Impacts	**Mitigation Measure**
1. Existing drainage pattern will be changed due to topographical alteration.	We will not disturb any natural drainage flowing in and around our project area.
2. Improper storage, handling, or disposal of overburden can lead to groundwater contamination.	We will Establish proper storage and handling protocols, conduct regular monitoring of potential contamination sources.
3. Alterations in surface water flow patterns can impact groundwater recharge and discharge areas.	We will preserve all the natural water bodies, drainage pattern to maintain sustainable flow regimes in rivers and streams, we will also try to implement watershed management practices, and conduct hydrological assessment to assess impacts.
4. Uncontrolled surface runoff and erosion can lead to sedimentation in water bodies, rivers affecting water quality and habitat.	We will promote the Implementation of erosion control measures such as terracing, garland drains, settling ponds, sediment basins, promote sustainable land management practices and monitor sedimentation rates.
GEOLOGICAL IMPACTS AND MITIGATION MEASURE	

Hydro-geological Impacts	Mitigation Measure
1. Uncontrolled land clearing, deforestation, or improper agricultural practices can result in soil erosion, leading to loss of topsoil and land degradation.	We will Implement erosion control measures such as terracing, contour plowing, and vegetative cover, promote sustainable land management practices, restore vegetation in degraded areas, and establish sedimentation control structures.
2. Certain areas are prone to geological hazards such as earthquakes, volcanic eruptions, or sinkholes.	We will conduct geological hazard assessments, establish building codes and regulations for hazard-prone areas, develop early warning systems, and implement structural reinforcement measures.

3.8.3.3 Ground Water Level

Study Area –

Pre-Monsoon: On the basis of depth of water level of the study area, the pre monsoonal depth to water level varies from about 4.1 mbgl to 25.3 mbgl in study area.

Post-Monsoon: On the basis of depth of water level of the study area, the post monsoonal depth to water level varies from 2.5 mbgl to 21.5 mbgl. The Pre-Monsoon and Post Monsoon Ground Water Level map is given below –

The ground water level of core and buffer zone of pre & post monsoon of study area is given in table no 3.19 & 3.20

Table 3.19: Ground water level in Core Zone

S. N	Pre-Monsoonal GWL in mbgl (Core Zone)		Post-Monsoonal GWL in mbgl (Core Zone)	
	From	To	From	To
1	7.1	15	5	10

Table 3.20: Ground water level in Buffer Zone

S. N	Pre-Monsoonal GWL in mbgl (Buffer Zone)		Post-Monsoonal GWL in mbgl (Buffer Zone)	
	From	To	From	To

1	4.1	25.3	2.5	21.5

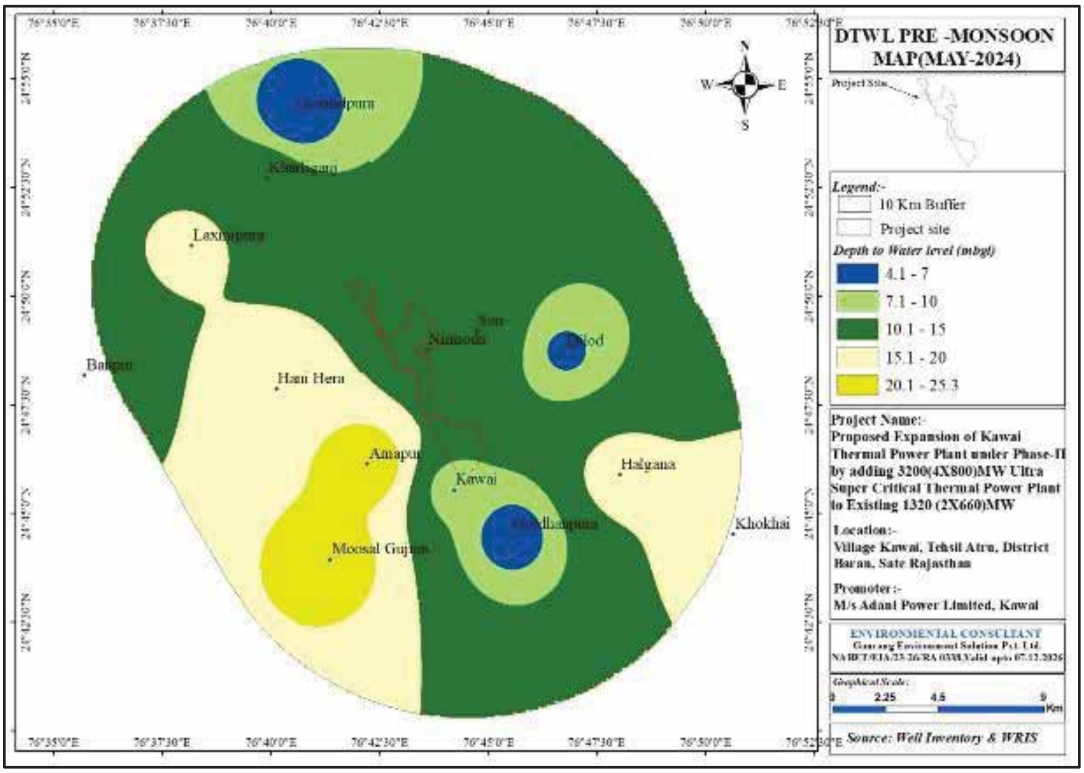


Figure 3.18: Pre-Monsoon Ground Water Level map of the study area

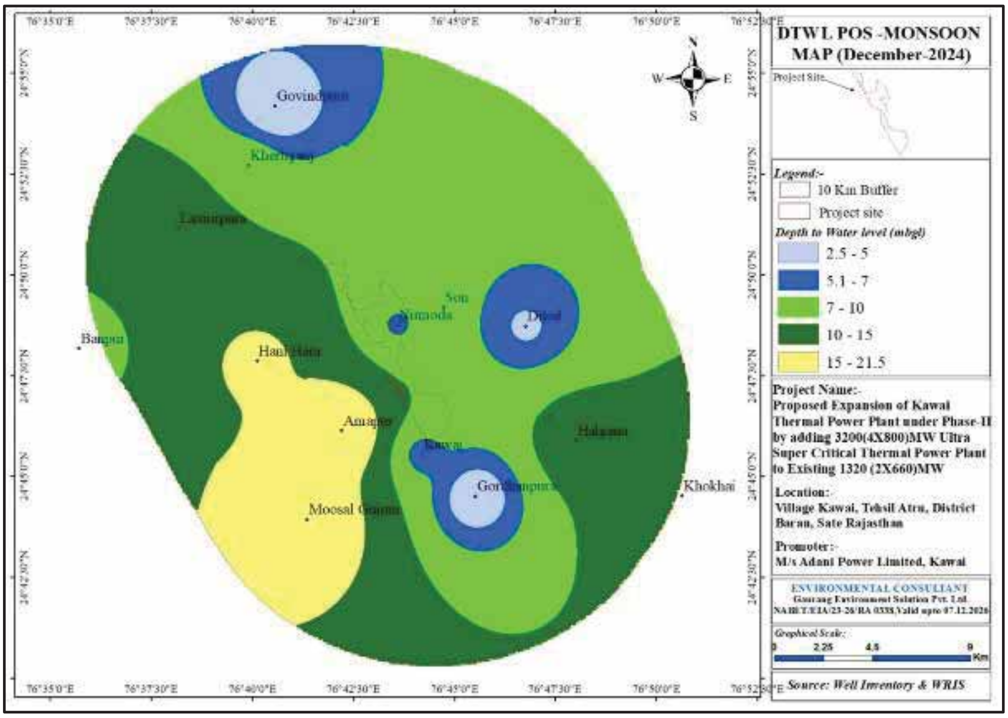


Figure 3.19: Post-Monsoon Ground Water Level map of the study area

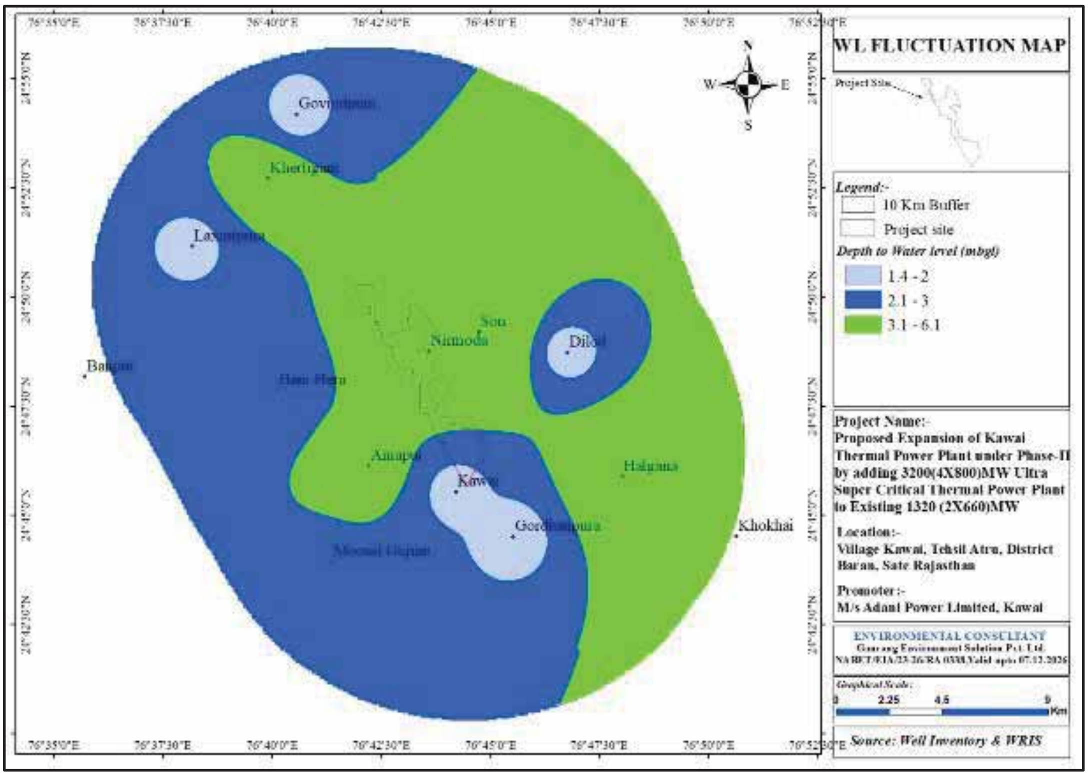
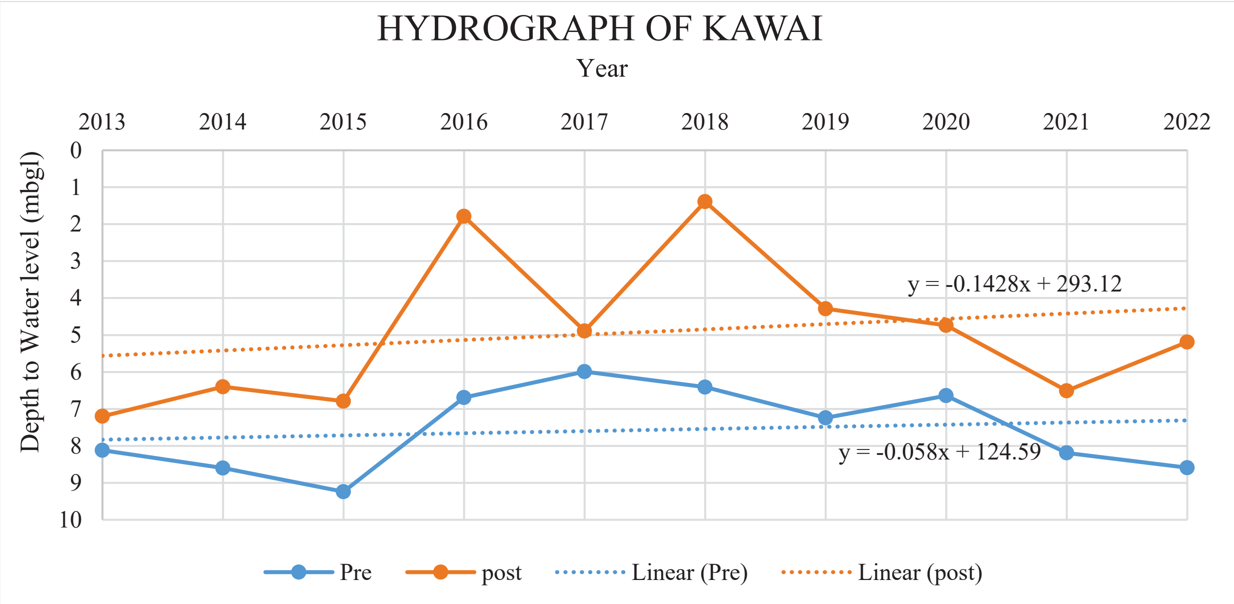


Figure 3.20: Water level Fluctuation map of the study area

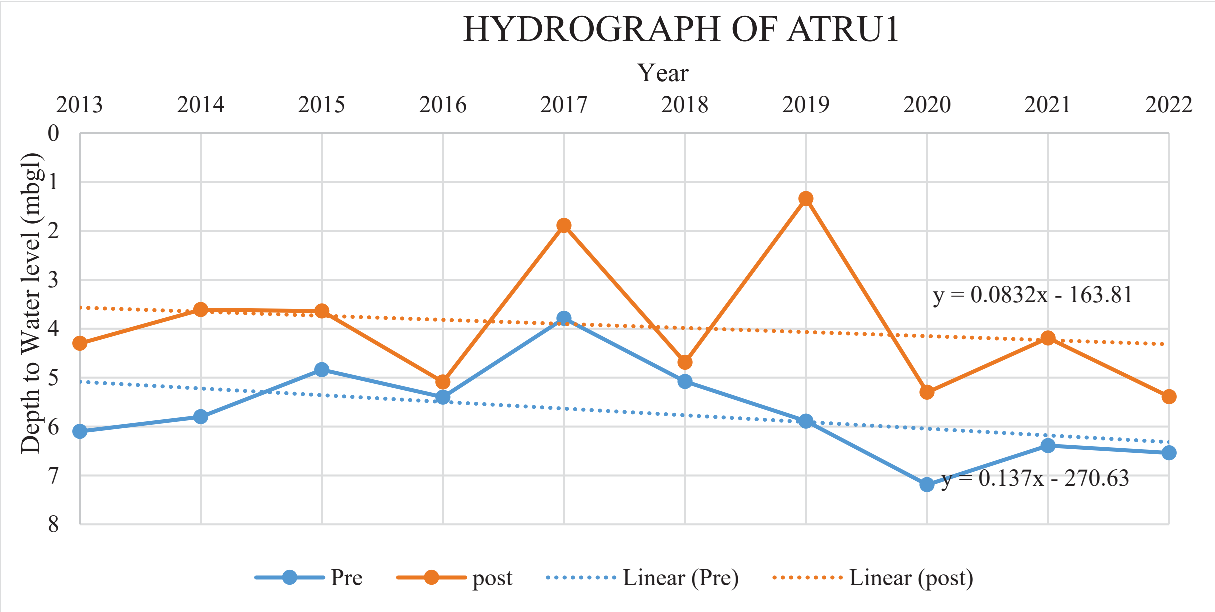
Long term water level data Analysis

In order to understand the long-term (10 years) ground water level changes, the CGWB observation wells located in and around the study area.

Year	KAWAI (24.749852°,76.740231°)		Atru 1 (24.889771°, 76.660502°)	
	Pre Monsoon	Post Monsoon	Pre Monsoon	Post Monsoon
2013	8.12	7.2	6.1	4.3
2014	8.6	6.4	5.8	3.61
2015	9.24	6.79	4.84	3.64
2016	6.69	1.79	5.4	5.09
2017	5.99	4.89	3.79	1.89
2018	6.41	1.39	5.08	4.69
2019	7.24	4.29	5.89	1.34
2020	6.64	4.74	7.19	5.3
2021	8.19	6.51	6.39	4.19
2022	8.59	5.19	6.54	5.39
Sources - Ground Water Year Book Of Rajasthan				



Post monsoon water level Trend y = -0.1428x + 293.12	m/year	0.142 m Rise
Pre monsoon water level Trend y = -0.058x + 124.59	m/year	0.058 m Rise



Post monsoon water level Trend y = 0.0832x - 163.81	m/year	0.083 m Fall
Pre monsoon water level Trend y = 0.137x - 270.63	m/year	0.137 m Fall

Status of Ground Water Development & Ground Water Resources

No ground water extraction is envisaged for the project. As per the Dynamic Ground Water Resources of Rajasthan, 2023, the total annual ground water recharge of Atru block is *9136.3* ham, total annual ground water extraction from irrigation, industry, and domestic sectors *14326.1 ham*. The stage of ground water extraction is *174.23 %*. Block come under "**Over exploited category**.

3.9 GROUND WATER QUALITY:

The purpose of this study is to:

- Assess the water quality characteristics for critical parameters.
- Evaluate the impacts on agricultural productivity, habitat conditions, recreational resources and aesthetics in the vicinity; and
- Predict impact on water quality by this project and related activities.

3.9.1 METHODOLOGY

A reconnaissance survey was undertaken, and monitoring locations were finalized. Chemical and Metals analysis was carried out as per standard Methods for ground water and surface water Analysis published by Bureau of Indian Standards and APHA.

Table 3.21: Analytical Protocol followed for Water Quality Monitoring and Analysis

S. No.	Parameter	Protocol Followed
1.	pH	IS:3025 (Part-11)
2.	Total Hardness (as $CaCO_3$), mg/l	IS:3025 (Part-21)
3.	Iron (as Fe), mg/l	IS:3025 (Part-53)
4.	Chlorides (as Cl), mg/l	IS:3025 (Part-32)
5.	Fluoride (as F), mg/l	IS:3025 (Part-23)
6.	Total Dissolved solids, mg/l	IS:3025 (Part-16)
7.	Magnesium (as Mg), mg/l	IS:3025 (Part-46)
8.	Calcium (as Ca), mg/l	IS:3025 (Part-40
9.	Copper (as Cu), mg/l	IS:3025 (Part-42)
10.	Manganese as Mn, mg/l	IS:3025 (Part-35)
11.	Phenolic Compounds (as C_6H_5OH), mg/l	IS:3025 (Part-43)
12.	Mercury (as Hg), mg/l	IS:3025 (Part-48) Mercury Analyzer
13.	Cadmium (as Cd), mg/l	IS:3025 (Part-41)
14.	Selenium (as Se), mg/l	IS:3025 (Part-56)/ IS 15303
15.	Arsenic (as As), mg/l	IS:3025 (Part-37)
16.	Cyanide (as CN), mg/l	IS:3025 (Part-27)
17.	Lead (as Pb), mg/l	IS:3025 (Part-47)
18.	Zinc (as Zn), mg/l	IS:3025 (Part-49)
19.	Chromium (as Cr^{+6}), mg/l	IS:3025 (Part-52)
20.	Alkalinity (as $CaCO_3$), mg/l	IS:3025 (Part-23)
21.	Aluminium (as Al), mg/l	IS:3025 (Part-55)

3.9.2 Water Sampling Locations

Ground Water:

Eight groundwater samples were collected as grab samples and were analyzed for various parameters. The analyzed results were compared with the standards for drinking water as per IS: 10500. The presentation of results is in the following tables.

Table 3.22: Ground water sampling stations

S. No.	Monitoring Locations	Station Code	Selection criteria	Distance (km)	Direction
1.	Project Site	GW1	Sampling location within the study area as well as between the plant and drainage in the direction of flow of ground water	--	--
2.	Phulbaroda	GW2		1.4	ESE
3.	Barlan	GW3		2.2	WSW
4.	Lakhnakheri	GW4		8.4	E
5.	Kawai	GW5		0.8	WSW
6.	Soni	GW6		2.8	NE
7.	Atru	GW7		4.8	NW
8.	Kherli Nahariya	GW8		8.8	WSW

Table 3.23: Ground Water analysis report

S.No.	Parameter	Unit	Analysis Results				Drinking Water Standards/Limit (IS:10500)	
			Project Site	Phulbaroda	Barlan	Lakhnakheri	Desirable Limit	Permissible Limit
			GW 1	GW 2	GW 3	GW 4		
1	Colour	Hazen	BDL(DL-1.0)	BDL(DL-1.0)	BDL(DL-1.0)	BDL(DL-1.0)	5.0	15.0
2	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4	Turbidity	NTU	BDL(DL-1.0)	BDL(DL-1.0)	BDL(DL-1.0)	BDL(DL-1.0)	1.0	5.0
5	pH Value	-	7.65	7.72	7.76	7.72	6.5-8.5	No Relaxation
6	Total Dissolved Solids	mg/L	1152	1075	1038	1214	500	2000
7	Total Hardness (as $CaCO_3$)	mg/L	461	416	440	477	200	600
8	Calcicum (as Ca)	mg/L	103.4	98.6	98.6	111.5	75	200
9	Magnesium (as Mg)	mg/L	49.2	41.2	47.0	48.2	30	100
10	Total Alkalinity (as $CaCO_3$)	mg/L	160	172	176	170	200	600
11	Chloride (as Cl)	mg/L	142	124	198	152	250	1000
12	Nitrate (as NO_3)	mg/L	6.8	6.3	7.2	8.2	45	No Relaxation
13	Sulphate (as SO_4)	mg/L	32.9	28.2	30.5	38.6	200	400
14	Sulphide (as H_2S)	mg/L	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	0.05	No Relaxation
15	Fluoride (as F)	mg/L	0.20	0.18	0.16	0.24	1.0	1.5
16	Free Residual Chlorine (As Cl_2)	mg/L	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	0.2	1.0
17	Chloramines (as Cl_2)	mg/L	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	4.0	No Relaxation
18	Phenolic Compound (as C_6H_5OH)	mg/L	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	0.001	0.002
19	Cyanide (as CN)	mg/L	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)	0.05	No Relaxation
20	Anionic Surfacatant (as MBAS)	mg/L	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	0.2	1.0
21	Ammonia (As Total Ammonia)	mg/L	BDL(DL-0.2)	BDL(DL-0.2)	BDL(DL-0.2)	BDL(DL-0.2)	0.5	No Relaxation
22	Iron (as Fe)	mg/L	0.08	0.1	0.09	0.05	1.0	No Relaxation
23	Zinc (as Zn)	mg/L	< 0.01	< 0.01	< 0.01	< 0.01	5.0	15.0
24	Boron (as B)	mg/L	< 0.1	< 0.1	< 0.1	< 0.1	0.5	1.0
25	Nickel (as Ni)	mg/L	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	0.02	No Relaxation
26	Manganese (as Mn)	mg/L	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	0.1	0.3

27	Lead (as Pb)	mg/L	BDL(DL-0.005)	BDL(DL-0.005)	BDL(DL-0.005)	BDL(DL-0.005)	0.01	No Relaxation
28	Selenium (as Sae)	mg/L	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	0.01	No Relaxation
29	Arsenic (as As)	mg/L	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	0.01	0.1
30	Cadmium (as Cd)	mg/L	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	0.003	No Relaxation
31	Copper (as Cu)	mg/L	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	0.05	1.5
32	Molybdenum (as Mo)	mg/L	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	0.07	No Relaxation
33	Chromium (as Cr)	mg/L	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	0.05	No Relaxation
34	Aluminium (as Al)	mg/L	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	0.03	0.2
35	Silver (as Ag)	mg/L	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	0.1	No Relaxation
36	Barium (as Ba)	mg/L	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	0.7	No Relaxation
37	Mineral Oil	mg/L	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	0.5	No Relaxation
38	Poly Chlorinated Biphenyls (PCB)	mg/L	BDL(DL-0.00005)	BDL(DL-0.00005)	BDL(DL-0.00005)	BDL(DL-0.00005)	0.0005	No Relaxation
39	Polynuclear Aromatic Hydrocarbon (PAH)	mg/L	BDL(DL-0.00005)	BDL(DL-0.00005)	BDL(DL-0.00005)	BDL(DL-0.00005)	0.0001	No Relaxation
40	Bromoform	mg/L	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	0.1	No Relaxatio
41	Dibromochloromethane	mg/L	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	0.1	No Relaxation
42	Bromodichloromethane	mg/L	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	0.06	No Relaxation
43	Chloroform	mg/L	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	0.2	No Relaxation
44	*E-Coli*	cfu/ 100ml	Absent	Absent	Absent	Absent	Shall not be detectable in any 100 ml	Not Specified
45	Total Coliform	cfu/ 100ml	Absent	Absent	Absent	Absent	Shall not be detectable in any 100 ml	Not Specified

Table 3.24: Ground Water analysis report

S.No.	Parameter	Unit	Analysis Results				Drinking Water Standards/Limit (IS:10500)	
			Kawai	Soni	Atru	Kherli Nahariya	Desirable Limit	Permissible Limit
			GW 5	GW 6	GW 7	GW 8		
1	Colour	Hazen	BDL(DL-1.0)	BDL(DL-1.0)	BDL(DL-1.0)	BDL(DL-1.0)	5.0	15.0
2	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4	Turbidity	NTU	BDL(DL-1.0)	BDL(DL-1.0)	BDL(DL-1.0)	BDL(DL-1.0)	1.0	5.0
5	pH Value	-	7.69	7.66	7.71	7.67	6.5-8.5	No Relaxation
6	Total Dissolved Solids	mg/L	1185	1055	1125	1182	500	2000
7	Total Hardness (as CaCO3)	mg/L	469	408	450	465	200	600
8	Calcicum (as Ca)	mg/L	106.6	98.6	100.2	109.9	75	200
9	Magnesium (as Mg)	mg/L	49.2	39.3	42.2	46.2	30	100
10	Total Alkalinity (as CaCO3)	mg/L	168	162	170	165	200	600
11	Chloride (as Cl)	mg/L	170	162	152	158	250	1000
12	Nitrate (as NO3)	mg/L	6.8	6.8	6.6	7.3	45	No Relaxation
13	Sulphate (as SO4)	mg/L	31.6	30.4	32.7	35.8	200	400
14	Sulphide (as H2S)	mg/L	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	0.05	No Relaxation
15	Fluoride (as F)	mg/L	0.21	0.17	0.19	0.21	1.0	1.5
16	Free Residual Chlorine (As Cl2)	mg/L	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	0.2	1.0
17	Chloramines (as Cl2)	mg/L	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	4.0	No Relaxation
18	Phenolic Compound (as C6H5OH)	mg/L	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	0.001	0.002
19	Cyanide (as CN)	mg/L	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)	0.05	No Relaxation
20	Anionic Surfacatant (as MBAS)	mg/L	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	0.2	1.0
21	Ammonia (As Total Ammonia)	mg/L	BDL(DL-0.2)	BDL(DL-0.2)	BDL(DL-0.2)	BDL(DL-0.2)	0.5	No Relaxation
22	Iron (as Fe)	mg/L	0.06	0.09	0.08	0.05	1.0	No Relaxation
23	Zinc (as Zn)	mg/L	< 0.01	< 0.01	< 0.01	< 0.01	5.0	15.0
24	Boron (as B)	mg/L	< 0.1	< 0.1	< 0.1	< 0.1	0.5	1.0
25	Nickel (as Ni)	mg/L	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	0.02	No Relaxation
26	Manganese (as Mn)	mg/L	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	0.1	0.3
27	Lead (as Pb)	mg/L	BDL(DL-0.005)	BDL(DL-0.005)	BDL(DL-0.01)	BDL(DL-0.005)	0.01	No Relaxation

28	Selenium (as Sae)	mg/L	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.005)	BDL(DL-0.001)	0.01	No Relaxation
29	Arsenic (as As)	mg/L	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	0.01	0.1
30	Cadmium (as Cd)	mg/L	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	0.003	No Relaxation
31	Copper (as Cu)	mg/L	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.001)	BDL(DL-0.01)	0.05	1.5
32	Molybdenum (as Mo)	mg/L	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.01)	BDL(DL-0.001)	0.07	No Relaxation
33	Chromium (as Cr)	mg/L	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	0.05	No Relaxation
34	Aluminium (as Al)	mg/L	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.001)	BDL(DL-0.01)	0.03	0.2
35	Silver (as Ag)	mg/L	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.01)	BDL(DL-0.001)	0.1	No Relaxation
36	Barium (as Ba)	mg/L	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	0.7	No Relaxation
37	Mineral Oil	mg/L	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.001)	BDL(DL-0.0005)	0.5	No Relaxation
38	Poly Chlorinated Biphenyls (PCB)	mg/L	BDL(DL-0.00005)	BDL(DL-0.00005)	BDL(DL-0.0005)	BDL(DL-0.00005)	0.0005	No Relaxation
39	Polynuclear Aromatic Hydrocarbon (PAH)	mg/L	BDL(DL-0.00005)	BDL(DL-0.00005)	BDL(DL-0.00005)	BDL(DL-0.00005)	0.0001	No Relaxation
40	Bromoform	mg/L	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.00005)	BDL(DL-0.01)	0.1	No Relaxatio
41	Dibromochloromethane	mg/L	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	0.1	No Relaxation
42	Bromodichloromethane	mg/L	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	0.06	No Relaxation
43	Chloroform	mg/L	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	0.2	No Relaxation
44	*E-Coli*	cfu/ 100ml	Absent	Absent	BDL(DL-0.01)	Absent	Shall not be detectable in any 100 ml	Not Specified
45	Total Coliform	cfu/ 100ml	Absent	Absent	Absent	Absent	Shall not be detectable in any 100 ml	Not Specified

Observations:

- The analysis results indicate that pH of the groundwater was found to be in range of 7.65 to 7.76 indicating a neutral to slightly alkaline nature of the groundwater. This is favorable for diverse applications, including drinking water.
- The TDS were found to be in the range of 1038 mg/l – 1214 mg/l, higher than the desirable limit (above 500 mg/l) and within the permissible limit (2000 mg/l).
- Other parameters like Total Hardness as $CaCO_3$ (408 mg/l –477 mg/l). The total hardness levels are higher than the desirable limit (above 200 mg/l) and within the permissible limit (600 mg/l) for drinking water, ensuring a balanced mineral composition.
- Total Alkalinity (160–176 mg/ l): falls within desirable limits, contributing to water stability and buffering capacity.
- Calcium as Ca (98.6–111.5 mg/ l) levels are within permissible limits, indicating a favorable mineral balance.
- Magnesium as Mg (39.3–49.2 mg/ l) levels are within permissible limits, contributing to overall mineral content.
- Chloride as Cl (115–198 mg/ l) levels are within desirable limit for pleasant taste in drinking water.
- Fluoride as F (0.16-0.24 mg/l) levels are within desirable limit, posing no health concerns.

3.9.3 Result and conclusion:

The groundwater analysis indicates overall suitability for various uses, including drinking. The measured parameters, such as pH, total alkalinity and various chemical constituents, align with water quality standards. Whereas, TDS, total Hardness, Calcium and Magnisium found exceeding desirable limit and within the permissible limit. Consequently, in the absence of an alternative source, groundwater can be considered safe for consumption and domestic applications after pretreatment.

Surface Water:

Seven surface water samples were collected as grab samples and were analyzed for various parameters. The analyzed results were compared with the standards for surface water as per IS: 2296. The presentation of results is in the following tables.

Table 3.25: Surface water sampling stations

S. No.	Monitoring Locations	Station Code	Selection criteria	Distance (km)	Direction
1.	Andheri Nadi (Up Stream)	SW 1	Surface water bodies in the study area as well as between the plant and drainage in the direction of flow of surface water	0.5	E
2.	Andheri Nadi (Dn Stream)	SW 2		0.5	E
3.	Bhupsi Nala	SW 3		3.9	W
4.	Lhasi Nadi	SW 4		2.8	SSE
5.	Atru (Water Body)	SW 5		3.8	NW
6.	Parbati River (Up Stream)	SW 6		3.5	E
7.	Parbati River (Dn Stream)	SW 7		3.4	E

Table 3.26: Surface Water analysis report

S.No.	Parameter	Unit	S1	S2	S3	S4	S5	S6	S7
1	pH	-	6.93	7.02	6.78	7.06	7.11	6.95	6.99
2	Turbidity	NTU	BDL(DL-1.0)	BDL(DL-1.0)	BDL(DL-1.0)	BDL(DL-1.0)	BDL(DL-1.0)	BDL(DL-1.0)	BDL(DL-1.0)
3	Total Suspended Solids (TSS)	mg/L	12	26	78	18	21	24	39
4	Total Hardness (as CaCO3)	mg/L	176	160	180	156	152	168	172
5	Total Alkalinity (as CaCO3)	mg/L	92	108	85	110	116	92	96
6	Chlorides (as Cl)	mg/L	86	74	90	96	92	104	112
7	Sulphate (as SO4)	mg/L	8.6	101.6	9.5	15.2	7.8	12.3	14.2
8	Nitrate (as NO3)	mg/L	2.2	1.6	2.5	2.6	2.0	2.7	2.5
9	Fluoride (as F)	mg/L	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)
10	Biochemical Oxygen Demand (BOD)	mg/L	2	2	3	2	2	3	4
11	Chemical Oxygen Demand (COD)	mg/L	6	6	8	6	6	8	12
12	Phenolic Compounds (as C_6H_5OH)	mg/L	BDL(DL-0.0005)	BDL(DL-0.0005)	14	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)
13	Lead (as Pb)	mg/L	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
14	Iron (as Fe)	mg/L	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)
15	Arsenic (as As)	mg/L	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
16	Cadmium (as Cd)	mg/L	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
17	Total Chromium (as Cr)	mg/L	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
18	Mercury (as Hg)	mg/L	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)
19	Copper (as Cu)	mg/L	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)

20	Zinc (as Zn)	mg/L	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
21	Selenium (as Se)	mg/L	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
22	Oil & Grease	mg/L	<5	<5	<5	<5	<5	<5	<5
23	Colour	Hazen	<1	<1	<1	<1	<1	<1	<1
24	Dissolved Solids	mg/L	4	4	4	3	4	5	6
25	Residual Free Chlorine	mg/L	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)
26	Boron (as B)	mg/L	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
27	Calcium (as Ca)	mg/L	44.8	40.0	46.4	41.6	43.2	38.4	36.8
28	Magnesium (as Mg)	mg/L	15.6	14.5	15.6	12.6	10.7	17.5	19.4
29	Dissolved Oxygen	mg/L	5.7	5.9	5.5	5.2	5.4	5.2	6.0
30	Nitrogen	mg/L	BDL(DL-0.5)	BDL(DL-0.5)	BDL(DL-0.5)	BDL(DL-0.5)	BDL(DL-0.5)	BDL(DL-0.5)	BDL(DL-0.5)
31	Ammonia	mg/L	BDL(DL-02)	BDL(DL-02)	BDL(DL-02)	BDL(DL-02)	BDL(DL-02)	BDL(DL-02)	BDL(DL-02)
32	Phosphorus	mg/L	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)
33	Faecal Coliform	MPN/100ml	162	81	220	160	95	95	85
34	Total Coliform	MPN/100ml	350	170	470	340	210	170	190

3.9.4 Observations:

- pH of the surface water was found to be in range of 6.78 to 7.11, indicating a neutral to slightly alkaline nature of the water.
- BOD was found to be in the range 2 mg/l -4 mg/l. These BOD levels suggest lower to moderate organic pollution in the water, indicating the presence of biodegradable organic matter.
- COD was found to be in the range 6 mg/l – 12 mg/l. The COD levels indicate the amount of oxygen required for the oxidation of both organic and inorganic substances, with moderate values suggesting increased pollution.
- DO was found to be in the range 5.2 mg/l – 6 mg/l.
- TSS was found to be in the range 12 mg/l – 78 mg/l.

3.9.5 Result and conclusion:

The surface water analysis indicates generally acceptable pH, DO and TDS levels. However, concerning signs of pollution are evident with slightly higher BOD and COD, suggesting the presence of organic pollutants. Wate can be used for drinking purpose after conventional treatment followed by disinfection.

Table 3.27: Water Quality Criteria as per CPCB

Designated Best Use	Class of Water	Criteria
Drinking water source without conventional treatment but after disinfection	A	• Total Coliform Organism MPN/100ml shall be 50 or less • pH between 6.5 and 8.5 • Dissolved Oxygen 6mg/l or more • Biochemical Oxygen Demand 5 days 20°C 2mg/l or less
Outdoor bathing (Organized)	B	• Total Coliform Organism MPN/100ml shall be 500 or less • pH between 6.5 and 8.5 • Dissolved Oxygen 5mg/l or more • Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	• Total Coliform Organism MPN/100ml shall be 5000 or less • pH between 6 to 9 • Dissolved Oxygen 4mg/l or more • Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Propagation of Wildlife and Fisheries	D	• pH between 6.5 to 8.5 • Dissolved Oxygen 4mg/l or more

Designated Best Use	Class of Water	Criteria
		• Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	• pH between 6.0 to 8.5 • Electrical Conductivity at 25°C micro mhos/cm Max.2250 • Sodium absorption Ratio Max. 26 • Boron Max. 2mg/l
	Below-E	• Not Meeting A, B, C, D & E Criteria

As per IS:2296 criteria, the water samples are suitable for drinking with conventional treatment (Class C) & propagation of Wildlife and Fisheries (Class D).

3.10 NOISE ENVIRONMENT

The environmental assessment of noise from the project activity and vehicular traffic can be undertaken by taking into consideration various factors like potential damage to hearing, physiological responses, and annoyance and general community responses.

- Characteristics of noise sources (instantaneous, intermittent or continuous in nature). It can be observed that steady noise is not as annoying as one which is continuously varying in loudness.
- The time of day at which noise occurs, for example high noise levels at night in residential areas are not acceptable because of sleep disturbance; and
- The location of the noise source, with respect to noise sensitive land use, determines the loudness and period of exposure.

The main objective of noise monitoring in the study area is to establish the baseline noise levels and assess the impact of the total noise expected to be generated by the construction and operation of the project activity around it.

Table 3.28: Noise Level as Per CPCB Norms

S. No.	Category of Area	Noise Level Leq. dB (A)	
		Day time	Night time
1.	Industrial area	75	70

2.	Commercial area	65	55
3	Residential area	55	45
4	Silence Zone	50	40

Note:

1. *Day time is reckoned in between 6 a.m. and 10 p.m.*
2. *Night time is reckoned in between 10 p.m. and 6 a.m.*
3. *Silence zones are referred to as areas upto 100 meters around such premises as hospitals, educational institutions and courts. The Silence zones are to be declared by the Competent Authority.*
4. *Use of vehicular horns, loudspeakers and bursting of crackers shall be banned in these zones.*
5. *Mixed categories of areas should be declared as one of the four above-mentioned categories by the Competent Authority and the corresponding standards shall apply.*

3.10.1 Identification of Sampling Locations

A preliminary reconnaissance survey has been undertaken to identify the major noise generating sources in and around the project site area. Noise level at different noise generating sources has been identified based on the activities in the study area and ambient noise due to traffic. The noise monitoring has been conducted for determination of ambient noise levels at eleven locations in the study area for post monsoon season (Oct-Dec' 2024). The noise levels at each location were recorded for 24 hours. The environment setting of noise monitoring locations is given in table above.

Table 3.29: Ambient Noise monitoring stations

S. No.	Monitoring Locations	Station Code	Selection criteria	Distance (km)	Direction
1.	Project Site	NQ1	Core zone	--	--
2.	Phulbaroda	NQ2	Up wind	1.4	ESE
3.	Bhakhravda	NQ3	Down wind	4.2	W
4.	Bilkhera	NQ4	Second Up wind	2.2	E
5.	Barlan	NQ5	Down wind	2.2	WSW
6.	Lakhnakheri	NQ6	Up wind	8.4	E
7.	Kawai	NQ7	Cross wind	0.8	WSW
8.	Soni	NQ8	Cross wind	2.8	NE
9.	Atru	NQ9	Habitation	4.8	NW

S. No.	Monitoring Locations	Station Code	Selection criteria	Distance (km)	Direction
10.	Kherli Nahariya	NQ10	Habitation	8.8	WSW
11.	Dara Block	NQ11	Sensitive	0.01	E

3.10.2 Method of Monitoring

Sound Pressure Levels (SPL) measurements were recorded at eleven locations. The readings were recorded using data logger & integrated representative value for every hour for 24-hrs is completed using software. The day noise levels have been monitored during 6 am to 10 pm and night noise levels during 10 pm to 6 am at all the locations covered in the study area. Noise levels recorded at each station are computed for equivalent noise levels. Equivalent noise level is a single number descriptor for describing time varying noise levels.

Table 3.30: Noise (Sound) Measuring Instrument

Instrument	Make	Model
Noise Level Meter	Lutron	SL-4001
Noise Level Meter	Envirotech	SLM-100

Table 3.31: Testing Method to be followed

Parameter	Technical Protocol
Noise Level in dB(A) for continuous 24 hours at 1 hour interval	IS 9989: 1981 (Reaffirmed Year 2014)

3.10.3 Presentation of Results

The statistical analysis is done to measure noise levels at eleven locations in the study area. The statistical analysis results are given in **Table-3.32.** The noise quality results obtained for the study period is given

Table 3.32: Ambient Noise Levels in the Study Area

S. No.	Locations	Day Time Leq. dB(A)	Night Time Leq. dB (A)
1.	Project Site	57.1	46.7
2.	Phulbaroda	45.1	37.6
3.	Bhakhravda	47.4	38.0
4.	Bilkhera	48.1	38.7
5.	Barlan	48.9	37.8
6.	Lakhnakheri	45.0	38.3
7.	Kawai	46.6	38.4
8.	Soni	46.1	36.8
9.	Atru	45.1	39.5
10.	Kherli Nahariya	48.1	38.7
11.	Dara Block	46.2	35.8

3.10.4 Observations

The observed noise levels generally adhere to CPCB standards, indicating acceptable noise pollution levels in the monitored locations.

3.11 ECOLOGY & BIODIVERSITY STUDIES

Documentation of biological components in a project area and its immediate surroundings is imperative in the case of any developmental project, to ensure that the ecological setup of the area does not degrade and in effect is improved. For understanding the impact of a project, it is better to prioritize the conservation issues, in terms of flora and fauna, in addition to other base line parameters. Biodiversity study of the project area was carried out to understand the status of predominant floral and faunal groups i.e. trees, shrubs, herbs, grasses, herpetofauna, avifauna and mammals. To collect data and information on specific components of the ecological system and pertinent issues widely used standard scientific methods were adopted. Field surveys were undertaken during Oct-Dec’ 2024 to collect relevant data.

OBJECTIVES OF STUDY:

With the aim assessing the floral, faunal and ecosystem biodiversity of the project area and developing strategies towards environment management plan including wildlife protection of the existing biota, the following objectives were formulated and followed:

- Identification and listing of ecologically significant floral/faunal species of the study area (rare/endangered/threatened/endemic/exotic) in accordance with IUCN/The Wildlife (Protection) Act, 1972 amendment-2022.
- Identification of ecologically sensitive areas (protected areas/ geologically significant areas/ biosphere reserves/ sanctuaries/ mangroves/ sacred groves/ wetlands/ heritage resources etc.).
- Develop appropriate strategies to safeguard biological environment.
- Suggest ways and means of conservation of schedule-1 species of flora and fauna, if any, reported in the study area and develop Wild Life Conservation for those identified Schedule-I species [as per The Wildlife (Protection) Act, 1972 amendment, 2022] of the study area.

CORE ZONE:

Thermal Power Plant Boundary located at Village Kawai, Tehsil Atru, District Baran, Rajasthan will be considerd as the core zone for the period of the study to furnish accurate information.

BUFFER ZONE:

The area encompassing 10 km radius from the boundaries of the project area of Thermal Power Plant, Kawai, say 10 km radius of the core zone, has been designated as the buffer zone (BZ) for this study purpose. There are no eco sensitive areas like National Park, Wild Life Sanctuary, Elephant/Tiger Reserve or Wild Life Corridors and and/or breeding or nesting ground and Eco-sensitive Zones or Biosphere Reserves or Ramsar Wetlands either within the Core zone (project site) or within the zone of influence (ZoI) say buffer zone i.e. within 10 km radius of project boundaries.

Hereinafter, wherever CZ is mentioned shall mean Core Zone, BZ is mentioned shall mean Buffer zone and study area (SA) is mentioned shall mean both core zone and buffer zone together.

3.11.1 STAGES OF BIODIVERSITY ASSESSMENT:

The biodiversity assessment was planned in two stages to ensure a comprehensive understanding of the region's ecological and biological richness. Initially, an overview of the ecosystem, flora, and fauna was developed using reliable and published data sources. This preliminary step provided a foundational understanding of the area's biodiversity. Building on this, the second stage involved assessing the current ecological conditions through field studies, employing standard protocols for biodiversity measurement. The process began with a rapid survey to gather immediate insights, followed by the compilation and analysis of secondary data to support and refine the findings.

3.11.1.1 RAPID SURVEY:

Rapid survey of the study area was carried out initially to prima facie identify and understand the prevailing physical and biological environments of the study area. The strategy adopted included the following:

- Interaction and discussion with the technical representatives of the project proponent to understand the project and the actual project activities.
- Collection of project related/location related/biodiversity related documents and/or secondary data like base maps, conceptual plans, list of activities, materials involved, requirements for activity fulfilments, specific area delineation within the project area for specific purpose/ activities etc.
- Discussion with EIA consultant team as a whole and specifically with Functional area Experts in the sectors of Geology/Hydrogeology, Water, Air and socio economics to have an understanding on the proposed activities of the project and further likely impact on to the environment, its nature/quantum/frequency/severity etc.
- Interaction with local inhabitants of the study area especially with senior citizens randomly.
- Interaction with different stakeholders of the project area like Forest Officers, school authorities, farmers, business people, student, government officials, forest authorities, auto

drivers, public in the markets, different category of workers/labourer representing a cross section of the society.

3.11.1.2 DESKTOP ASSESSMENT:

Secondary data related to the flora, fauna and ecosystem were collected from different sources. The sources of secondary data are given following table.

Table 3.33: - Sources Of Secondary Data

S. No.	Information	Source
1.	Description of Biological- inventory of flora and fauna in 10 km radius, endemic species, endangered species, aquatic fauna, Forest land, forest type and density of vegetation, biosphere, national park, wildlife sanctuaries, tiger reserve, elephant reserve, turtle nesting ground, core zone of biosphere reserve, habitat of migratory birds, routes of migratory birds	District Gazetteers
		Zoological Survey of India
		Botanical Survey of India
		Environmental Information system (ENVIS), MoEF&CC
		IUCN Red data Book
		Schedule of WL(P) Act
		Book of Indian Birds
		Butterflies of India (Singh, 2011)
		Reptiles of India (Daniel, 2002)

3.11.1.3 FIELD SURVEY FOR ASSESSMENT:

The micro level assessment was mainly based on the field visit and further to physically assess the ground realities so as to have a comparison and ascertainment of the secondary data what were published and considered to be reliable. It included the primary data collection on different biodiversity components of the study area towards achieving the objectives of the study using well established and/or nationally and internationally accepted techniques of ecological assessments pertaining to different life forms and/or habitats.

On completion of the assessment throughout the whole area of existing core zone (CZE), and the area proposed as likely to be added to the existing core zone (CZ), the following are the buffer zone areas visited for prima facie qualitative studies as a part of field level assessment of ecology & biodiversity. The field assessments were conducted from Oct 2024 to Dec 2024.

3.11.1.4 QUADRAT METHOD:

Quadrates of 10x10 m were randomly selected within core and buffer zone, wherein each quadrate was used assess the trees (>5 cm GBH) and a 5 x 5 m sub quadrant within that quadrat for shrubs and 1 x 1 m for herbs. Randomly the quadrates were selected to maximize sampling activities and also to minimize the species homogeneity like area of house backyard, avenue plantations, pond areas, agricultural area, wildlife area, stream areas, forestry plantations, natural forest areas etc.

3.11.2 ECOSYSTEM DIVERSITY:

As a part assessing the ecosystem diversity,

a) The General Character of the existing site was assessed where the following were the key points that were looked into:

i. Aesthetics
ii. Landscape
iii. Geological features
iv. Lakes
v. Canal
vi. Forest and bush
vii. Breeding and Spawning grounds
viii. Habitats
ix. Flight paths
x. Migratory paths

(b) Existing artificial features were assessed, where the key points looked in to were:

i. Roads
ii. Railways
iii. Buildings
iv. Agricultural activities
v. Other facilities related to current use of local ecology

(c) Further, had interactions with local inhabitants, local shop keepers, and Government officials including forest authorities. Other than ecological aspects, the following were also among the discussion aspect with the above said cross section of the society:

a. Consistency of the proposed development with the statutory provisions, where the key points considered were:
   i. Local country planning
   ii. Heritage orders
   iii. Measures under tribal or native people legislation
   iv. International conventions (protecting wetland etc.)

b. History & background of the site, like

(i) Tribal activity on the site

(ii) Archaeological

(iii) Cultural

(iv) Heritage

Based on the above observations and discussions, the rapid surveys, the land use and land cover map of the study area prepared as a part of EIA/EMP, major floral and faunal habitats were identified. Accordingly, five major habitat types were identified in the study area, even by combining certain LULC types. They are (i) Urban Land (ii) Barren land (iii) Agricultural land (iv) Forest land and (v) Water systems. Core zone had only Barren land and greenbelt area. Buffer zone had all the five habitats mentioned above.

Urban Land: Those ecosystems dominated by man-made structures which may include cities, towns, villages, strip development along highways, transportation, power, and communication facilities and area such as those occupied shops and institutions that may, in some instances, be isolated from urban areas.

Agricultural Land: All ecosystem modified or created by man specifically to grow or raise biological products for human consumption or use. This include cropland, pasture, orchards, groves, nurseries, ornamental horticultural areas and confined feeding areas.

Forest Land: Those ecosystems that have a tree crown density (crown closure percentage) of 10% or more and are stocked with trees capable of producing timber or other wood products.

This includes land from which trees have removed to less than 10%, but which have not been developed for other uses.

Water Systems: Those ecosystems persistently covered by water. This includes streams, creek, rivers, canals, nallahs and other linear bodies of water. This also includes lakes (both fresh and saline water) and reservoirs.

A. FLORAL DIVERSITY:

The following are the activities done in the flora assessment of the core zone:

i. Status of flora species was assessed in the identified habitat types (agricultural, barren, forest and water system habitats) existing in the core and buffer zone.

ii. Terrestrial flora quantification was done by standard quadrate method

iii. Further, the following points were also considered while conducting field level survey of flora.

- Any oldest or largest of trees with uniqueness
- Rare or uncommon species
- Type of populations
- Unique or scarce habitats
- Threatened or endangered communities
- Allergic plants
- Poisonous and venomous species
- Pest or weed or nuisance creating items
- Populations that might expand dramatically if the immediate environment is changed

B. FAUNAL DIVERSITY:

Only the major faunal taxonomical groups were addressed at field survey & investigations. Different standard method as convenient for different category of individual were applied as is described below. Many methods were adopted for achieving the objectives, but having a common criterion of strategy was adopted. Among those criteria, the grid method was followed as a major one. Four square kilometre grid were overlaid on the base map of the study area (Core zone + Buffer Zone) to identify the individual sampling units. All the full grids were selected and discarded the incomplete grid. Within each selected grid, search trail with 500 m segment as spatial replicates, that is four replicates per grid were selected thus becoming 2.0 km. in addition to the search trails in the selected grid, as above, camera traps/clippings were also deployed.

Mammals:

Because of their ambiguous behaviour and relatively low abundance at which they occur and the wide range of environmental niches they may occupy, mammals are the most difficult groups to survey on. Different trapping method used for different mammals groups were as follows:

i. **Pitfall traps:** Here the target group was small mammals such as delicate mouse (Pseudomys). Small to medium size hole was dug in the ground and a small plastic container was place in the hole. A driff-fence (with different length and height) was made on the ground to intersect with plastic container and guide animals into it.

ii. **Cage traps:** This was towards targeting medium sized ground dwelling and arboreal animals. Collapsible rectangular trap with one or more trap door made. It was placed on ground and attracted with any appropriate food item. It may also be placed on trees and appropriate food preferable to the target species is made use of.

iii. **Mist nets:** it mainly target the bats. Fine, light-weight nylon mesh is nipped between two poles in which bats become entangled during flight. It is usually stung close to water holes and across creeks during nighfall, as they come for water. The superfine nature of the nylon mesh avoids detection by bat's echolocation, and hence, there are likely chances that some bats fly into the net and get entangled. A very close continuous watch is required here, as, it is so important to remove captured individual as quickly as possible to decrease stress and further the risk of injury to the individual.

iv. **Tracks and scats:** This is a method that can be adopted for almost all mammals. If one cannot actually catch or see an animal, it may not be possible to say what it was. Signs of the anmials's presence such as footprints or scats can be interpreted fruitfully. In addition to these, bones teeth and skulls can also be used to identify the species positively. The field guide by Triggs, B (1996) can be used to identify such remains of mammals.

v. **Spotlighting: The** target groups of this method is all mammals' especially nocturnal arboreal species. This is a common method which involve a times search in specific area or more general search over a wider area. It requires more effort because of the greater number of places an animal may use. Eyes shine may be commonly detected but not always.

Birds:

Birds are mostly one of the simplest group to sample with regard to the method used, but may become more complex due to high diversity in any area and the variety of calls and colour changes within species itself. The following trapping methods were employed for the purpose. Early morning times and evening times were most commonly used in uninhabited area, but the timing in between were used in inhabited areas. Efforts were also made to identify the presence of any breeding/nesting sites or roosting sites of birds in the area**.**

I. **Visual and Call Census: It** involved identifying species visually (either by naked eye or by binocular) Bird calls are extremely useful in surveying birds.
II. **Additional signs:** The identification of old eggs, nets and feathers or other signs (like owl pellets) give a valuable information on the presence of a species in the surveyed area.
III. **Point count method:** Point count method with limited distance (100 m, Hutto et al. 1986, Bibby et al. 1992) was employed with slight modification of 25 m. Point counts were performed in the morning, beginning with increased bird activity, and finishing around 3 hours later, the time for sampling at each point was 15 minutes, and another 15 minutes was the time necessary for the displacement from one point to another.
IV. **Flock count method:** for terrestrial and aquatic bird assessments, this method was also adopted, wherever possible.

Reptiles & Amphibians:

Intensive search method was adopted along the water hedges of all aquatic habitats to list and count the amphibians and reptiles. The following method are adopted for accomplishing the objectives.

i. **Pitfall traps:** The target group was lizards and frogs. Small to medium size hole was dug the ground and a small plastic container was placed in the hole. A different fence (with different length and height) was made on the ground to intersect with plastic container and guide animals into it.
ii. **Active searches:** This type of searches is actively and deliberately done at fixed time in a fixed locality where habitat is physically disturbed in order to uncover animals that may be hiding. A passive search on the other hand may involve simply observing animals for a fixed time.
iii. **Spotlighting:** It is similar to active searches but done at night, aiming the target groups like gekoes, frog and snakes.

iv. **Flock Count Method:** for terrestrial and aquatic bird assessment, this method was also adopted, wherever possible.

v. **Reptiles & Amphibians**: Intensive search method was adopted along the water hedge of all aquatic habitats to list and count the amphibians and reptiles. The following methods are adopted for accomplishing the objectives.

Fishes:

Various major water bodies like pond, reservoirs, streams, stream-bed pools, wells, paddy field, river and bunds that have open end to receive surface run-off were considered for field assessment. Nylon dragnet with mesh size 2 mm used sometimes, but at other times catches from the local people at the sites went through during the time of river monitoring were also utilized for this assessment.

3.11.3 RARE, ENDANGERED OR THREATENED (RET) FLORA & FAUNA/ SCHEDULE I SPECIES:

The objectives of the study not only included the qualitative and quantitative assessment of flora and fauna of the study area, but also envisaged the identification of the presence of any Rare, Endangered or threatened (RET) species listed in Schedule I of The Wildlife (Protection) Amendment Act, 2022 and/or current IUCN Red list.

Sampling Details

For fulfilling the objectives of the study, finding out the species diversity is of utmost importance. The following are the assessments involved therein.

i. **Species Diversity:** In order to ascertain the community of flora, terrestrial & aquatic birds, the species were grouped into taxonomic classes and the percentage of each group was calculated from the total count of each sample. Then the diversity was calculated for each community using Shannon Wiener Diversity Index (SWDI).

$$n$$

$$d = -\sum$$

$$(ni/N).\log^2$$

$$(ni/N)\ i=1$$

Where,

n= number of species

N= total number of individuals of all species

ni= number of individuals of "I"th species

d= Shannon Wiener Diversity index

where proportion is obtained by dividing the number of individuals of species by total number of individuals of all species for which log2 proportion is obtained by index table (Shannon and Weiner, 1963).

ii. **Relative Density:** It is study of the numerical strength of a species with reference to the total number of all species.

iii. **Relative Frequency**: it is the study of distribution or occurrence of a species in the study area.

iv. **Relative Dominance:** Ecological dominance is the degree to which one or several species have a major influence controlling the other species in their ecological community, because of their large size, population, productivity, or related factors.

v. **Importance Value Index (VI):** it is the sum of (ii), (iii) and (IV) above.

IVI= Relative Density + Relative Frequency + Relative Dominance.

3.11.4. SAMPLING METHODS & LOCATIONS:

For the assessment of floral and faunal community, 15 locations were identified in the buffer zone, as there was little scope for phyto-sociological studies in the core zone because of being hectic project activities. Qualitative assessment was done in all the 15 locations.

As mentioned above, 15 sampling locations/plots were selected for study. In those selected locations, sampling plots of different size were taken to quantify the floral and faunal species, as stated below. Listing of species were done based on actual sighting, interviewing locals, indirect reliable evidences, literature survey, data collected from forest department and internet references.

Table 3.34 Sampling locations for primary data Field level assessment

S.No.	Latitude	Longitude	Location Name
1.	24°48'17.95"N	76°43'36.83"E	Project site
2.	24°48'26.73"N	76°43'32.57"E	Project site
3.	24°48'43.12"N	76°42'52.70"E	Project site

4.	24°48'28.47"N	76°42'55.84"E	Project site
5.	24°49'37.93"N	76°43'21.36"E	Project site
6.	24°50'13.04"N	76°41'57.67"E	Project site
7.	24°50'13.04"N	76°43'13.73"E	Near Kherli Gaddiya
8.	24°44'32.72"N	76°45'25.00"E	Near Rijhaa
9.	24°43'44.25"N	76°45'43.82"E	Near Khopur
10.	24°49'24.70"N	76°47'19.22"E	Near Parbati River, Mothpur
11.	24°43'37.39"N	76°41'28.00"E	Near Mooral Gujran
12.	24°43'37.62"N	76°40'43.72"E	Near Mooral Gujran
13.	24°46'21.09"N	76°38'56.99"E	Near Mooral Gujran (Water Body)
14.	24°46'33.89"N	76°46'49.50"E	Near Moondla
15.	24°52'38.23"N	76°41'06.34"E	Near Atru

1. **Flora:**

Quadrates of 10 x 10 m were randomly selected within core and buffer zone, wherein each quadrate was used to assess the trees (>5 cm GBH) and a 5 x 5 m sub quadrant within that quadrat for shrubs and 1 x 1 m for herbs. The plant species were identified referring to various published data sources as mentioned in previous paras, local name identified largely from the information provided by the local inhabitants especially aged people.

Terrestrial flora quantification was done by standard quadrate method. Accordingly, in each quadrant, individual species of trees (10 x 10 m), shrub (5 x 5 m) and herb (1 x 1 m) were identified separately and recorded on site during the field investigations.

2. **Fauna:**

Mammals:

A total of 10 x 25 m radius plots was intensively searched for indirect evidences of mammalian fauna without discarding those which came to sight as direct evidence. Additionally, early mornings and late nights were also used for slow travel through cross roads across the study area covering almost entire places, exclusively in search of fauna, especially mammalian fauna for physical sighting and ascertaining purposes. All the scientific / common names are taken after referring published data sources as mentioned in para 3.3.2, referring websites related to fauna identification etc.

Birds:

In the process of accounting terrestrial birds, 10 x 25 m point count method was adopted. Total & Flock count method was employed for taking stock of aquatic birds during different periods of the study.

Reptiles & Amphibians:

Amphibian & Reptiles were utilized for intensive search of these in both core and buffer zones.

Fishes:

Various major water bodies like ponds, reservoirs, streams, stream-bed pools, wells, paddy fields, rivers and bunds that have open end to receive surface run-off were considered for field assessment. Nylon dragnets with mesh size 2 mm were used sometimes, but at other times catches from the local people at the sites went through during the time of river monitoring were also utilized for this assessment.

Phytoplankton:

For the study of phytoplankton, samples were collected from 10 cm depth below the water surface. Fresh Polythene bottles of 250 ml capacity (Polylab) were used for collection of water samples. After the sampling, the sample was preserved by adding Lugol's solution.

Zooplankton:

For the quantification of zooplankton samples, water was filtered at each site by using standard plankton net made up of fine silk cloth (mesh size 25 µm). After the sampling, the preservation of samples was carried out without delay to avoid damage to animal tissue by bacterial action. The collected filtrate was preserved in the 4% formalin solution (Analytical grade). The density of zooplankton was estimated with the help of APHA (2012). After preservation the zooplankton samples were kept in well-ventilated room at temperature less than 25°C. The samples were kept in the wide mouth bottle. A good quality pre-printed labels were used, on which date and time of sampling, fixative and preservative used and other field information were written for ready reference at the time of analysis.

3.11.5 BIOLOGICAL BASELINE STATUS ASSESSMENT

3.11.5.1 Pattern of Assessment:

In this section, the present biodiversity status of the study area is discussed in detail. The biodiversity status comprises the existence of different ecosystems, different life forms of floral components (tree, shrub, herb, grass etc.) and major faunal groups (mammals, terrestrial birds, aquatic birds and mammals. The baseline status of biodiversity assessment is being discussed at three levels.

- Core Zone: The project area of 822.54 hectares
- Buffer Zone: Area within 10 km radius of the lease boundaries
- Study area: Combined area of both core & buffer zone

3.11.5.2 Ecosystem Components:

The study area comprises the project area (Core Zone- CZ) and the area within 10 km radius (Buffer Zone- BZ) of the project boundaries. Five major habitat types were identified in the study area, even by combining certain LULC types. They are (i) Urban land (ii) Barren land (iii) Agricultural land (iv) Forest land and (v) Water systems. Core zone had only Barren land and greenbelt areas. Buffer zone had all the five habitats mentioned above.

3.11.5.3 Status of Flora:

The plant species spotted in the study area are discussed at the ongoing paras. A described above, quadrat method was adopted for studies. Accordingly, in each quadrant, individual species of trees (10 x 10 m), shrub (5 x 5 m) and herb (1 x 1 m) were identified separately and recorded on site during the field investigations. The field study denoted the following:

A. Core Zone (CZ) - Flora:

a. Trees

Table: 3.35: List of Tree (Existing Greenbelt included) Species Reported in the Core Zone (CZ)

S.No.	Scientific Name	Common/Vernacular Name	Family
1.	*Ficus benghalensis*	Bargad	Moraceae

2.	*Acacia leucophloea*	Reonja	Mimosaceae
3.	*Butea monosperma*	Palash	Fabaceae
4.	*Albizia lebbeck*	Siris	Fabaceae
5.	*Prosopis cineraria*	Khejri	Fabaceae
6.	*Acacia nilotica*	Desi babool	Fabaceae
7.	*Azadirachta indica*	Neem	Meliaceae
8.	*Ziziphus mauritiana*	Ber	Rhamnaceae
9.	*Terminalia arjuna*	Arjun	Combretaceae
10.	*Peltophorum pterocarpum*	Peela Gulmohar	Caesalpiniaceae
11.	*Madhuca longifolia*	Mahua	Sapotaceae
12.	*Tectona grandis*	Sagvan	Verbenaceae
13.	*Ficus benjamina*	Pukar	Moraceae
14.	*Pongamia pinnata*	Karanj	Fabaceae
15.	*Delonix regia*	Gulmohar	Caesalpiniaceae
16.	*Senna siamea*	Semia	Caesalpiniaceae
17.	*Syzygium cumini*	Jamun	Myrtaceae
18.	*Mangifera indica*	Aam	Anacardiaceae
19.	*Psidium guajava*	Amrud	Myrtaceae
20.	*Manilkara zapota*	Chiku	Sapotaceae
21.	*Mimusops elengi*	Maulshri	Sapotaceae
22.	*Tamarix aphylla*	Pharras	Tamaricaceae

b. Shrubs

Table 3.36: List of Shrub Species Reported in the Existing Core Zone (CZ)

S.No.	Scientific Name	Common/Vernacular Name	Family
1.	*Adhatoda vasica*	Aadusa	Acanthaceae
2.	*Carissa carands*	Karonda	Apocynaceae
3.	*Euphorbia royleana*	Thor	Euphorbiaceae

c. Herbs/Grasses

Table 3.37: Common Herb, Grasses and Climbers Species Reported in the Existing Core Zone (CZ)

S. No.	Scientific name	Common/ Vernacular Name	Family
1.	*Argemone mexicana*	Satyanashi	Papaveraceae
2.	*Brachiaria remosa*	Kuri	Poaceae
3.	*Hetropogon contortus*	Surwala	Poaceae
4.	*Themeda quadrivalvis*	Ratra	Poaceae

Ziziphus* mauritiana** ***Butea monosperma

Figure:3.21 Photographs of observed fauna in the CZ

B. Buffer Zone Flora:

a. Trees

Table 3.38: List of Tree Species Reported in the Buffer Zone

Sl. No.	Scientific Name	Common Name
Tree		
1	*Acacia leucophloea*	Aranjia
2	*Acacia senegal*	Khumtha
3	*Albizzia odoratissima*	Chichwa
4	*Albizzia procera*	Garra
5	*Butea monosperma*	Dhak
6	*Bauhinia vareigata*	Khachnar
7	*Boswellia serrata*	Salar
8	*Cassia fistula*	Amaltas
9	*Cassia siamea*	Khasod
10	*Madhuca indica*	Mahua
11	*Phoenix spp*	Kohra
12	*Terminalia arjuna*	Kohra
13	*Tectona grandis*	Sagwan
14	*Zizyphus xylocarpa*	Ghat ber
Shrubs		

15	*Adhatoda vasica*	Aadusa
16	*Capparis separia*	Kanter
17	*Carissa carands*	Karonda
18	*Euphorbia royleana*	Thor
19	*Ocimum americanum*	Bapsi
20	*Zizyphus numularia*	Jhadi ber
Herbs		
21	*Argemone mexicana*	Satyanasi
22	*Asparagus dumosus*	Narkanta
Grasses		
23	*Brachiaria remosa*	Kuri
24	*Cymbopogon jwarancusa*	Bhagori
25	*Cymbopogon martini*	Rosha
26	*Hetropogon contortus*	Surwala
27	*Themeda quadrivalvis*	Ratra
Climbers		
28	*Aristolochia bracteata*	Bhringi
29	*Butea perviflora*	Palasbel

Phyto-sociological analysis of the Buffer Zone:

To characterize the floral composition of the zone of impact of 10 km radius of the project site referred as buffer zone, all the information gathered during field survey should have to be tabulated and analysed. The quantitative data thus obtained through quadrate methods on the floral component of buffer zone was analyzed to arrive at Phyto-sociological attributes, viz., Frequency, Density, Abundance, Dominance, IVI etc. Relative Frequency, Relative Density and Relative Dominance were calculated by the following formulas (Phillips, 1959, Misra et al. 1956).

Primary data on the biota of the trees, shrubs and herbs in the buffer zone that were encountered during the field assessment and secondary data assessment is as given in earlier stipulated tables. 3.39 tree species were observed in the buffer zone during phyto-sociological studies. Among them phyto-sociological study and quantitative analysis were done for the mainly observed following individual species. Finally, the Importance value Index (IVI) is worked out.

Table: 3.39 Phyto-sociological analysis of the Major Dominant trees of buffer zone

Species Name	R D (%)	R F (%)	R Do (%)	(IVI)	(H')
Acacia leucophloea	25	28	30	83	2.7
Acacia senegal	18	22	25	65	2.45
Albizzia odoratissima	15	18	20	53	2.3
Albizzia procera	12	15	18	45	2.15
Butea monosperma	10	12	15	37	2.05
Bauhinia vareigata	8	10	12	30	1.98
Boswellia serrata	7	8	10	25	1.8
Cassia fistula	6	7	8	21	1.75
Cassia siamea	5	6	7	18	1.65
Madhuca indica	4	5	6	15	1.55

RD= Relative Density; RF= Relative Frequency; RDo= Relative Dominance; IVI= Important value index; H'= Shannon-Weiner Species Diversity Index

Relative Density: *Acacia leucophloea* has the highest relative density (25%), indicating it is the most abundant tree species in the Buffer zone.

Relative Frequency: *Acacia leucophloea* also has the highest relative frequency (28%), meaning it is widely distributed across the Buffer zone.

Relative Dominance: *Acacia leucophloea* has the highest relative dominance (30%), contributing significantly to the total basal area in the Buffer zone.

Importance Value Index (IVI): *Acacia leucophloea* has the highest IVI (83%), indicating its overall ecological importance in Buffer zone.

Shannon-Weiner Species Diversity Index (H'): The Shannon-Weiner Species Diversity Index measures the species diversity in the study area. Higher values indicate greater diversity. ***Acacia nilotica* has the highest diversity index (H' = 2.70)**, suggesting a relatively high level of species diversity in the area.

Acacia leucophloea is the most dominant species in Buffer zone, with the highest IVI, relative density, frequency, and dominance.

Other species like *Acacia senegal* also contribute significantly to the overall forest structure.

The Shannon-Weiner Species Diversity Index (H') shows that the area has a moderate level of species diversity, with ***Acacia** leucophloea* contributing to a higher diversity compared to other species**.**

Butea monosperma

Acacia leucophloea

Madhuca indica

Tectona grandis

Fig: 3.22 Photographs of the observed Flora in Buffer Zone

Agricultural crops, vegetable & fruit cultivations of the study area

Table 3.40 List of Agricultural Crops, Vegetable & Fruit Cultivations

Category	Name	Scientific Name	Season	Remarks
Agricultural Crops	Wheat	*Triticum aestivum*	Rabi (Winter)	Major staple crop
	Barley	*Hordeum vulgare*	Rabi (Winter)	Grown for fodder and food
	Mustard	*Brassica juncea*	Rabi (Winter)	Important oilseed crop
	Gram (Chickpea)	*Cicer arietinum*	Rabi (Winter)	Grown as a pulse crop
	Bajra (Pearl Millet)	*Pennisetum glaucum*	Kharif (Monsoon)	Drought-tolerant staple

	Maize (Corn)	*Zea mays*	Kharif (Monsoon)	Used for food and fodder
	Jowar (Sorghum)	*Sorghum bicolor*	Kharif (Monsoon)	Grown for fodder and grains
	Cotton	*Gossypium hirsutum*	Kharif (Monsoon)	Grown in limited areas
	Soybean	*Glycine max*	Kharif (Monsoon)	Major oilseed crop
	Lentil	*Lens culinaris*	Rabi (Winter)	Important pulse crop
	Groundnut	*Arachis hypogaea*	Kharif (Monsoon)	Oilseed crop
Vegetables	Onion	*Allium cepa*	Rabi & Kharif	Grown widely in the region
	Tomato	*Solanum lycopersicum*	Rabi & Kharif	Grown in small areas
	Brinjal (Eggplant)	*Solanum melongena*	Rabi & Kharif	Commonly cultivated
	Okra (Lady's Finger)	*Abelmoschus esculentus*	Kharif (Monsoon)	Popular summer vegetable
	Potato	*Solanum tuberosum*	Rabi (Winter)	Grown in cooler months
	Green Chilli	*Capsicum annuum*	Rabi & Kharif	Widely used in cooking
	Spinach	*Spinacia oleracea*	Rabi (Winter)	Seasonal leafy vegetable
	Cabbage	*Brassica oleracea var. capitata*	Rabi (Winter)	Grown in cooler months
	Cauliflower	*Brassica oleracea var. botrytis*	Rabi (Winter)	Seasonal vegetable
Fruits	Mango	*Mangifera indica*	Summer	Grown in orchards
	Guava	*Psidium guajava*	Year-round	Popular fruit in the region
	Lemon	*Citrus limon*	Year-round	Grown for juice and pickles
	Banana	*Musa paradisiaca*	Year-round	Limited cultivation
	Pomegranate	*Punica granatum*	Year-round	Drought-tolerant fruit
	Papaya	*Carica papaya*	Year-round	Grown in smaller areas
	Ber (Indian Jujube)	*Ziziphus mauritiana*	Summer	Drought-resistant fruit
	Custard Apple (Sitaphal)	*Annona squamosa*	Summer	Grown in arid areas
	Amla (Indian Gooseberry)	*Phyllanthus emblica*	Winter	Used for medicinal purposes
	Watermelon	*Citrullus lanatus*	Summer	Seasonal fruit

Secondary source: - *Singh, R.B. (2018); Sharma, K.C. (2015); Meena, S.L., & Verma, J.R. (2020);*

Crop of *Allium cepa*

Crop of *Brassica juncea*

Crop of *Cicer arietinum*

Figure:3.23 Photographs of observed Crops in the BZ

C. Others

Table 3.41 Aquatic Flora Reported in the Accessible Study Area

S. No.	Scientific Name	Common Name	Family	Habitat	Ecological Importance
1.	*Nelumbo nucifera*	Indian Lotus	Nelumbonaceae	Ponds, Lakes	Supports aquatic biodiversity, sacred significance
2.	*Typha angustifolia*	Narrow-leaved Cattail	Typhaceae	Marshes, Wetlands	Provides habitat for birds, erosion control
3.	*Eichhornia crassipes*	Water Hyacinth	Pontederiaceae	Lakes, Slow-flowing Rivers	Absorbs pollutants, but invasive in nature
4.	*Hydrilla verticillata*	Hydrilla	Hydrocharitaceae	Freshwater Bodies	Oxygenates water, habitat for aquatic organisms
5.	*Vallisneria spiralis*	Tape Grass	Hydrocharitaceae	Streams, Lakes	Stabilizes sediment, oxygenates water
6.	*Nymphaea nouchali*	Red Water Lily	Nymphaeaceae	Ponds, Lakes	Ornamental, provides shelter for aquatic species
7.	*Ipomoea aquatica*	Water Spinach	Convolvulaceae	Ditches, Marshes	Edible leaves, purifies water
8.	*Azolla pinnata*	Mosquito Fern	Azollaceae	Ponds, Rice Fields	Nitrogen fixation, used as biofertilizer
9.	*Salvinia molesta*	Giant Salvinia	Salviniaceae	Still Water Bodies	Controls algal growth, but invasive
10.	*Potamogeton crispus*	Curly-leaf Pondweed	Potamogetonaceae	Freshwater Lakes	Provides food for waterfowl, habitat for fish

11.	*Lemna minor*	Duckweed	Araceae	Ponds, Still Water	Absorbs nutrients, used in wastewater treatment
12.	*Trapa natans*	Water Chestnut	Lythraceae	Lakes, Slow-moving Rivers	Edible fruits, supports aquatic biodiversity
13.	*Spirogyra spp.*	Filamentous Algae	Zygnemataceae	Freshwater Bodies	Primary producer, base of aquatic food chains

Secondary source: - *Cook, C.D.K. (1996); Subramanyam, K. (1962); Sharma, R.K., & Singh, R.P. (2018); Meena, M.L., & Rathore, J.S. (2020);*

Table 3.42 Phytoplankton Reported/Observed in The Accessible Study Area

S. No	Scientific Name	Common Name	Family	Habitat	Ecological Importance
1.	*Anabaena spiroides*	Blue-Green Algae	Nostocaceae	Freshwater Lakes	Nitrogen fixation, primary producer
2.	*Oscillatoria limosa*	Filamentous Cyanobacteria	Oscillatoriaceae	Ponds, Wetlands	Produces oxygen, supports aquatic food chains
3.	*Microcystis aeruginosa*	Microcystis	Microcystaceae	Eutrophic Water Bodies	Forms algal blooms, potential toxin producer
4.	*Chlorella vulgaris*	Chlorella	Chlorellaceae	Freshwater Ponds	High photosynthetic efficiency, used in biofuel production
5.	*Scenedesmus quadricauda*	Scenedesmus	Scenedesmaceae	Still Water Bodies	Primary producer, supports aquatic ecosystems
6.	*Navicula spp.*	Navicula Diatom	Naviculaceae	Lakes, Rivers	Bioindicator of water quality, primary producer
7.	*Fragilaria crotonensis*	Fragilaria	Fragilariaceae	Freshwater Streams	Contributes to silica cycling, supports zooplankton
8.	*Spirogyra spp.*	Filamentous Green Algae	Zygnemataceae	Ponds, Streams	Produces oxygen, forms mats that shelter aquatic organisms
9.	*Pediastrum simplex*	Pediastrum	Hydrodictyacea e	Freshwater Ponds	Supports aquatic food chains, bioindicator of water quality
10.	*Euglena viridis*	Euglena	Euglenaceae	Polluted Water Bodies	Bioindicator of organic pollution, mixotrophic behavior
11.	*Synedra ulna*	Synedra Diatom	Bacillariaceae	Lakes, Streams	Indicator of nutrient levels, primary producer
12.	*Cyclotella meneghiniana*	Cyclotella Diatom	Stephanodiscace ae	Freshwater Lakes	Important in nutrient cycling, supports zooplankton
13.	*Nostoc commune*	Nostoc	Nostocaceae	Wetlands, Shallow Ponds	Nitrogen fixation, improves soil fertility when submerged

Secondary Source: *Prescott, G.W. (1978); Venkataraman, G.S. (1969); Desikachary, T.V. (1959); Singh, R.P., & Sharma, A. (2017); Meena, M.L., & Rathore, J.S. (2019)*

Table 3.43 Summary of Flora

S. No.	Type Vegetation	Core Zone	Buffer Zone

1.	Trees	22	14
2.	Shrubs	03	06
3.	Herbs Grasses, Climbers	04	09

3.11.5.3 Status of Fauna:

To assess faunal diversity in the field, random sightings were prioritized, and various observation techniques were employed as outlined in the study methodology. Avian fauna were surveyed through multiple field trials conducted in and around the core and buffer zones, primarily during early mornings and late afternoons. Amphibians were located near paddy fields, other agricultural areas, stagnant water bodies, and along perennial and seasonal streams. Reptiles were searched by lifting stones, inspecting rock crevices, and examining wall spaces in structures.

During the random surveys, interactions with local residents and direct sightings revealed that due to the area's village setting, combined with ongoing commercial, agricultural, and residential activities, along with frequent vehicle and human movement, the chance of encountering many animals has diminished. The faunal diversity observed in both the core and buffer zones is tabulated below, with species specific to the core zone clearly marked.

Table 3.44 Fauna of core zone

S.No.	Common Name	Scintific Name	Family	W(P)AA -2022
Mammals				
1.	Five stripped palm squirrel	*Funambulus pennantii*	Sciuridae	II
2.	Common House rat	*Rattus rattus*	Muridae	IV
Avifauna				
3.	Brown Rock Chat	*Cercomela fusca*	Muscicapidae	II
4.	Common Myna	*Acridotheres tristis*	Sturnidae	II
5.	House sparrow	*Passer domesticus*	Passeridae	II
6.	Jungle Babbler	*Turdoides striata*	Timaliidae	II
7.	Indian Ring Dove	*Streptopelia decaocto*	Columbidae	II
8.	Rock Pigeon	*Columba livia*	*Columbidae*	II
9.	House crow	*Corvus splendens*	*Corvidae*	II
Herpetofauna				
10.	Common House Gecko	*Hemidactylus frenatus*	*Gekkonidae*	-
11.	Garden Lizard	*Calotes versicolor*	*Agamidae*	-

Mammals:

Table 3.45 Fauna-Mammals reported in the study area

S.No.	Common Name	Scintific Name	Family	W(P)AA -2022
1	Mongoose / Neola	*Herpestes edwardsi*	Herpestidae	I
2	Five stripped palm squirrel	*Funambulus pennantii*	Sciuridae	II
3	Striped Hyaena	*Hyaena hyaena*	Hyaenidae	I
4	Buffalo or Domestic Asian water buffalo	*Bubalus bubalis*	Bovidae	IV
5	Common House rat	*Rattus rattus*	Muridae	IV
6	Indian porcupine	*Hystrix indica*	Hystricidae	I
7	Blue Bull / Nilgai	*Boselaphus tragocamelus*	Bovidae	II
8	Grey Musk Shrew	*Suncus murinus*	Soricidae	II
9	Indian Hare	*Lepus nigricollis*	Leporidae	II
10	Indian field mouse	*Mus booduga*	Muridae	IV
11	Indian Hedgehog	*Paraechinus micropus*	Erinaceidae	II
12	Indian Camel	*Camelus bactrianus*	Camelidae	IV
13	Jackal	*Canis aureus*	Canidae	I
14	Indian fox	*Vulpes bengalensis*	Canidae	I
15	Jungle cat	*Felis chaus*	Felidae	I
16	Common Langur	*Presbytis entellus*	Cercopithecidae	IV
17	Black buck	*Antilope cervicapra*	Bovidae	I
18	Wild pig	*Sus scrofa*	Suidae	II

Five stripped palm squirrel

Blackbuck

Common Langur

Figure:3.24 Photographs of observed Mammals in the Buffer Zone

Birds:

Total 20 bird's species reported in the buffer area, six species seen in buffer zone only is a schedule I species as per the Wildlife (Protection) Act, 1972 (Amendment-2022). In the buffer zone any RET (Rare, Endangered and Threatened) species of flora/fauna are not found either in core zone or buffer zone based on both the primary survey and on the reliable secondary data.

Table 3.46 Fauna-Birds reported in the study area

S.No.	Common Name	Scintific Name	Family	Status W(P)AA -2022
1	Indian Black *Drongo*	*Dicrurus macrocercus*	*Dicruridae*	II
2	Brown Rock Chat	*Cercomela fusca*	*Muscicapidae*	II

3	Indian Cuckoo	*Cuculus micropterus*	*Cuculidae*	II
4	Crow Pheasant	*Centropus sinensis*	*Cuculidae*	II
5	Common Myna	*Acridotheres tristis*	*Sturnidae*	II
6	Indian roller	*Coracioas Bengalensis*	*Coraciidae*	II
7	House sparrow	*Passer domesticus*	*Passeridae*	II
8	Jungle Babbler or seven sister	*Turdoides striata*	*Timaliidae*	II
9	*Cattle Egret*	*Bubulcus ibis*	*Ardeidae*	II
10	Oriental Magpie robin	*Copsychus saularis*	*Muscicapidae*	II
11	Rose-Ringed Parrot	Psittacula krameri	*Psittacidae*	II
12	Common Babbler	Turdoides caudata	*Timaliidae*	II
13	Indian Ring Dove	*Streptopelia decaocto*	*Columbidae*	II
14	Common Kingfisher	*Alcedo atthis*	*Alcedinidae*	II
15	Common Bulbul	*Pycnonotus barbatus*	*Pycnonotidae*	II
16	Indian Robin	*Saxicoloides fulicatus*	*Muscicapidae*	II
17	Jungle Crow	*Corvus macrorhynchos*	*Corvidae*	II
18	Rock Pigeon	*Columba livia*	*Columbidae*	II
19	House crow	*Corvus splendens*	*Corvidae*	II
20	Peafowl	*Pavo cristatus*	*Phasianidae*	I

Egret

Oriental Magpie robin

	
Indain Roller	**Indian peafowl**
	
Indian robin	**Rose ringed parakeet**
	
Common kingfisher	**Indian Ring dove**

Figure: 3.25 Photographs of observed birds in the Buffer Zone

Reptiles:

Table 3.47 Fauna-Herpetofauna reported in the study area

S.No.	Common Name	Scintific Name	Family	W(P)AA -2022
Amphibian				
1	Microhyla ornate	*Microhyla ornata*	*Microhylidae*	-
2	Common Indian Toad	*Duttaphrynus melanostictus*	*Bufonidae*	-
3	Indian Bullfrog	*Hoplobatrachus tigerinus*	*Ranidae*	II
Reptiles				
1	Indian sand boa	*Eryx johnii*	*Boidae*	I
2	Common House Gecko	*Hemidactylus frenatus*	*Gekkonidae*	-
3	Garden Lizard	*Calotes versicolor*	*Agamidae*	-
4	Yellow-Green House Gecko	*Hemidactylus flaviviridis*	*Agamidae*	-
5	Keeled Indian Mabuya or golden skink	*Mabuya carinata*	*Scincidae*	-
6	Common Rat Snake	*Ptyas mucosus*	*Colubridae*	I
7	Russell's viper	*Daboia russelii*	*Viperidae*	I

Table 3.48: Summary of Fauna

S.No.	Types of Fauna	Core Zone	Buffer Zone
1.	**Mammals**	02	18
2.	**Birds**	7	20
3.	**Herpetofauna**	02	10

Figure: 3.26 Night survey for Nocturnal Fauna

Figure: 3.27 Survey for Waterfowl

Table: 3.49: List of Schedule-I species as per the WPAA- 2022

S. No.	Common Name	Scientific Name
1.	Blackbuck	*Antilope cervicapra*
2.	Indian Grey Mongoose	*Herpestes edwardsii*
3.	Striped Hyaena	*Hyaena hyaena*
4.	Indian porcupine	*Hystrix indica*
5.	Indian Fox	*Vulpes bengalensis*
6.	Jackal	*Canis aureus*
7.	Jungle Cat	*Felis chaus*
8.	Indian peafowl	*Pavo cristatus*
9.	Indian sand boa	*Eryx johnii*
10.	Common Rat Snake	*Ptyas mucosus*
11.	Russell's Viper	*Daboia russelii*

**As per the Forest Working Plan, Baran (2013-14 to 2022-23*

3.12 SOCIO-ECONOMIC ENVIRONMENT

3.12.1 Objective

The socio-economic baseline data of the study area is discussed in this section. The other objectives are as follows:

- To study the socio-economic status of the people living in the study area of the proposed project.
- To assess the impact on socio-economic environment due to proposed expansion project
- To assess the impact of the project on State Gross Domestic Product (SGDP).
- To evaluate the community development measures proposed to be taken up by the project proponent, if any.
- To suggest community development measures needs to be taken for the study area.

3.12.2 Methodology

S.No.	Collection of data:	With Effect From:
Secondary Sources		
I	Census of India, 2011	Latest Update available from 2011 & extrapolated up-to 2024*
II	Minimum Wages Act, 1948 Minimum Wage in Rajasthan	Latest Update available dated w.e.f. January 1, 2023 to September 30, 2023
III	RFCTLARR Act 2013	Not applicable
IV	Protected Monuments List	1/07/2017 latest update www.asi.nic.in
Primary Sources		Method / Technique
Field observations		Transect walk

Extensive site-specific survey:	Non-Probability Random Sampling Target sample of people interviewed
Manner and the order of Questions:	Open Questions
Survey period:	1 Sub-round / per monitoring season
Type:	Urban – Rural mix frame Survey

Rajasthan:-

Rajasthan has a total population of 68,548,437 people, according to the 2011 Indian Census. The population increased by 21.2 percent from 56.5 million in 2001. Males outnumbered females in 2011, with a gender ratio of 0.928 females for every one male. In Rajasthan in 2011, 45.57 percent of workers were cultivators, 17.53 percent were farm labourers, and 2.41 percent worked in the household industry. In terms of religion, Hindus account for 88.49 percent of the population in Rajasthan. Muslims make up 9.07 percent of the population, Sikhs 1.27 percent, and Jains 0.91 percent. Rajasthan's literacy rate was 67.06 percent (80.51 percent male and 52.66 percent female). While Rajasthan's literacy rate is lower than the national average of 74.04 percent, and its female literacy rate is the lowest in the world, the state has been lauded for its efforts and accomplishments in increasing literacy rates. The literacy rate in Rajasthan's rural areas is 76.16 percent for males and 45.8 percent for females.

District Baran

Baran district has eight tehsils, in which Shahbad tehsil has the highest number of villages (236) whereas Baran tehsil has lowest number of villages (92). 20.79 percent lives in urban regions of district. In total 2,54,214 people lives in urban areas of which males are 1,31,717 and females are 1,22,497. Sex Ratio in urban region of Baran district is 930 as per 2011 census data. Similarly child sex ratio in Baran district was 901 in 2011 census. Child population (0-6) in urban region was 33,771 of which males and females were 17,769 and 16,002. This child population figure of Baran district is 13.49 % of total urban population. Average literacy rate in Baran district as per census 2011 is 77.97 % of which males and females are 87.77 % and 67.48 % literates respectively. In actual number 1,71,884 people are literate in urban region of which males and females are 1,00,016 and 71,868 respectively.

Tehsil Atru

Atru, located at 22.35° N latitude and 82.73° E longitude in Rajasthan, India, is a significant commercial center in the state. As per the 2011 Indian Census, Atru has a population of 1,206,640, with 51% males and 49% females. Approximately 14% of the population is under the age of 6.

The town boasts an average literacy rate of 72.37%, higher than the national average of 70.28%, with 80.27% male literacy and 60.24% female literacy. Atru is particularly known for its prominent role in the coal and power industries, hosting several thermal power plants that play a crucial part in the region's economic growth and electricity generation.

Additionally, Kawai, another key location in Rajasthan, is known for its concentration of power generation facilities, particularly thermal power plants, which significantly contribute to the state's energy supply and economic development

.

3.12.3 Demographic composition:

The study area is of 10.0 km from the project location. The list of villages falling in the study area is 117 villages/urban area, the segregation is present in Table 3.50 into the following manner:

31 villages/urban are falling are from 0.0 km to 2.0 km radius boundary

24 villages/urban are falling are from 2.0 km to 5.0 km radius boundary

62 villages/urban are falling are from 5.0 km to 10.0 km radius boundary

The villages in the 10.0 km of the study area from the project site are given in Table no. 3.50

Table 3.50 Villages in Study Area

S. No	Villages & distance from the project		
	0-02 km	03-05 km	06-10 km
1	Ambapura	Alampura	Ajnawar
2	Baldevpura	Anandpura	Antana
3	Barlan	Atru	Balharpur
4	Bhakhravda	Baraodi	Bamori
5	Bherupura	Dilod Hathi	Banpur
6	Bilkhera	Ghaghonya	Baravda
7	Chhatarpura	Halgana	Barsodiya
8	Dara	Kachhawan	Berkya
9	Dilod	Kesholi	Bhagwanpura
10	Hanihera	Kherlivasla	Bhaunra
11	Kanchanpura	Kunda	Bheranpura
12	Kanwarpura	Mawasa	Byaskheri
13	Karikhera	Modari	Charpura
14	Kawai	Mundla	Chenpura
15	Kherli Gaddiyan	Musai Gujran	Dadwara
16	Kolukhera	Musenmata	Digdoli_(MP)
17	Lolaheri	Nayapura	Gandoliya
18	Maharajpura	Panduheli	Ganeshpura
19	Moakhera	Rampura	Gangotri_(MP)

20	Narsinghpura	Salpura	Gobindpura
21	Nayagaon	Simlod	Gorakhpura
22	Nimoda	Sripura	Hanuvatkhera
23	Parlya	Ugrapura	Haripura
24	Patna	Umedganj	Jharkhand
25	Ranipura		Kachra
26	Sagora		Kachri
27	Shekharpur		Kadili
28	Solaheri		Kansal
29	Soni		Karaiyavan
30	Tigri		Kasimpura
31	Umarthana		Kerwaliya
32			Khalda
33			Khaldi
34			Kharkhara
35			Kheri
36			Kherla
37			Kherli
38			Kherli Nahariya
39			Khermodari
40			Khonpur
41			Kishanpura
42			Kohni
43			Kotri
44			Lakhanakheri
45			Lakshmipura
46			Lekdiyai
47			Maheshpura
48			Mirwara_(MP)
49			Modya_(MP)
50			Mothpur
51			Motipura
52			Nalkheri
53			Narayanpura
54			Nathmodari
55			Rajpura
56			Ratanpura
57			Rijha
58			Ruppura
59			Sigri
60			Sojatpura
61			Tancha
62			Tanchi

*Source: *Census of India, 2011 & extrapolated up to 2024**

3.12.4 Population:

In the study area, there are 20,014 households. The total population falling in the project area is 1,01,964 in 10 km radius. The total male population consists of 51.89% and female population accounts to be 48.11% of the total population. The sex ratio of the 10.0 km study area is 927 females over thousand males. There are approx 4 to 5 members in a family. The 0-6 population comprises of 14.82% of the total population of the study area. The sex ratio of 0-6 population is 898 females over thousand males.

Table 3.51: Population & Literate

Sr. No.	Village	Population			Literacy		Illiterates		ST Total		SC Total		Total Worker	Main Worker	Marg Worker	Non Worker
		Male	Female	0-6 total	Male	Female	Male	Female	Male	Female	Male	Female				
1	Ajnawar	1107	980	310	692	316	415	664	416	367	160	147	1144	896	248	943
2	Alampura	189	174	52	121	51	68	123	158	151	2	1	205	106	99	158
3	Amapura	301	298	91	224	161	77	137	257	248	32	37	324	113	211	275
4	Anandpura	170	142	52	110	50	60	92	39	33	0	0	191	92	99	121
5	Antana	938	834	216	754	498	184	336	0	0	276	221	1021	475	546	751
6	Atru (CT)	5818	5323	1430	4271	2953	1547	2370	528	466	1496	1429	3759	2875	884	7382
7	Baldeopura	335	297	78	248	120	87	177	257	227	41	36	370	365	5	262
8	Balharpur	234	250	101	126	104	108	146	231	247	1	1	239	238	1	245
9	Bamori	666	625	157	520	354	146	271	117	119	91	70	807	391	416	484
10	Banpur	304	247	70	209	129	95	118	64	58	75	56	307	161	146	244
11	Barawada	467	414	135	336	140	131	274	103	86	174	154	433	239	194	448
12	Barlan	440	398	104	331	191	109	207	233	213	96	86	416	194	222	422
13	Barodiya	340	341	115	197	96	143	245	176	181	11	15	186	176	10	495
14	Berakya	172	170	34	140	83	32	87	8	6	37	35	174	78	96	168
15	Bhagwanpura	471	395	122	353	193	118	202	205	171	83	60	542	233	309	324
16	Bhakhrawada	91	107	22	69	64	22	43	5	4	11	8	74	37	37	124
17	Charpura	402	395	179	200	85	202	310	0	0	0	0	409	53	356	388
18	Chhatrapura	548	528	133	444	261	104	267	455	440	68	66	543	244	299	533
19	Dadwara	270	265	63	210	133	60	132	260	256	5	5	352	127	225	183
20	Dara	412	392	118	304	182	108	210	76	75	97	86	443	163	280	361
21	Deelod Hathi	964	852	241	646	345	318	507	225	199	192	163	568	403	165	1248
22	Deeloda	510	460	149	343	211	167	249	23	19	159	156	404	347	57	566

23	Digdoli	530	527	260	182	162	348	365	518	512	0	0	441	211	230	616
24	Gandhotri	19	13	4	18	10	1	3	0	0	0	0	9	9	0	23
25	Gandoliya	579	550	158	439	277	140	273	12	10	286	271	623	49	574	506
26	Ganeshpura	382	395	148	244	155	138	240	177	180	48	56	466	60	406	311
27	Ghaghonia	254	237	62	171	109	83	128	21	26	83	79	264	254	10	227
28	Gorakhpura	107	87	22	87	37	20	50	0	0	39	29	120	96	24	74
29	Halgana	346	302	93	261	159	85	143	45	49	70	51	337	152	185	311
30	Hani Hera	526	472	128	341	221	185	251	15	10	186	176	604	230	374	394
31	Hanuwat Khera	379	364	97	275	160	104	204	149	151	84	67	372	253	119	371
32	Haripura	367	305	77	291	149	76	156	227	188	76	59	254	134	120	418
33	Kachara	534	523	156	397	256	137	267	102	106	138	126	513	278	235	544
34	Kachhawan	273	233	111	172	85	101	148	103	89	20	18	238	237	1	268
35	Kachri	643	583	214	436	290	207	293	242	214	156	137	617	232	385	609
36	Kadeeli	424	386	156	186	110	238	276	0	0	14	8	483	427	56	327
37	Kansal	295	275	74	190	132	105	143	31	25	81	69	360	136	224	210
38	Kanwarpura	362	320	114	195	116	167	204	206	198	1	5	314	239	75	368
39	Kari Kheri	96	84	23	75	40	21	44	2	3	0	0	46	46	0	134
40	Karmodiya	329	341	121	225	197	104	144	0	0	26	24	321	291	30	349
41	Kashi Pura	212	204	52	153	96	59	108	105	96	4	2	213	207	6	203
42	Kawai (CT)	4943	4544	1378	3636	2406	1307	2138	270	266	1344	1292	3498	2638	860	5989
43	Kerwaliya	654	629	153	505	292	149	337	36	28	127	135	628	226	402	655
44	Kesholi	228	206	46	152	96	76	110	23	23	73	62	279	199	80	155
45	Khalda	390	373	89	261	141	129	232	105	108	130	122	349	342	7	414
46	Khaldi	253	227	58	195	126	58	101	176	165	14	15	263	225	38	217
47	Khankhara	385	360	114	251	164	134	196	249	245	29	24	378	137	241	367
48	Kheri	747	689	216	506	200	241	489	319	292	53	43	823	328	495	613
49	Kherla	263	266	95	110	56	153	210	231	242	0	0	272	272	0	257

50	Kherli	379	355	111	274	169	105	186	46	43	30	38	372	125	247	362
51	Kherli Bansla	451	452	146	315	214	136	238	97	91	66	63	361	300	61	542
52	Kherli Gaddiyan	428	385	142	329	227	99	158	6	8	61	51	413	110	303	400
53	Kherli Naharya	293	278	83	210	108	83	170	150	131	43	43	320	131	189	251
54	Khopar	508	486	168	353	214	155	272	0	0	140	152	549	296	253	445
55	Kishanpura	622	585	186	418	217	204	368	17	16	103	80	917	812	105	290
56	Kohni	769	671	166	619	324	150	347	24	28	120	114	637	447	190	803
57	Koloo Khera	605	523	171	446	293	159	230	39	28	76	78	300	288	12	828
58	Kotri	692	589	171	493	277	199	312	21	25	250	199	775	387	388	506
59	Kundi	1289	1260	398	922	521	367	739	212	193	204	188	1174	614	560	1375
60	Lakha Kheri	309	283	88	187	112	122	171	208	183	5	9	260	228	32	332
61	Laxmipura	403	388	136	234	158	169	230	212	218	26	32	325	319	6	466
62	Lolaheri	233	208	61	150	87	83	121	143	131	54	44	245	160	85	196
63	Mahesh Pura	303	263	122	195	110	108	153	52	42	198	169	244	211	33	322
64	Mawasa	552	508	148	426	229	126	279	7	4	225	214	556	319	237	504
65	Mirwada	192	173	73	53	46	139	127	2	3	0	0	158	74	84	207
66	Motipura	316	271	99	220	101	96	170	25	20	58	51	296	288	8	291
67	Mundala	362	380	118	271	188	91	192	167	166	63	78	339	172	167	403
68	Musai Gujran	745	725	214	546	266	199	459	18	14	222	219	617	339	278	853
69	Musen Mata	462	430	115	370	241	92	189	318	293	96	91	443	392	51	449
70	Nalkheri	347	292	103	273	162	74	130	56	52	27	13	373	252	121	266
71	Narayanpura	234	250	73	170	115	64	135	4	3	33	35	214	109	105	270
72	Narsinghpura	682	636	273	366	158	316	478	17	13	10	9	419	166	253	899
73	Naya Pura	313	299	167	84	19	229	280	313	299	0	0	186	153	33	426
74	Nayagaon	504	450	125	345	200	159	250	481	429	15	13	496	480	16	458
75	Neemoda	361	302	112	232	96	129	206	86	58	21	23	235	75	160	428

76	Panduheri	129	115	29	88	65	41	50	21	18	24	17	146	84	62	98
77	Patna	1139	994	259	844	489	295	505	361	293	186	176	1104	863	241	1029
78	Rajpura	436	434	124	311	175	125	259	25	20	45	44	477	466	11	393
79	Rampuriya	330	305	112	133	44	197	261	326	304	4	1	396	332	64	239
80	Ranipura	99	96	25	32	14	67	82	99	96	0	0	101	38	63	94
81	Ratanpura	2001	1916	651	1263	761	738	1155	159	144	704	663	1522	808	714	2395
82	Reenjha	206	181	43	177	87	29	94	23	24	53	51	151	146	5	236
83	Rooppura	399	351	96	309	179	90	172	10	9	79	74	372	267	105	378
84	Salpura	394	376	107	267	171	127	205	57	50	131	136	439	204	235	331
85	Sangora	291	262	89	188	108	103	154	4	2	142	124	314	124	190	239
86	Shahupura	710	674	172	558	390	152	284	0	0	144	113	688	376	312	696
87	Shripura	634	669	224	354	204	280	465	81	93	24	22	746	386	360	557
88	Sigri	234	209	65	167	94	67	115	21	15	5	3	246	59	187	197
89	Simlod	546	490	174	345	156	201	334	202	208	35	30	502	163	339	534
90	Sodalheri	237	223	91	138	74	99	149	168	153	13	10	223	156	67	237
91	Soni	233	212	79	170	77	63	135	165	155	20	20	211	56	155	234
92	Tancha	1073	1013	276	799	466	274	547	57	57	263	258	1040	722	318	1046
93	Tanchi	597	576	158	438	262	159	314	42	51	131	134	619	534	85	554
94	Teegri	245	255	84	180	121	65	134	17	18	68	95	245	86	159	255
95	Ugrapura	193	193	74	131	65	62	128	66	63	67	71	203	105	98	183
96	Umar Thana	353	333	106	270	207	83	126	258	222	63	73	357	320	37	329
97	Ummedganj	409	352	110	305	140	104	212	311	289	16	6	447	280	167	314
98	Barsodiya	**Data not Available**														
99	Bhaunra	**Data not Available**														
100	Bheranpura	**Data not Available**														
101	Bherupura	**Data not Available**														
102	Byaskheri	**Data not Available**														
103	Chenpura	**Data not Available**														

104	Gobindpura	**Data not Available**														
105	Jharkhand	**Data not Available**														
106	Kanchanpura	**Data not Available**														
107	Karaiyavan	**Data not Available**														
108	Khermodari	**Data not Available**														
109	Lekdiyai	**Data not Available**														
110	Maharajpura	**Data not Available**														
111	Moakhera	**Data not Available**														
112	Modari	**Data not Available**														
113	Mothpur	**Data not Available**														
114	Nathmodari	**Data not Available**														
115	Parlya	**Data not Available**														
116	Sojatpura	**Data not Available**														
117	Shikarpura	**Data not Available**														
TOTAL (upto 2011 Census)		**52911**	**49053**	**15108**	**36770**	**22163**	**16141**	**26890**	**12394**	**11567**	**36770**	**22163**	**47769**	**29736**	**18033**	**54195**
TOTAL (upto 2024 Census)		**93044**	**86260**	**26567**	**64660**	**38974**	**28384**	**47286**	**21795**	**20341**	**18556**	**17284**	**84002**	**52291**	**31711**	**95302**

***Source:** *Census of India, 2011 & extrapolated up to 2024**

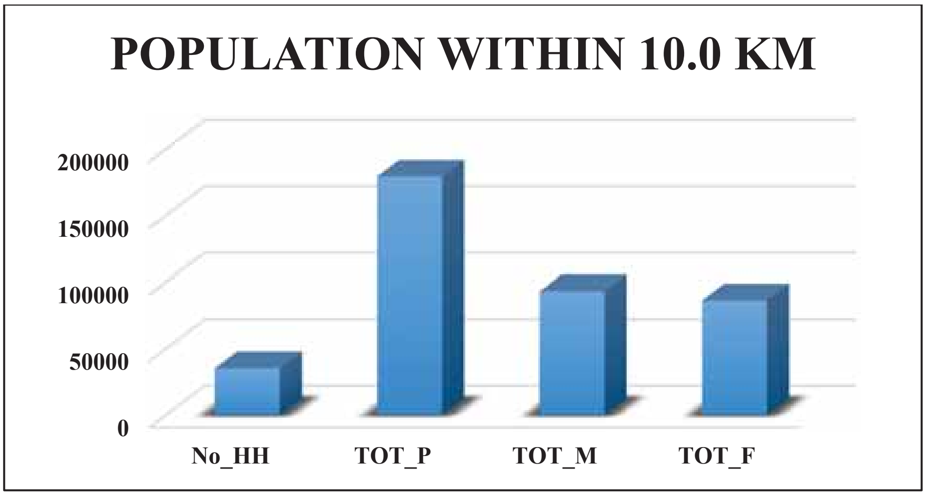


Figure 3.28 Total Population within 10.0 km from Project Site

3.12.5 Social Structure:

In the study area, Schedule Caste population is 29.98% which is 35,840 of the total population. The males are 19.94 % of the total male population and females account for 20.04 % of the total female population. The sex ratio of SC population is 931.50 females over thousand males. In the study area, Schedule Tribe population is 23.50% which is 42,135 of the total population. The males are 23.42 % of the total male population and females account for 23.58 % of the total female population. The sex ratio of ST population is 933 females over thousand males. Fig. 3.20 Schedule Caste & Schedule Tribe within 10.0 km of the study area.

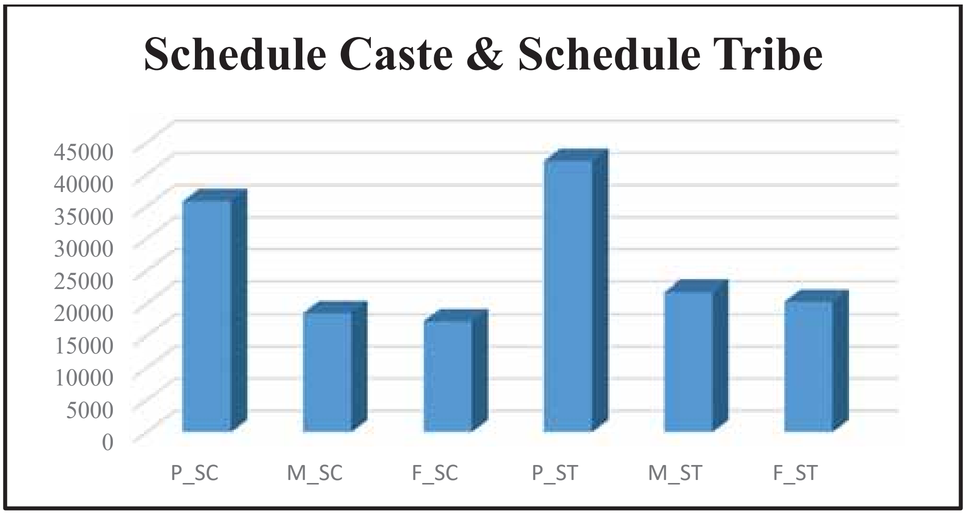


Figure 3.29 Schedule Caste & Schedule Tribe within 10.0 km of the study area

3.12.6 Literacy Status of The Study Area:

Persons aged seven years and above, who can both read and write with understanding in any language, are considered literate. In the study area, the literate people are 1,03,634 which is 57.80% of the total population. The male literates are 69.49% of the total male population, and female literates are 45.18 % of the total female population. In the study area, the illiterate people are 75,670 which is 42.20 % of the total population. The male illiterates are 30.50% of the total male population, and female literates are 54.81% of the total female population.

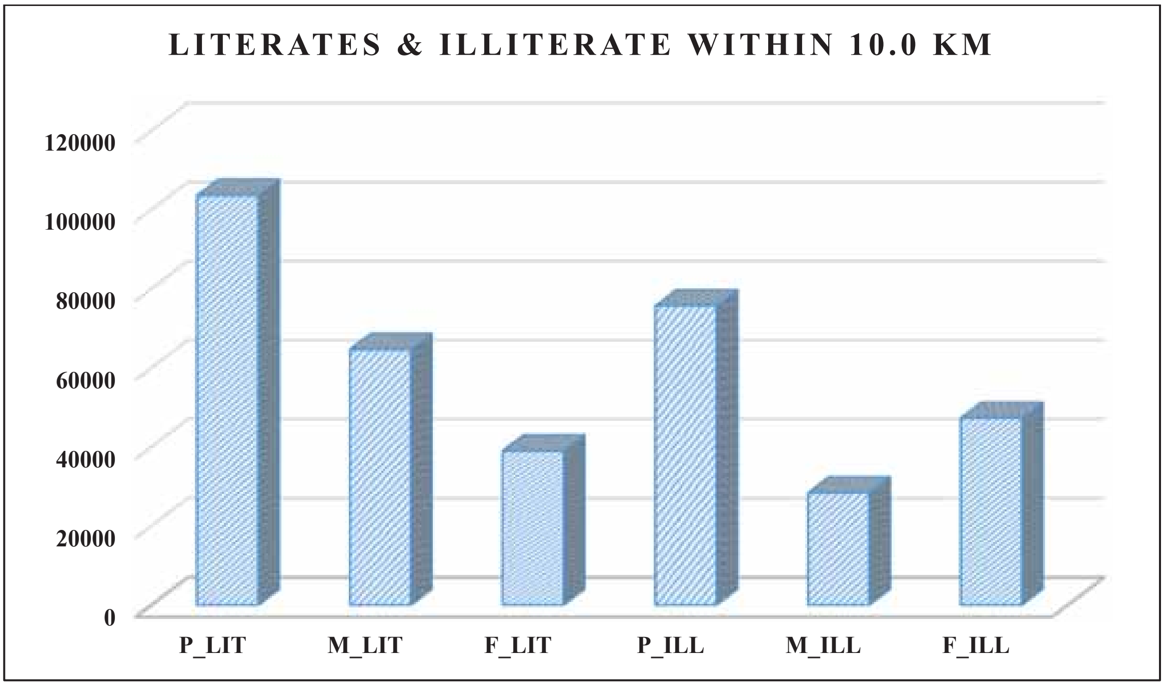


Figure 3.30 literates & Illiterate within 10.0 km of the Study area

3.12.7 Worker's Profile & Occupational Structure:

The work participation in the study area is 84,002 which accounts to be 46.85 % of the total population. The male work participation is 52.17 % with respect to male population and female work participation accounts to be 41.11 % with respect to female population in the study area.

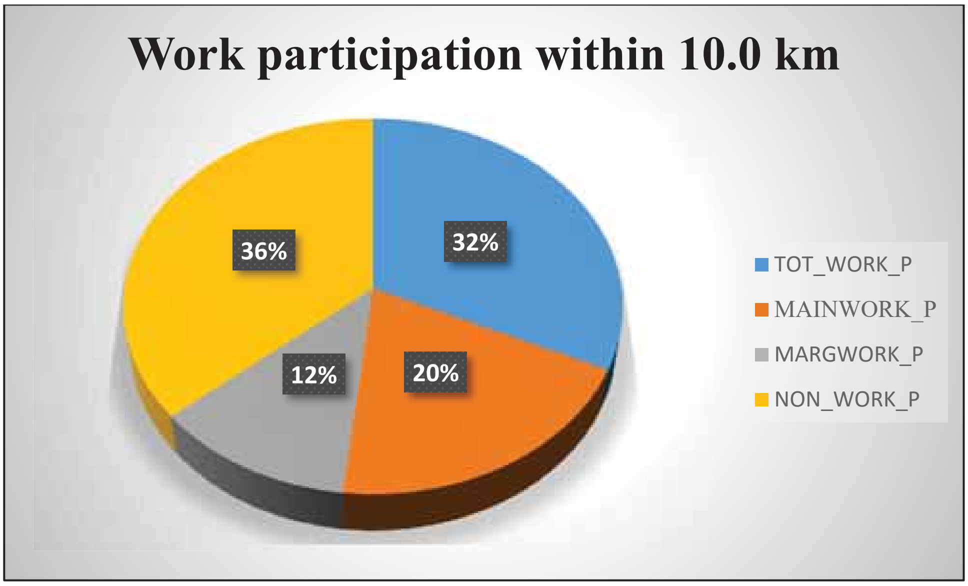


Figure 3.31: Work participation within 10.0 km of the Study area

The main work participation is 62.00 % and marginal work participation is 37.75 % of the total working population. Further analysis of data has revealed that there exists total male dominancy of 52.17% in main work participation. Marginal work participation shows total female and total male dominancy which is 32.81% while marginal male work participation is 17.56%. The males are working in the nearby small industries, agriculturist, labourers, etc as main workers. Women on the other hand work as marginal workers due to their occupancy in household and domestic chores. Women work mostly as marginal cultivators in their fields.

3.12.8 Housing Pattern:

The housing pattern in Kawai and surrounding villages of Baran, Rajasthan reflects the cultural, climatic and economic characteristics of the region. Kawai, located in the south-eastern part of Rajasthan, is a semi-rural area where most of the houses are made of mud or brick walls. There are also some concrete houses in rural areas. Various materials used for walls include mud/unbaked bricks, stone, baked bricks, etc. Traditional architecture is still common, although urbanization is gradually influencing housing styles.

3.12.9 Health (Medical):

Primary government hospitals are available in most villages and for high level treatment, hospitals are available in Kawai or tehsil area. All modern equipment's like X-ray, ECG machine, dental unit etc. are available in these hospitals. Benefits of Chiranjivi Yojana and other government schemes are also available in these hospitals. Child health center is also attached to this hospital.

3.12.10 Education:

Most of the villages have primary schools and all these have separate educational facilities under these columns. Nursery/LKG/UKG classes are included in pre-primary schools, classes upto class 5 are included in primary school; classes from VI to VIII are included in middle school. Classes from IX and X are included in secondary school. Classes from XI and XII are included in senior secondary school. In case of combined schools like primary school with middle school or middle school with secondary school, these are also included in the number of primary and middle schools respectively. Complete educational institutions information is given under these columns.

Table 3.52: Details of Primary, Middle and Secondary Schools

Sr.No.	Name of CD Block	Total number of inhabited villages	Type of educational institutions available			
			No school	At least one primary school and no middle school	At least one primary school and one middle school	At least one middle school and one secondary school
1	Antah	152	39	43	70	41
2	Baran	90	22	15	53	26
3	Atru	141	46	38	57	33
4	Kishanganj	190	73	60	57	25
5	Shahbad	177	93	26	58	23
6	Chhabra	188	90	49	49	25
7	Chhipabarod	176	62	54	60	27
Total		**1114**	**425**	**285**	**404**	**200**

*Source: *District Census Handbook (DCHB) 2011*

3.12.11 Cropping Pattern/ Agriculture:

Baran district, located in the south-eastern part of rajasthan, is an important agricultural region, where a wide variety of crops are grown, owing to its irrigation facilities and favorable climatic conditions for certain types of crops. The economy of the district is primarily agricultural, with agriculture being the main source of livelihood for a large part of its population. Agriculture is an important part of the economy in Baran district, and it depends heavily on the irrigation resources of the region. Wheat, maize, pulses, oilseeds and fruits such as guava and pomegranate form the backbone of agricultural production in the district.

Total Cultivated Area: The total cultivable area in Baran district was about 2.04 million acres (827,700 hectares). This figure includes land used for cultivating both food and cash crops across the district.

Crops: The main crops grown in Baran include wheat, maize, pulses, Groundnut (Peanut), and gram. Wheat is the primary crop, given the region's favorable conditions for paddy cultivation.

Irrigation: Baran has seen an increase in irrigation through canals, tubewells, and ponds. The availability of irrigation water has helped diversify the cropping pattern and made agriculture more sustainable. The Kalisindh River and its canals are the main sources of irrigation in the region, enabling the cultivation of crops beyond rain-fed farming.

Area Sown: The net sown area represents the land that has been used for crop cultivation during a given agricultural season. Baran district has a significant area under cultivation, with various crops like wheat, maize, pulses, oilseeds, and fruits such as guava and pomegranate. A substantial part of the cultivated area is irrigated, especially through sources like canals, tube wells, and rainwater harvesting systems.

3.12.12 Transport and communication network:

Road: National Highway 27 (NH 27): This major highway passes through Baran, connecting it to important cities like Jaipur (capital of Rajasthan) and Jabalpur (in Madhya Pradesh). NH 27 is crucial for inter-state connectivity and the movement of goods and people. State Highways: Baran is connected to other parts of Rajasthan through a network of state highways that facilitate regional connectivity to neighboring districts like Kota, Jhalawar, and Bundi.

District Roads: Baran has a substantial number of rural roads that connect rural areas of the district to towns and cities. These roads are vital for activities, allowing farmers to transport their produce to local markets. Both paved and unpaved roads are common, especially in the more remote rural areas, although more efforts are being made to improve these roads.

Public Transport: Public bus services connect Baran to neighboring towns, cities, and rural areas. The Rajasthan State Road Transport Corporation (RSRTC) runs buses connecting Baran to cities such as Jaipur, Kota, Bundi, and other parts of Rajasthan. Local buses serve various villages in Baran, providing essential transportation for daily commuting activities.

Rail: Baran is well connected by rail; its main railway station is located at Baran. The station is part of the Western Railway zone and connects Baran to major cities like Jaipur, Kota, Mumbai, and Delhi. Rail connectivity is particularly important for transporting agricultural produce, cement, and other commodities to larger markets. Kota Junction Located about 80 km from Baran, Kota is a major railway hub and is well connected to other parts of the country. Many passengers and goods are transited through Kota for wider national connectivity.

3.12.13 Post, Telegraph & Telephones:

Post Offices: Baran district of Rajasthan has a network of post offices that cater to the needs of both urban and rural populations. These post offices offer a wide range of services, including mail handling, savings accounts, money orders and insurance, as well as services from India Post Payments Bank (IPPB).

Types of Post Offices: Postal services in Baran District are an essential part of the communication and financial network, connecting rural and urban populations, facilitating the delivery of mail, goods, and services, and promoting financial inclusion. With an expanding range of services, including banking, insurance, and digital transactions, the postal network plays a key role in the district's development and offers considerable opportunities for future growth.

Sub Post Offices: These are smaller branches spread across the district, serving various towns and villages.

Branch Post Offices: These are located in more remote areas and provide basic postal services.

Postal Services: Baran has a number of post offices spread across the district, providing services like mail delivery, banking, and government-related functions. These post offices also serve as important communication points for rural residents. Private courier services are also available, though they are more commonly used for business and urban-to-urban communication.

E-Commerce and Logistics: The post offices also facilitate e-commerce deliveries and provide logistics support to online retailers, especially in the rural areas of the district. Entire area of the district is connected with STD and Fax facilities.

3.12.14 Primary Survey:

Methodology used for the Field Survey

In order to access and evaluate likely impacts arising out of any development projects on socio-economic environment, it is necessary to gauge the apprehensions of the people in the study areas.

Methodology applied for selection of sample & data collection

The methodology which is applied for primary source of data collection i.e. gathering data through field survey for socio-economic environment.

Table 3.53: Methodologies applied for gathering data through field survey

Step by step working / process	Type	Main participants

Individual/ Settlement	Household survey/ FGD	People including those are impacted directly or indirectly Local People Stockholders
Govt. office	Discussion	Panchayat office, Govt. School, PHCs (Public Health Center), Khoddal, Darrabhata and many more villages, Korba.

Site Visit

A site visit was done by Gaurang Environmental Solutions Private Limited (GESPL) consultant for socio-economic studies from 09/12/2024 to 14/12/2024 for 6 days. The survey team performed the survey in villages with a socio-economic study format. In the study area, the city was chosen by random sampling for a socio-economic survey.

Table 3.54: Sampling location for Socio-economic Survey

Sr. No.	Survey Area	Particular
1	Nimoda, Tigri, Sodalhedi Amapura, Dara, Dilod, Salpura, Kawai & Kherli Gaddiyan	Govt school, Public Health Centre, Parished Office and FGD (focus group Discussion)

Sampling Method

Conducting a socio-economic survey in a specific region, such as the area surrounding the Kawai Thermal Power Plant in Rajasthan, requires careful planning to ensure that the data collected is representative and relevant. This survey would aim to assess the socio-economic conditions of the population living in proximity to the thermal power plant, including factors such as employment, income levels, education, health, and the environmental impact of the power plant

Field Survey and Observations

Field survey and observations were made at each sampling ward area and the socio-economic status of that region was studied. Visits were made at hospitals, primary health center and sub-center to collect the requisite details of that region.

Interview Method

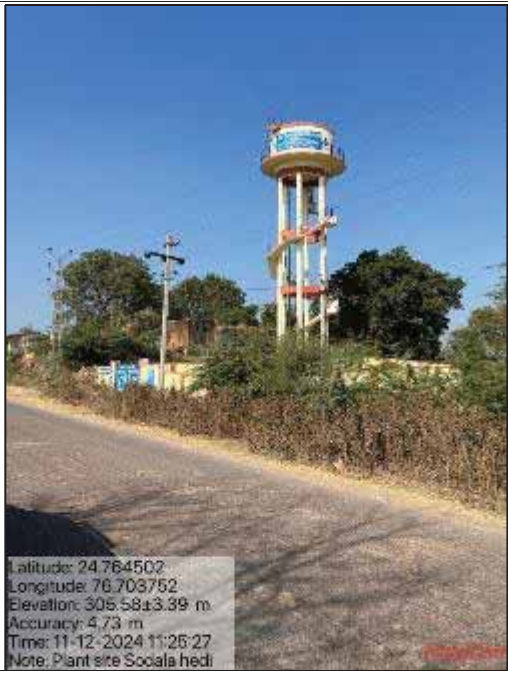
The interview method helps to collect more correct and accurate information as the interviewer is present during the field survey. The structured interview method was used to collect the data regarding awareness and opinion of the samples selected from various socio-economic sections of the community. Structured interviews involve the use of a set of predetermined questions that includes fixed and alternative questions. The questionnaire mainly highlights the parameters such as income, employment and working conditions, housing, food, water supply, sanitation, health, energy, transportation and communication, education, and environment and pollution to assess the standard of living of that particular region and general awareness, opinion, and expectation of the respondents about the existing project.

Public consultation meeting was organized at survey area village (Nimoda, Dara, Sodalheri, Tigri Annuppur, Dilod, Salpura, Kawai & Kherli Gaddiyan). Overall number of participants in all type of consultation (FGD) was 30.

Focus Group Discussion Observations: - Focus Group Discussion Observations are conducted with the likely impacted stakeholders, given as below:

Table 3.55: Focus Group Discussion Observations

Components	Description
Survey	
Types of Houses	In the survey, it was seen that the house of the village Nimoda, Tigri, and Dara area is pucca and many families have their vehicle (mostly used two-wheeler), mobile phone, internet, television, newspaper, etc. Rural most of the houses in the areas are made of mud or brick walls. Most of the pucca houses are also in rural areas. Domestic installations have electricity for 10-16 hours. **Household photos**  

<table>
<tr>
<td>Drinking Water Facilities</td>
<td>
</td>
<td>After survey, it was seen that the most sources of water supply are hand pumps, open wells, tube well, and government supplies.</td>
</tr>
<tr>
<td>Education Standard</td>
<td colspan="2">After the survey, the people told that due to the project activities, many educational institutions will be established in the study and surrounding areas. Most of the villages in Nimoda, Tigri, Dara, and Sodalhedi areas have government schools. The Atru Tehsil has govt. collage, govt. Technical Institute, and Govt. Stadium. Most of the Atru Tehsil has a Pvt Primary/ Middle/ Secondary/ Sr. secondary School/ Collages/Technical Institute following education institutions have been observed during the site visit.

Govt. Schools / Collage: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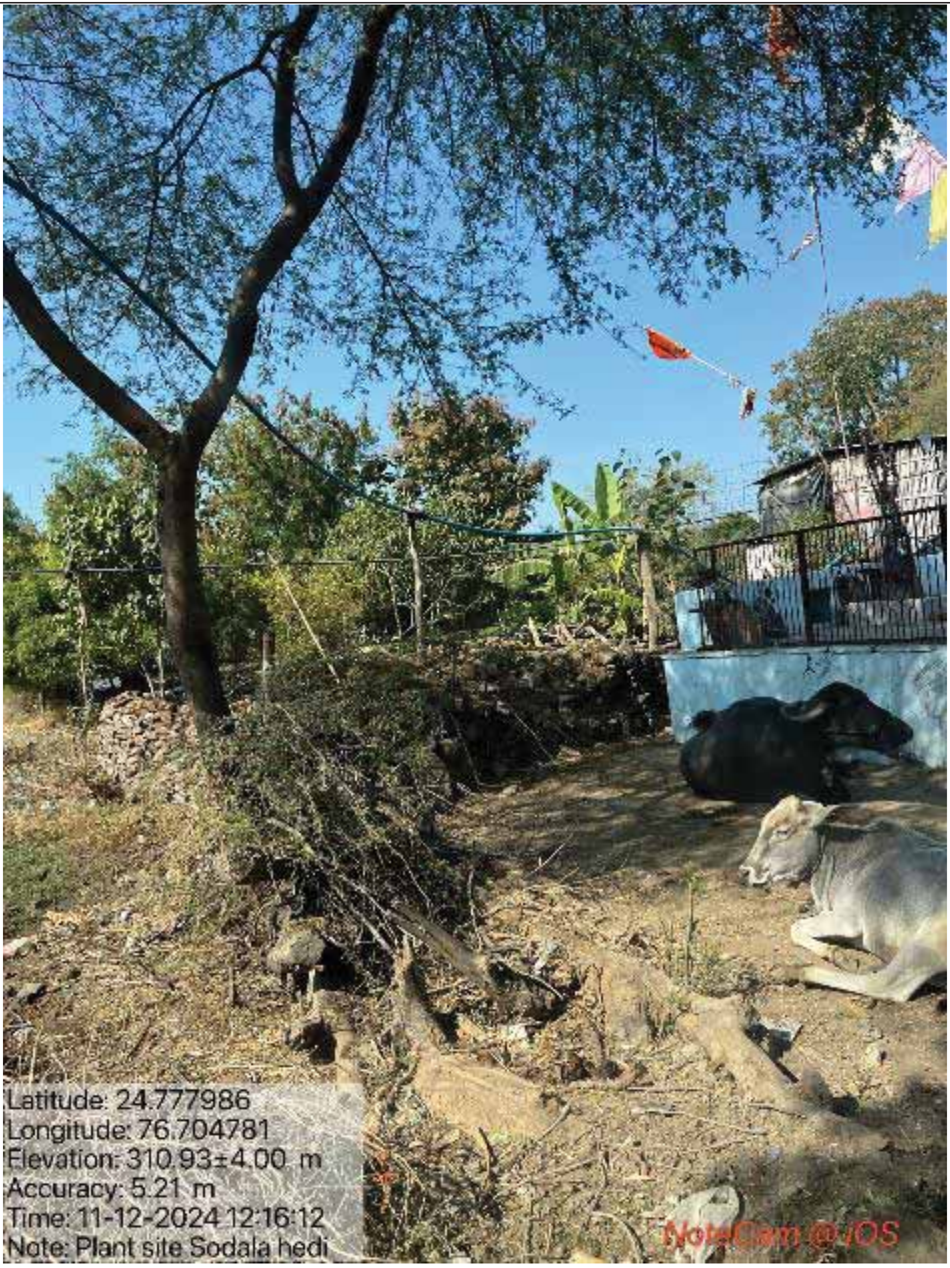
Govt. Sr. Sec. School at village, Sodalhedi

- **Govt. Sr. Sec. School, Village-Amapura, Baran.**

Govt. Primary. School, Village-Tigri, Kawai.

Health Facilities	Primary Health Centre in the study area is available at a distance of 2.00 Kms (Approx.) village & health sub centers are also available in most of the nearby area. Community Health worker & doctors visit villages periodically & provide health facilities to the people. Vaccination & health camps are also organized by PHC to aware the people about family planning, hygiene, & health care.  Primary Health Center (PHC) **<u>Nearby Medical Facilities:</u>** Primary Health Center (PHC), Village - Dara, Kawai
Electricity	The electricity supply in the city of Baran has indeed seen improvements over the years, thanks to ongoing development initiatives. However, like many parts of India, Baran faces some challenges, especially in rural areas, as demand for electricity continues to grow. In Baran city, the issues related to electricity supply are often minimal due to urban infrastructure improvements. The city benefits from better access to the grid, and local power stations help meet the needs of the population. Moreover, Baran is part of the Rajasthan state power network, which has seen modernization efforts and expansion in recent years.

Agricultural Facilities	 Baran district's agricultural landscape is shaped by the Kharif and Rabi cropping systems. Kharif crops such as cereals, maize, cotton, and soybean dominate due to the monsoon rainfall, while Rabi crops like wheat, chickpea, mustard, and barley thrive in the cooler months with irrigation support. The combination of these seasonal crops allows farmers in Baran to make the best use of the available resources, despite the challenges posed by the semi-arid climate
Crops	The main kharif crops are Rice, Wheat, Maize (Corn), Soybean, Groundnut (Peanut) and Pulses in the sandy tracts of the district whereas Rabi, Wheat, Chickpea (Gram), Mustard, Barley are mainly raised in the district.

Animals' husbandry	 Cows-Buffaloes are mainly used for milk production for own Consumption and sale. Goats and fish are mainly used for meat production.

Economy		Mostly economy mainly revolves around agriculture and small business.






Village: Tigri & Amapura

Focus Group Discussion (FGD)


Village : Baran (Fire Office)

***Source: Primary-Field survey**

3.13 TRAFFIC STUDY

The primary traffic volume count survey was done on Village Road (Near Village Bhakhravda 24°47'38.10"N, 76°43'9.94"E) and on Trijunction of SH 51 & SH 37A to collect existing traffic data on the transport infrastructure and then ascertaining the existing traffic scenario through analysis of the obtained traffic data.

INDIAN ROAD CONGRESS (IRC) GUIDELINES

Factors for conversion of different type of vehicles into equivalent passenger car unit (PCU) based on their relative interference value as per IRC guidelines i.e. IRC 64:1990 (*Guidelines for capacity of Roads in Rural Areas*) is given below:

Table 3.56: Recommended PCU factor for various types of vehicles on Rural Roads

S. No.	Vehicle type	Equivalency factor for PCU
	Fast vehicles	
1.	Motor cycle or scooter	0.50
2.	Passenger car, Pick-up van or auto-rickshaw	1.00
3.	Agricultural tractor, Light commercial vehicle	1.50
4.	Truck or Bus	3.00
5.	Truck-trailer, agricultural tractor-trailer	4.50
	Slow Vehicles	
6.	Cycle	0.50
7.	Cycle-rickshaw	2.00
8.	Hand cart	3.00
9.	Horse-drawn vehicle	4.00
10.	Bullock cart*	8.00

*for smaller bullock-carts, a value of 6 will be appropriate.

Source: IRC 64:1990

TRAFFIC ANALYSIS AS PER IRC GUIDELINES

Traffic analysis is carried out by understanding the existing carrying capacity of the roads near to the project site and the connecting main roads in the area. Then depending on the capacity of the project, the number of vehicles that will be added to the present scenario will be compared to the carrying capacity.

METHODOLOGY

The methodology adopted for the traffic study includes

- Identification and analysis of existing transport network.
- identifying traffic survey locations, conducting 24-hour preliminary traffic survey to gather base data information about existing traffic and travel pattern on surrounding roads, traffic forecast due to proposed project,
- identifying impact of increased traffic on existing road network by adding increased PCU to the existing PCU to estimate the impact of increased PCU due to proposed expansion project on the Level of Service,
- Preparing a traffic management plan based on internal circulation plan and these propose development projects to manage the traffic.

EXISTING CONNECTIVITY TO SITE

The site is well connected to the SH-37A through Village Road (Near Village Bhakhravda) Lat. 24°47'38.10"N, 76°43'9.94"E.

Table 3.57.: Current capacity of road as per IRC:60-1990

S. No.	Road name	Lane	Width	Design volume PCU/Day
1.	SH-37A	Double lane	10 m	15000
2.	Village Road (24°47'38.10"N, 76°43'9.94"E)	Single lane	6 m	6000

Table 3.58: Existing traffic volume at Trijunction of SH 51 & SH 37A

S. No	Type of Vehicle	Current Volume in Vehicles / day	PCU Factor	PCU/day	PCU/hr
1.	Cycle	82	0.5	41	1.7
2.	Passenger Car, Pickup Van	83	1	83	3.5
3.	Three Wheelers	78	1	78	3.3
4.	2 axle & 3 axle, bulker, / trailer	43	4.5	193.5	8.1
Total		**286**	**-**	**395.5**	**16.5**

Table 3.59: Existing traffic volume on Village Road (24°47'38.10"N, 76°43'9.94"E)

S. No	Type of Vehicle	Current Volume in Vehicles / day	PCU Factor	PCU/day	PCU/hr
1.	Cycle	84	0.5	42	1.8
2.	Passenger Car, Pickup Van	73	1	73	3.0
3.	Three Wheelers	79	1	79	3.3
4.	2 axle & 3 axle, bulker, / trailer	36	4.5	162	6.8
Total		**272**	**-**	**356**	**14.8**

Table 3.60: Reference V/C ratio for LOS & performance of the road

Road	Volume (in PCU/Day)	Capacity (in PCU/Day)	Existing V/C Ratio	LOS	Performance
SH-37A	395.5	15000	0.0264	A	Excellent
Village Road (24°47'38.10"N, 76°43'9.94"E)	356	6000	0.0593	A	Excellent

Table 3.61: Reference V/C ratio for LOS & performance of the road

V/C	LOS	Performance
0.0 - 0.2	A	Excellent
0.2 - 0.4	B	Very Good
0.4 - 0.6	C	Good / Average / Fair
0.6 - 0.8	D	Poor
0.8 - 1.0	E	Very Poor

Source: IRC 64:1990

CONCLUSION

From the 24-hour study, it was observed that traffic movement on the studied roads is excellent. At present, the calculated traffic load is about 395.5 vehicles per day. The majority of vehicles include Passenger Car, Pickup Van. The LOS value is calculated as 0.0264 i.e. “A” and the traffic condition is “Excellent”.

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CHAPTER - IV
ANTICIPATED ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

4.1 INTRODUCTION

Identification of possible impacts due to an activity is very important while this helps to construct implementation measures and focusing attention upon relevant environmental parameters with the activities involved. This chapter describes identification of impacts which may be adverse or beneficial due to proposed activity on various environmental attributes. Accordingly, predict and assess the environmental impacts; observe each environmental aspect- their impact relationship and identify its degree of significance.

The proposed expansion project is likely to create impact on environment, hence identify possible mitigation measures for the project activities and proposed most appropriate mitigation measures to make impacts less in degree, based on the reduction in significance achieved and practicality in implementation.

Details of likely impact on environment due to the project location, project design, decommissioning, during project construction and regular operations are discussed in this section.

Identified environmental impacts have been listed in the table below. Mitigation measures are formulated based on the significance of the impact.

Environmental impacts have been identified based on an assessment of environmental aspects associated with the project. The symbol '●' indicates an adverse (negative) impact and 'o' indicates a beneficial (positive) impact.

Table 4.1: Impact identification matrix

S. No.	Project Stages, Activities	Aspects	Impact (Type: N, AN, E; Duration: 0, T, P)	LU / LC	AQ	NV	SW	GW	S	EB	SE	OH / CH & S	Impacts (+/-) with remarks
1	PROJECT DESIGN, LOCATION AND CLEARANCES												
1.1	Preparation of conceptual and final designs & getting its approvals from various authorities	Employment generation	N, P								o		SE (+): Generation of work to service providers
1.2	Tendering and award of work to the selected bidders	Generation of business opportunities	N, T								o		SE (+): Injection of a substantial and large economic stimulus to the local economy
2	PROJECT PRE-CONSTRUCTION PHASE												
2.1	Site Preparation	Dust generation	N, 0		•								AQ (-): Deterioration of indoor air quality
2.2	Tree removal	Land cover change	N, 0	•									LU/LC (-): Change in certain land cover as applicable
		Fugitive Dust generation	N, 0		•								AQ (-) : Air quality deterioration
		trees uprooted will be transplanted to form part of project greenbelt	N,P							•			EB (-) : Shifting of trees, habitat fragmentation and loss of habitat,
2.3	Movement of vehicles (HEMMs, trucks, tractors, etc.) for	Vehicular exhaust and dust emissions	N, T		•								AQ (-) : Air quality deterioration
		Noise generation	N, T			•							NV (-) : Noise pollution

S. No.	Project Stages, Activities	Aspects	Impact (Type: N, AN, E; Duration: 0, T, P)	LU / LC	AQ	NV	SW	GW	S	EB	SE	OH / CH & S	Impacts (+/-) with remarks
	transportation of construction equipment, debris generated due to construction activities	Works contracts for agencies involved in this activity	N, T								o		SE (+) : Employment for construction workers and vendors
		Operation of vehicles	AN, T								•		SE (-) : Wear and tear of roads
		Accidents during work activity	AN, T									•	OH (-) : Risk of occupational injuries
3	**CONSTRUCTION PHASE**												
3.1	Cut & fill, removal of top soil & excavation and leveling of site	Dust generation	N, T		•								AQ (-) : Air quality deterioration
		Noise generation and vibration	N, T			•							NV (-) : Noise pollution and vibration effects on workers
		Generation of top soil & excavated soil	N, 0						•				S (-) : Depletion of top soil cover & loss of native soil
3.2	Storage of construction material in warehouse	Fugitive dust emissions	N, T		•								AQ (-) : Air quality deterioration
3.3	Civil construction (Excavation of earth, Raft and foundation, Carriage / reuse / disposal of excavated earth, Dressing and compaction, Reinforcement, Concrete structure, brick works & finishing activities)	Land utilized for establishing new / additional structures	N, P	•									LU/LC (-) : Change in certain land cover as applicable
		Dust generation	N, P		•								AQ (-) : Air quality deterioration
		Noise generation	N, P			•							NV (-) : Noise pollution
		Generation of C&D Wastes	N, 0						•				S (-) : Land quality degradation

S. No.	Project Stages, Activities	Aspects	Impact (Type: N, AN, E; Duration: 0, T, P)	LU / LC	AQ	NV	SW	GW	S	EB	SE	OH / CH & S	Impacts (+/-) with remarks
				Potential Environmenental Impacts on Environment									
		Accidents during work activity	ANT ,									•	OH (-) : Occupation Risk to the workers and labors working at
3.4	Movement of Vehicles (Earth moving equipment, JCB, trucks, cranes, tractors, etc.) for carrying cut & fill material, C&D waste, excavated soil, construction material, employees etc.	Vehicular exhausts and dust emissions	N T ,		•								AQ (-) : Air quality deterioration
		Noise generation and vibration	N, T			•							NV (-) : Noise pollution and vibration effects on workers
		Spillage of C&D waste from trucks on site or on nearby road	AN, 0						•				S (-) : Risk of soil contamination
		Job opportunities	N, T								o		SE (+) : Employment for contractors, construction
		Use of roads for transportation	AN, T								•		SE (-) : Wear and tear of roads
		Driving transport vehicles	AN, T									•	OH (-) : Risk involved in transportation activity such as accidents etc.
3.5	Water usage / leakage / spillage construction activities at project site	Leaching of contaminated water due to improper handling & storage of water	AN 0 ,						•				S (-) : Risk of soil contamination
3.6	Storage and disposal of generated waste (C&D)Wastes, Municipal Waste, Hazardous & E- waste) and Soil	Contamination of soil due to leaching of water due to improper handling & storage	AN, 0						•				S (-) : Risk of soil contamination

S. No.	Project Stages, Activities	Aspects	Impact (Type: N, AN, E; Duration: 0, T, P)	LU / LC	AQ	NV	SW	GW	S	EB	SE	OH / CH & S	Impacts (+/-) with remarks
				Potential Environmenental Impacts on Environment									
3.7	External Development (Roads, Greenbelt, etc.)	Greenbelt / Space development	N, P							o			EB (+) : Habitat improvement will attract avian diversity, minimize noise and air pollution Green belts/Tree plantation not only absorb air and water pollutants but also will help in arresting noise and soil erosion and creating favorable aesthetic conditions.
3.8	Construction works resulting in personnel hit by objects, electric shock, falling from heights and similar incidents	Accidents during work activity	E, E T/P									•	OH (-) : Occupational risk / casualty
3.9	Fire, asphyxiation due to release of hazardous materials or lack of oxygen	Emission of PM, SO_2 & NOx	E, T/P		•								AQ (-) : Air quality deterioration
		Accidents during work activity	E T/P ,									•	OH (-) : Occupational risk / casualty
3.10	Damage to buildings / surrounding natural environment due to unforeseen activities / act of war / terrorist acts and natural calamities	Noise generation	E, 0			•							NV (-) : Noise pollution
		Damage to trees near the project	E, 0							•			EB (-) : Affects tree growth & development
		Accidents during work activity	E, 0								•		SE (-) : Loss of life or injuries

S. No.	Project Stages, Activities	Aspects	Impact (Type: N, AN, E; Duration: 0, T, P)	Potential Environmenental Impacts on Environment									Impacts (+/-) with remarks
				LU / LC	AQ	NV	SW	GW	S	EB	SE	OH / CH & S	
		Accidents during work activity	E, 0									•	OH (-) : Occupational risk to workers
4	**OPERATION PHASE**												
4.1	**Raw Material Handling**												
a	Unloading of raw materials (coal, limestone)	Air Pollution	N, P		•								AQ (-) : Air quality deterioration Dust suppression systems shall be provided
b	Transportation of Material through Conveyor	Dust emission	N, P		•								AQ (-) : Air quality deterioration DE system with Bag Filters at all Junction Points
		Noise generation	N, P			•							NV (-): Noise pollution Insignificant
		Spillage of material	N P ,						•				S (-): Risk of soil contamination Closed conveyor shall be provided
(c)	Stacking & reclaiming of material through Stacker cum Reclaimer	Dust is airborne from Stockpile			•								AQ (-) : Air quality deterioration Stationary Water Sprinklers shall be provided
		Noise generation from operation of Stacker cum Reclaimer				•							NV (-): Noise pollution Regular maintenance of machinery
4.2	**POWER GENERATION**												
(a)	Generation of Steam in Boiler	Generation of noise due to steam leakage	N, P			•							NV (-) : Noise pollution Prevent leakages and Provide Glass wool lagging

S. No.	Project Stages, Activities	Aspects	Impact (Type: N, AN, E; Duration: 0, T, P)	Potential Environnemental Impacts on Environment									Impacts (+/-) with remarks
				LU / LC	AQ	NV	SW	GW	S	EB	SE	OH / CH & S	
(b)	Generation of Power in TG Set	Generation of noise	N, P			•							NV (-): Noise pollution Acoustic enclosure for TG Set proposed

N *= Negligible (or No impact): The impact is so small that it can be ignored or doesn't cause any real change.*

AN *= Adverse Negligible (Adverse but not significant): There's a small negative impact, but it's still very minor — not enough to need big actions.*

E *= Extensive (or Extreme): A major impact — very significant and often requires urgent or substantial intervention*

O *=* *One-time (Short-term) Impact*

T *=* *Temporary Impact (will disappear with time or recovery)*

P *=* *Permanent Impact (long-lasting or irreversible)*

The proposed expansion project phases for which impacts are identified in detail are: -

- **Construction phase:** Temporary or short term impact; and,
- **Operation phase:** long term impacts

The following attributes are of utmost significance to carry out the Environmental Impact Assessment of the proposed expansion project and are being discussed in detail for each attribute of construction and operation phase

1. Land environment.
2. Water environment.
3. Air environment.
4. Noise environment.
5. Solid & Hazardous waste.
6. Biological environment.
7. Socio economic environment

4.2 IMPACT DURING CONSTRUCTION PHASE- SITE PREPARATION/ ERECTION/ FABRICATION/ CIVIL WORKS

Construction activity includes foundation works, civil works, fabrication and erection of plant & machinery. The proposed expansion plant shall be constructed in a phased manner to keep impact on the environment low. The major activities during construction phase are given below:

Project Activities

1. Civil works
2. Fabrication
3. Vehicular movement
4. Loading and unloading of construction items, plant & machinery
5. Storage of construction material, plant & machinery
6. Erection & installation of structures and machinery

7. Maintenance of construction machinery

4.2.1 IMPACT ON LAND ENVIRONMENT

Identification of Impacting Activities for the Proposed Expansion Project

S. No.	Activity	Aspect	Impact	Mitigation/ Management
1.	Soil Excavation Soil will be excavated for foundation works, site levelling and other purposes.	• Excavated soil when stored in open surface in loose will lead in increase in air borne dust. • Possibility of soil erosion	• respiratory diseases • decreased visibility. • Loss of fertility of land due to erosion • Higher run-off rate due to soil erosion resulting in increased sedimentation in water ways.	• Soil will be excavated in phased manner adopting cut and fill techniques. • Total cut will be backfilled within site & used for plantation. • Temporary stabilization of the top soil will be carried out to prevent the fertility loss
2.	Civil construction & erection of plant & machinery	change in land cover from vacant / open land to paved / built up land.	Decrease in aesthetics of the area	Planned development with green belt & plantation 289.44 Hectare (~35 %) of total land) will improve the aesthetics of the area.

4.2.2 IMPACT ON SOIL

S. No.	Activity	Aspect	Impact	Mitigation/ Management
1.	Clearance of vegetation / trees	• Loss of top-fertile soil	• Loss of fertility of land due to erosion • Higher run-off rate due to soil erosion resulting in increased sedimentation in water ways.	• Planned development with green belt & plantation in 289.44 Hectare (~35 %) of total land area with 7,23,600 nos. of trees will aid in prevention of soil erosion. • Drainage channels / garland drain as per natural contours of the area to direct storm –water run off towards water reservoir in scientific manner will prevent

S. No.	Activity	Aspect	Impact	Mitigation/ Management
				sediment build-up in water ways and prevent soil erosion.
2.	Soil Excavation Soil will be excavated for foundation works, site levelling and other purposes.	• Excavated soil when stored in open surface in loose will lead in increase in air borne dust. • Possibility of soil erosion	• Respiratory diseases • decreased visibility. • Loss of fertility of land due to erosion • Higher run-off rate due to soil erosion resulting in increased sedimentation in water ways.	• Soil will be excavated in phased manner adopting cut and fill techniques. Total cut material will be backfilled within site & used for plantation. • Temporary stabilization of the top soil will be carried out to prevent the fertility loss. • The excavated topsoil would be kept in an isolated earmarked area with tarpaulin cover and utilized for landscaping and greenbelt development
3.	Movement of vehicles	Compaction of soil	reduced soil fertility since compacted soil has a reduced rate of both water infiltration and drainage	Demarcated vehicular movement area during construction phase.
4.	Generation of hazardous waste like used oil from machinery, oil soaked cotton / rags, waste oil & grease from vehicle / equipment maintenance and discarded containers construction related activity like paint works	Spillage of liquid and solid / hazardous wastes resulting in contamination of soil	• Adverse impact on flora, fauna and human health due to direct or indirect contact. • Soil contamination can lead to the degradation of essential soil nutrients, which can then impact plant growth and, ultimately, the entire food chain.	Hazardous waste like used chemical, paint containers etc. will be stored in covered designated rooms with impervious flooring before being sold off to authorized recyclers.
5.	Sewage generation and discharge from labor camp	Contamination of soil due to accumulation of toxic substances like heavy metals	• Adverse impact on flora, fauna and human health through plants / crops • Increased disease vectors	Sanitation facility in labour camps by means of soak pits will be ensured.

Hence, no significant impact is envisaged on the soil quality of the project area. Construction activities would be confined to the plant boundary. Therefore, no impact on the soil quality of the study area located beyond the plant boundary has been envisaged.

4.2.3 IMPACT ON WATER QUALITY & MITIGATION MEASURES

The overall impacts on water environment during construction phase due to proposed activity shall be temporary and marginal.

Activity / Aspect	Impact	Mitigation / management plan
• Discharge of untreated sewage generated from labour camp on land, surface water bodies. • Land clearance (the silt and soil can erode and increase sediment load in waterways), open storage of construction material, excavated earth construction waste can increase sediment load in water ways due to run-off from construction site, excavated soil pile etc. from project premises • Storage of hazardous waste like used oil, discarded containers etc. in open on unpaved area	• Risk of contamination of ground or surface water due to discharge of waste water resulting in odour nuisance and water borne diseases in animals and humans and phytotoxicity in plants / crops • Increased sediment load can affect aquatic biodiversity by making the waterway turbid and restricting the amount of sunlight entering the waterway in surface water bodies and water ways. • Risk of contamination of soil, ground water, surface water bodies, toxic substance accumulation by crops / plants, rendering ground water unfit for human / animal consumption and	• Domestic consumption demand & water requirement for civil works during construction phase will be met from existing water source. • Excavation during dry season only and proper management of excavated soil through stabilized and covered stockpiling of excavated earth to be used for plantation. • 100% excavated earth will be backfilled within project premises for site levelling and grading. • The stockpiles of construction material will be protected with toe wall of adequate height along with garland drain & sedimentation traps to prevent uncontrolled discharge of runoffs during monsoon and reuse the collected waste water for construction purpose after primary settling. • Provision of storm water drains with oil & grease traps and sedimentation traps as per contour & drainage pattern. • Storm water diversion channels to divert storm run-off from flowing over the construction areas.

Activity / Aspect	Impact	Mitigation / management plan
resulting in spillage and leaching to sub-soil, water table / aquifer. • Improper collection & storage of MSW, plastic waste etc. generated from labour camp	adversely impacting on human and animal health. • Contaminated ground water is extremely difficult to treat. • Odour nuisance from open storage of MSW, increase in disease vectors affecting human and animal health.	• Removal & proper disposal of all the debris from site, as soon as construction is over. • Domestic sewage generated will be treated in existing STP and reused in the greenbelt & plantation and also arranged by contractor if required. • Storage of hazardous chemical & hazardous waste in covered room with impervious flooring. • Wash offs containing these chemicals will be drained into impervious trays / barrels for disposal as hazardous wastes. • Water consumption during construction phase will be met through the surface water from Parwan River/Dam.

4.2.4 IMPACT ON AIR QUALITY

Dust is the predominant pollutant affecting the air quality during the construction phase. Project activities during construction phase would cause a marginal increase in dust levels and gaseous emissions in the ambient air for short duration.

However, this increase in concentration levels of pollutants is distributed throughout the project site and shall fall under the category of area source and would be temporary in nature and localized.

Activity / aspect	Impact	Mitigation / Management Plan
• Excavation for foundations and backfilling for site levelling & grading. • Civil works and plant erection / fabrication • Road laying	Increased concentration of fugitive dust, SO_2, NOx, PM, CO and unburnt hydrocarbons in ambient air leading to: • respiratory illnesses, • reduced visibility,	• Phase wise construction of project components. • Unloading of construction material and stockpiling of the same at the earmarked site would be provided with water sprinkling to arrest fugitive dust emission.

• Vehicular movement for transportation of construction material & manpower to site • Operation of on-site construction machinery / equipment	• Acidification of surface water affecting marine biodiversity and acidification of soil reducing soil micronutrients • Damage to trees as NO_X is a phytotoxin in elevated concentration. Sped up weathering of monuments /buildings /metal & concrete structures	• Wind barrier screen would be provided around stockpiles to reduce the wind speed and consequently, reduce the fugitive dust emission. • Ensuring vehicles with valid PUC certificates are used. • Regular & preventive maintenance of construction vehicles & machinery • Water sprinkling shall be carried out at the construction sites at regular intervals • No use of asbestos fibre; and Construction site shall be barricaded and dust screens shall be placed

Keeping in mind the nature of the emission sources during construction phase and the phased manner in which construction activity is to be carried out, it is likely that increase in PM levels due to construction would mainly be confined to the project site. Thus, it is inferred that minor negative impact within a few 100 meters from the source within the site would occur on the ambient air quality under the worst conditions, which are mitigated by implementing environmental management plan. However, no significant impacts are expected on the overall ambient air quality due to construction activities at the sensitive receptors outside the project premises.

4.2.5 IMPACT ON NOISE LEVELS

The noise generation during the construction will have significant impact on the existing ambient noise level however it will be temporary, of short duration & mostly restricted to project premises. Increase in noise level will be near the source only and is not expected to create any noise pollution at far off distances and outside the plant premises which itself spans 822.54 hectares. The potential impacts on noise level may arise out of the following:

- Vehicular traffic;

- Civil works such as trenching, foundation casting, steel fabrication work, mechanical works
- Construction equipment like cranes, generators, pumps, compressors, rock drills, pneumatic tools, saws, vibrators etc.
- The typical noise levels of some construction equipment based on "BS 5228: 1997 Noise and Vibration Control on Construction and Operation Sites" are given in Table 4.2.

Table 4.2: Typical Noise Levels of Construction Equipment

Particulars	Noise Levels dB(A)	Reference Distance
Earth Movers		
Front End Loaders	72-84	0.9 m
Backhoes	72-93	
Tractors	76-96	
Scrapers, Graders	80-93	
Pavers	86-88	
Trucks	82-94	
Material Handlers		
Concrete mixers	75-88	0.9 m
Concrete pumps	81-88	
Cranes (movable)	75-86	
Cranes (derrick)	86-88	
Stationary Equipment		
Pumps	69-71	0.9 m
Generators	85-90	
Compressors	74-86	

Source: *BS 5228: 1997 Noise and Vibration Control on Construction and Operation Sites*

The peak noise levels from continuous construction activity are anticipated to be about 85-90 dB (A) which will be temporary & and for short duration only during construction activities. Overall, the impact of noise generated on the environment is likely to be low, reversible and localized in nature.

All the above-mentioned sources at the proposed construction activities will be intermittent and would be experienced occasionally. It may also be noted that, most of the construction activities will be carried out only during the daytime. The general noise level due to construction activities, such as working of HEMM installation, may sometimes go up to 85 dB(A) at the work site during day time. The workers in general are likely to be exposed to an equivalent noise level of 70-75 dB (A) in an eight (8) hour shift for which all statutory precautions as per law will be implemented. Use of proper PPEs like ear plugs will further mitigate adverse impacts of noise on the workers, if any.

Overall, the impact of generated noise on the environment will be insignificant, reversible and local in nature and mainly confined to the day hours.

Activity / aspect	Impact	Mitigation / Management Plan
• Vehicular movement; • Civil works such as trenching, foundation casting, steel fabrication work, mechanical works • Construction equipment operation like cranes, generators, pumps, compressors, rock drills, pneumatic tools, saws, vibrators etc.	• Constant loud noise can adversely affect human & animal health • Physical impact on health: tinnitus or deafness, Respiratory agitation, high blood pressure, headaches • Psychological impact: stress, fatigue, depression, anxiety and hysteria. • Behavioral disorder: aggressiveness & irritability • Memory and concentration: affects people's ability to focus, which can lead to low performance over time	• Provision of silencers on noise generating machinery; • Major Construction/installation work will be carried out works during day hours only. • Ensuring use of PPEs like ear muffs/ear plugs by workers. • Regular & preventive maintenance of Vehicles and construction machinery. • Ensuring that exhaust mufflers and provision of silencers on noise generating machinery; • Moveable noise barriers will be considered • Greenbelt development & plantation to be undertaken from the construction stage itself.

4.2.6 IMPACT ON BIOLOGICAL ENVIRONMENT & MITIGATION MEASURES

Due to removal of vegetation: The impact of construction activities would be primarily confined to the project site, covering a total of 822.45 Ha. land. The site development works will lead to land clearing & levelling activities involves removal of few vegetation & grasses. The few neem, Babul and palash trees are mostly along the project periphery &

shall form part of greenbelt of the project. Removal of vegetation will lead to loss of habitat for fauna in the core zone. A three-tier greenbelt on plant periphery with avenue plantation along roads within plant premises using native plant species in an area covering 289.44 hectare of total plant area.

Due to deposition of dust on pubescent leaves: Construction activities leads to removal of top soil, often leads to soil erosion that generate fugitive dust due to vehicular movement. The generation of fugitive dust due to vehicular movement would have negative impact on the surrounding vegetation due to deposition of dust on pubescent leaves which may lead to temporary reduction of photosynthesis. However, this would be confined to the initial periods of the construction phase and would be minimized through water sprinkling, paving roads and phase wise judicious construction management plan.

Due to increase noise level: Additional vehicular movement for import of construction materials and operation of construction machinery may lead to increase of noise level in the surrounding environment causing adverse impact on human health and disturbance to faunal species. Noise prone construction activities such as piling, drilling, excavation, cutting, etc. would be done during daytime only. The noise pollution certified construction machinery would be allowed for operation at site, thus, increased noise level at project boundary would be contained below the permissible limit.

Impact on Aquatic Ecology and Mitigation Measures

Due to construction waste water: Runoff construction waste water from project site may drain into nearby rivers/ water bodies near plant premises that may cause water pollution, however, it is proposed that no waste water will be discharged and it will be reused for plantation through settling basin. Hence, no impact on aquatic ecology envisaged.

Table 4.3: Impact of Flora on Biological Environment

Impact of Flora		Mitigation and Measure
Impact on Flora	***1. Loss of Flora Species:*** Tree species have unique characteristics and adaptations that allow them to thrive in specific environments. Removing trees	***1. Reforestation and Afforestation:*** Planting new trees is crucial for replacing those that have been cut

Impact of Flora		Mitigation and Measure
	results in the loss of these species, reducing the overall diversity of flora in the area. ***2. Disruption of Forest Structure:*** They provide the canopy layer, understory vegetation, and ground cover, creating a multi-layered structure. Tree cutting disrupts this structure, resulting in changes to light penetration, humidity, and temperature levels. This can have cascading effects on the growth and survival of other plant species adapted to specific microenvironments within the forest. ***3. Alteration of Plant Communities****:* Trees often form associations with other plant species, including understory plants, shrubs, and groundcover. These plant communities rely on the presence of trees for various ecological interactions such as shade tolerance, seed dispersal, and nutrient cycling. When trees are cut down, the plant communities that depend on them may decline or disappear, leading to a shift in the composition of the flora. ***4. Decreased Biodiversity:*** Trees provide habitats, food sources, and nesting sites for a wide range of plant species. Removing trees can result in the loss of these habitats and resources, leading to a decline in plant biodiversity. This reduction in flora diversity can have far-reaching effects on ecosystem functioning and resilience. ***5. Increased Invasive Species:*** In the absence of the dominant tree species, invasive plants may establish themselves and outcompete native flora. These invasive species can alter the composition and dynamics of the plant community, further reducing the diversity of native plants. ***6. Soil Degradation:*** Trees play a crucial role in soil conservation and nutrient cycling. Their root systems help stabilize the soil, prevent erosion, and improve its fertility. with trees the exposed soil becomes vulnerable to erosion, loss of organic matter, and reduced nutrient availability. This degradation of the	down. Reforestation involves replanting trees in areas where forests have been depleted, while afforestation involves establishing new trees in areas that were previously devoid of trees. These practices help restore tree cover and promote the recovery of flora in the affected areas. ***2. Selective Logging and Sustainable Harvesting:*** Instead of clear-cutting entire trees, selective logging involves carefully choosing specific trees for extraction while leaving others intact. Sustainable harvesting practices ensure that only a portion of the trees are cut, allowing for regeneration and the maintenance of forest ecosystems. This approach helps preserve the overall structure and composition of the forest, minimizing the impact on flora. ***3. Restoration of Degraded Areas:*** Rehabilitating degraded areas through ecological restoration efforts can help revive flora that has been negatively affected by tree cutting. This may involve soil stabilization, reintroduction of native plant species, and implementing measures to enhance natural regeneration processes.

Impact of Flora		Mitigation and Measure
	soil can negatively impact the growth and establishment of many plant species.	
Impact on Fauna	***1. Loss of Habitat:*** Trees provide essential habitats for many animal species. When trees are cut down, the loss of habitat can lead to the displacement or even extinction of fauna that depend on those trees for shelter, food, nesting sites, and protection from predators. This loss of habitat disrupts the delicate balance of ecosystems and can have severe consequences for animal populations. ***2. Disruption of Food Sources:*** Trees contribute to the availability of food sources for fauna. Fruits, nuts, leaves, and flowers provided by trees are vital components of the diets of many animals. When trees are removed, these food sources become scarce or disappear altogether, leading to nutritional deficiencies and potential population declines for species that rely on them. ***3. Loss of Biodiversity:*** Trees support a diverse array of fauna, including birds, mammals, reptiles, insects, and amphibians. When trees are cut down, the biodiversity of an area decreases, and certain species may decline or become locally extinct. This loss of biodiversity can disrupt ecological interactions, such as pollination, seed dispersal, and predation, which are crucial for the functioning of ecosystems.	***1. Habitat Conservation:*** Protecting and conserving existing habitats is crucial for maintaining fauna populations. ***2. Reforestation and Habitat Restoration:*** Planting new trees and restoring degraded habitats can help mitigate the impact of tree cutting on fauna. Reforestation efforts involve replanting trees in areas that have been cleared, while habitat restoration aims to bring back the natural vegetation and ecosystem functions. These practices provide new habitats and food sources for fauna, allowing them to recolonize and thrive. ***3. Species Monitoring and Research:*** Monitoring fauna populations and conducting research on their ecological requirements and behavior can help inform conservation strategies. This information can guide the implementation of targeted measures to protect vulnerable species and their habitats, identify critical areas for conservation, and assess the effectiveness of mitigation efforts.

4.2.7 IMPACT ON SOCIO-ECONOMIC ENVIRONMENT

Construction phase will affect the influx of Population in the area. During construction, phase significant increase in income of local people is expected as local unskilled, semiskilled and skilled persons will gain direct or indirect employment during construction phase. Since the immigration of work force during construction phase is likely to be very small, the social impacts on demography, literacy, health care, transport facilities and cultural aspect are expected to be insignificant. The following impacts will occur during this phase on social environment:

Economic Impacts

The relatively short-lived economic impacts of the construction stage are likely to be experienced in local area for the duration of construction phase as workers make everyday purchases from local traders in nearby areas. This is likely to give a short-lived stimulus to the shopkeepers / traders that will disappear as soon as the construction is complete.

Noticeable, flow-on economic impacts will be experienced in other sectors of economy as a result of purchase of construction materials and the payment of wages and salaries to the personnel engaged in the proposed project.

Increase of Temporary Employment

During construction period, increase in income of local people is expected as local semiskilled and skilled persons will gain direct or indirect employment during construction phase. The local people will be given more preference for the unskilled activities under normal condition, as construction labour is proposed to be hired mostly from nearby area and the same are expected to be available with wages as per applicable rules. Provision of wage employment to the local populace during construction period of the project will solve un-employment problem in the local area temporarily to some extent. This will enhance the income levels of the construction labourers and lead to their socio-economic well-being during the construction phase of the proposed facility, which will be a positive impact due to the project. Since the immigration of work force during construction phase is likely to be very small, the social impacts on demography, literacy, health care, transport facilities and cultural aspect are expected to be insignificant.

Influx of Construction Workers

While the labourers may be from nearby villages, some skilled staff like Site Supervisor and his team will be hired during the construction period to oversee and supervise the construction activities onsite, which may be from other states or other district. Sudden and relatively short-lived influxes of construction skilled workers to communities near the project site may have the potential to 'skew' certain demographic variables and the traditional social coherence

4.2.7.1 MITIGATION MEASURES

- Preference will be given to locals for direct and indirect employment opportunity;
- Local suppliers for construction machinery and construction material will be given preference;
- Local transporters will be preferred for transportation of machinery / earth / materials;
- To train unskilled local work, short-term skill development course will be organized in the area.

4.2.8 IMPACTS DUE TO INCREASE IN TRAFFIC

The project development will lead to increased movement of HEMMS like cranes, excavators, dozers, dumpers, etc., mass transport vehicles, trucks, motor cars, etc. Adequate road infrastructure is essential for reduction of traffic congestion and air and noise pollution to the extent possible.

Existing Road infrastructure will be used for movement of men & material during construction phase. Project site development identifies several transportation activities during the construction as:

- Transportation of construction workers.
- Transportation of construction aggregates/excavated material.
- Transportation of solid and liquid hazardous and non-hazardous wastes.

4.2.8.1 MITIGATION MEASURES

A traffic circulation and management plan for construction vehicles inside project site will be implemented to provide adequate proactive measures against identified possible traffic congestion and safety issues. To achieve this objective of safe, smooth, congestion free as well as minimum impact of construction vehicles on air and noise, following traffic movement requirements shall be fulfilled at site.

- Route of vehicles inside project site shall be kept shorter to the extent possible.
- Signage plan shall be demarcated throughout the road for guidance of the driver.
- Speed limits shall be imposed throughout site.
- Pedestrian access at worksite and route shall be marked throughout the site for ensuring safety.
- As far as possible, transportation of construction materials will be scheduled for off peak traffic hours. This will reduce the risk of traffic congestion and of road accidents on the access roads to the site.
- Traffic control and construction activities shall co-ordinate to provide for safe and efficient flow of traffic together with efficient, safe, and rapid progress of the construction activity.
- All site roads, parking areas, pedestrian crossings, and other areas accessed by vehicles and pedestrians, shall be appropriately lit and designed to avoid extremes of light variation (i.e., moving from a brightly lit area to a dark one). Parking area, pedestrian walkways and Roads will have a minimum level of lighting as per National Lighting Code 2010.
- Contractors shall implement physical safeguards whenever reasonably practicable wherever pedestrians are required to cross vehicle routes. Measures may include the use of gates, barriers, and traffic lights. Safety barriers, in accordance with Indian Standard Codes, shall be constructed where required as determined by site risk based assessment.
- Adequate parking facilities will be provided for the construction phase.

4.2.9 SOLID WASTE GENERATION & MANAGEMENT

The solid waste generated in the project site may be broadly classified as hazardous and non-hazardous wastes. During construction phase, solid wastes in terms of construction & demolition waste, food packet wrappers, paper, plastic drums, paints, oil containers etc. will be generated. This may cause environmental degradation at the project site as well as its immediate surroundings, if adequate measures are not taken.

4.2.9.1 CONSTRUCTION & DEMOLITION (C&D) WASTE

a. Impact

About 50,000 MT of construction waste is anticipated from construction phase of the project. C&D waste if stockpiled and buried without any treatment, will not only increases the cost of waste cleaning and transferring, it will also occupy a large amount of land and cause serious environment impact due to waste leakage, dust, sand generated during the stockpiling and transferring.

✓ **Air Pollution**

The waste plaster of C&D Waste may contain sulphate ions, which could be converted to hydrogen sulphide in anaerobic conditions such as in landfills. In the same conditions, lignin and tannin may be dissolved form waste cardboard and wood and further decomposed to Volatile Fatty Acids (VFA) under anaerobic conditions. These substances could cause air pollution.

✓ **Water Pollution**

Leachate from C&D Waste dumping sites contains a large amount of calcium silicate hydrate, calcium hydroxide, and sulphate and heavy metal ions. Surface and ground water will be polluted if the leachate flows into watercourses and aquifers without proper control.

✓ **Soil pollution.**

- The hazardous ingredients in C&D Waste and leachate generated will cause soil pollution, including changes of the physical and chemical characteristics of soil, impact on the activities of microorganisms in soil, and accumulation of hazardous substances in soil. According to research (*Sun et al, 2015*), it takes decades for stockpiled C&D Waste to be stabilized. Although C&D Waste could be stabilized without generation of harmful gas and leachate, large areas of land are still occupied by a large number of inorganic substances, which may continue to cause persistent environmental impacts.

b. Mitigation Measures

C&D waste generated during construction phase shall be handled as per the Construction and Demolition (C&D) Waste Management Rules, 2016 notified vide G.S.R. 317(E) 29.03.2016 & subsequent amendments.

Contractor / Subcontractor will be informed to comply with all the applicable rules of C&D Waste Rules 2016. Waste shall be segregated into four streams such as concrete, soil, steel, wood and plastics, bricks and mortar and waste management plan will be developed and appropriate approvals will be obtained and the concerned authorities will be informed regarding the relevant activities from the planning stage to the implementation stage. Following mitigation measures are proposed:

- The Contractor shall be responsible for preparing a demolition quality control (QC) plan
- Required SPCB and local administration approval to be obtained for handling and disposal of C&D waste, inline to C&D Waste rules 2016
- Debris net curtain and barricade shall be provided around the construction area to prevent any accidents.
- Spotters should be utilized to prevent workers from entering the area where the excavator is working
- Metal waste should be separated from the debris and hauled separately for recycling
- C&D debris shall not be stored long-term on the site. All debris shall be hauled-off the site as soon as possible. All debris should be taken to a construction debris recycling facility
- Concrete should be separated mechanically from demolition debris by using excavators.
- All the inert construction waste including excavated soil, sand & gravel to be used within premises for levelling & grading works.

- Remaining C&D waste to be sold to vendors through auction &/or disposed off through construction contractor
- Wire and other metal, both ferrous and non-ferrous, will be cut in pieces on site and hauled to metal recyclers.
- Concrete should be separated mechanically from demolition debris by using excavators.

4.2.9.2 MUNICIPAL SOLID WASTE: -

a. Impacts

About 1 TPD of municipal solid waste is anticipated during construction phase. MSW if not handled properly may lead to air-borne or water borne diseases; etc. Municipal solid waste from labour camp and office area are required to be disposed off on a daily basis and to be handed over to authorized agency.

b. Mitigation measures

In order to avoid any solid waste disposal problems, an effective MSW management system by means of collection of wastes in different types of dust bins, temporary storage at designated area within project premises and transporting the same & disposed off through MSW disposal system of municipality, Baran through recognized agency.

4.2.9.3 HAZARDOUS WASTE:

a. Impact

- Hazardous waste like used oil, oil soaked cotton/rags, used/discarded containers, contaminated soil due to oil spillage etc. poses risk of contamination for air, water, soil, flora and fauna and humans as well.
- Hazardous waste if not segregated and handled properly will lead to pollution load and serious health impacts on construction workers & surrounding environment.

b. Mitigation measures

- Hazardous and flammable materials such as diesel, fuel oil, lubricating oil during development phase shall be stored properly as per the safety regulations and applicable rules.
- Accidental spillages of oil from construction equipment and storage sites shall be prevented & Spill Prevention, Control & Counter measure (SPCC) plan will be put in place.
- Hazardous wastes generated in the project premises during construction phase will be stored in separate covered area with impervious flooring and catch drains with adequate secondary containment and labelling as per the requirements of HoW Rules;
- Records of hazardous wastes generation and disposal will be maintained as per the requirements of HoW Rules
- Hazardous waste shall be handled as per the Hazardous Waste Handling Rule, 2016. Strict adherence to the established solid waste collection and disposal system will ensure clean environment during development period

4.2.10 SUMMARY & CONCLUSION

From the overall assessment of pollution sources and nature of pollutants it may be concluded that the impacts during construction phase are found to be temporary, however mitigation of the same requires strict adherence to environment management plan and mitigation measures in place.

4.3 IMPACT DURING OPERATIONAL PHASE

Impact on the environment during operation phase will be due to the handling of fuel & waste and due to operation of production unit & burning of fossil fuel.

These emissions, discharges and disposal may release different pollutants, which may affect air, water, land and ecological environment directly. However, all these are mainly primary impact. In addition to these primary impacts, any industrial project has some overall impact on its surrounding socio-economic environment through the existence of social and economic linkages between the project and society, which are actually secondary impact.

Under this section, all the primary impacts due to this proposed expansion project are being discussed and wherever required, impacts have also been quantified.

Accordingly, in the subsequent paras, impacts on land, air environment, water environment, soil, noise, biological environment and socio-economic due to the proposed expansion project are discussed.

4.3.1 WATER ENVIRONMENT

Water environment may be affected by the industry due to:

- Withdrawal of water,
- discharge of polluted water / waste water, and
- contaminated leachate from storage of solid & hazardous waste

4.3.1.1 IMPACT DUE TO WATER USE

The water requirement of 56 MCM/Year for makeup to the closed cycle re-circulation system of condenser cooling will be drawn from Parwan Dam/ River to plant site through existing pipeline of about 18.4 km in length. At present the water allocation of 34 MCM/year is received from the Parwan River/Dam (permission from WRD Jaipur, Rajasthan. vide letter no. CEWR/TA (W)/1482 dated 11.08.2009 has already obtained) for existing Ph-I 1320 (2x660) MW Units. It is proposed to utilise the power plant wastewater for plant reuse to achieve the Zero Liquid Discharge (ZLD) concept. It is envisaged to utilize cooling water blow down for ash handling purposes and treated wastewater will be used for plantation and gardening activities.

Streams of wastewater emanating from the power station sources during operational phase will be treated individually based on the wastewater quality. The treated wastewater will be recycled for plant use and for green belt development. Therefore, there will be no impact on the ground water resources.

The major wastewater generated from the plant like DM Plant discharge will be treated in a wastewater treatment plant and recycled. The coal pile area run off water during monsoon season will be led to a pond. Coal particles will settle down in the pond and clear water will be allowed to overflow to the central monitoring basin for treatment.

In the power plant, some specific locations in the Steam /Turbine Generator area require washing, to maintain good plant housekeeping and prevent build-up of dirt and waste material, which generates wastewater. This wastewater along with the process drain will be led to an oil water separator for separation of oil. The clear water will be led to the central monitoring basin. The dirty oil will be recovered separately in a drum.

The wastewater treatment plant, which receives discharges from neutralization pit of DM Plant, clarified wastewater from Oil Water Separator, etc. will be designed to enable maximum re-use/recycling. The treated wastewater will be utilised for plant consumptive requirements and for green belt development.

The wastewater from TPP shall be treated / neutralized in neutralization tank / pit and pumped to existing ash dyke using 2x100% transfer pumps.

The wastewater management system is designed for efficient recycling and reuse, focusing on minimizing environmental impact. The major sources of plant effluents include CW blowdown, WT plant effluent, coal pile area runoff, and plant drains. Specific measures for each effluent source is outlined as follows:

CW Blowdown:

- Part of CW blowdown will be utilized for ash/coal handling systems and horticulture needs.
- Excess blowdown will be directed to a guard pond.

Water Treatment Plant Effluent:

- Mainly comprises WT plant regeneration waste and filter backwash.
- Effluents will be pumped to the guard pond through a neutralizing pit.

Coal Handling Area Runoff:

- Drains from the coal handling area runoff will be directed to a settling pond.
- Settled coal particles will allow clear water to overflow to the storm water drain.

Plant Drains (SG/TG Area):

- Drains from SG/TG area will be led to a sump, collecting wastes from transformer and fuel oil farm areas.
- Oily effluents will undergo treatment in an oil-water separator, with clear water going to the guard pond and oily residue disposed of properly.

Guard Pond Treatment:

- Suitable treatment in the guard pond will ensure compliance with regulatory limits.
- Treated water from the guard pond can be used for irrigation or other purposes by local villagers.

Clarifier Sludge:

Clarifier sludge from CW and DM plant clarifiers will be pumped to the sludge handling system, featuring a thickener and centrifuge.

Cooling Tower Blowdown:

Cooling tower blowdown will be directed to the guard pond to maintain acceptable temperature levels before reuse within the plant or discharge outside.

Domestic Sewage:

Domestic sewage will undergo treatment in the proposed Sewage Treatment Plant (STP). Treated sewage will be utilized for greenbelt development.

The impact on water resources shall be insignificant as wastewater generating within the project site will be treated in the ETP & STP and is being recycled & reused following the zero liquid discharge (ZLD) concept.

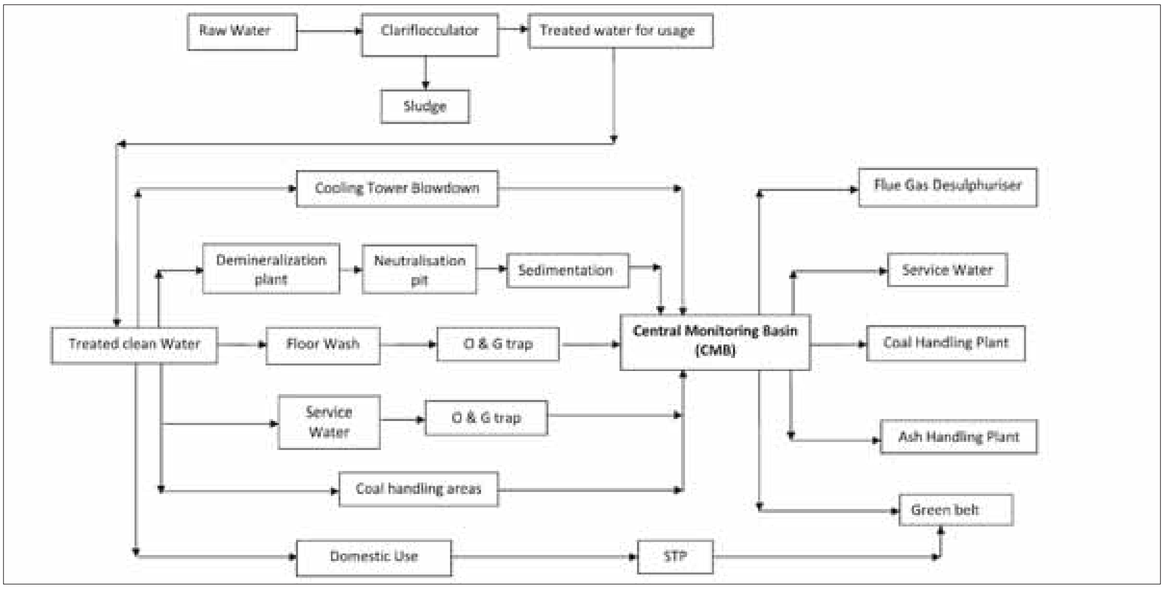


Figure 4.1: Schematic diagram of effluent treatment scheme

4.3.1.2 WATER CONSERVATION MEASURES AND OPTIMIZATION PLAN

The Water conservation measures and optimization adopted are listed below:

1. Recirculating type of cooling water (CW) system with mechanical draft cooling towers (CT) is being adopted. The cooling water system is designed considering Cycles of Concentration (COC) of 5.0 (five). During plant operation, all the measures will be taken to operate the plant above 5 COC which will help further reduce in water consumption. Moreover, drift loss in cooling tower will be maintained less than 0.02% by using multi-layer drift eliminators.
2. Recycling and reutilization of cooling tower blow down water is considered by adopting CW Blow down recycle scheme. Blow down water will be recycled back as cooling tower make up water and the reject water and balance CW blowdown water will be recycled to Ash handling system. No fresh water will be utilized for Makeup of Ash handling system.
3. In the water pre-treatment (PT) plant, thickener will be installed to recover underflow water of the PT plant clarifiers. Appx. 75% water is recovered from the thickener.
4. Effluent collected from various sources will be utilized in the Coal Handling Plant dust suppression system after necessary treatment.

5. In Sewage treatment plant (STP), the sewage generated is treated and utilized in Horticulture.
6. High Concentration Slurry Disposal System will be adopted for ash disposal which will reduce the water requirement substantially.

4.3.1.3 Rainwater Harvesting System

Rainwater harvesting provides an independent water supply during regional water restrictions and in developed countries is often used to supplement the main supply. It provides water when there is a drought, can help mitigate flooding of low-lying areas, and reduces demand on wells which may enable groundwater levels to be sustained. It also helps in the availability of potable water as rainwater is substantially free of salinity and other salts. Application of rainwater harvesting in urban water system provides a substantial benefit for both water supply and wastewater subsystems by reducing the need for clean water in water distribution system, less generated storm water in sewer system, as well as a reduction in storm water runoff polluting freshwater bodies.

There has been a large body of work focused on the development of Life Cycle Assessment and Life Cycle Costing methodologies to assess the level of environmental impacts and money that can be saved by implementing rainwater harvesting systems.

Area statement of proposed project site:-

S. No.	Type of structure/ Surface	Area(Sq. m.)
1	Plant Area	1380000
2	Reservoir	0
3	Coal Stock Yard	652000
4	Ash Dyke	570600
5	Ash based Industries	0
6	Township	0
7	Green Belt	1694400
Total		**42,97,000**

Designing of RWH System:

In designing any rainwater harvesting structure, capturing rainfall and runoff for local use is the key concept. Hard surface such as roof pavements and roads that decrease groundwater percolation constitute catchments and generate the high runoff which has to be diverted in to the storage tank & recharged in to ground water regime through simple filtration & injection well system for subsequent extraction by service wells. To improve water availability, rainwater harvesting is the most imminent & long-term solution.

In view of above, rainwater-harvesting structures at this point can serve the purpose of arresting roof top rainwater and runoff generated through roads in the area. The design is based on average annual rainfall, peak rainfall intensity and the intake capacity of the water by the aquifers. In order to determine intake capacity of water by unsaturated zone & aquifers zone, the recharge tests were carried out in the investigated area. For good design of rainwater harvesting, following points are to be kept under consideration:

- ✓ Ideal location with good ground slope.
- ✓ The location has adequate subsurface permeability of the aquifer to accommodate maximum recharge of rainwater through injection well.
- ✓ Rate of filtration should exceed average rainfall intensity.
- ✓ Clogging of filtration media should be cleaned periodically. Ground water pollution does not take place.

Design considerations:

The important aspects to be looked into for designing the rain water harvesting system to augment ground water resources are:

- ✓ Hydrogeology of the area including nature and extent of aquifer, soil cover, topography, depth to water level and chemical quality of water.
- ✓ The availability y of source water one of the prime requisites for ground water recharge, basically assessed in terms of non-committed surplus monsoon runoff.
- ✓ Area contributing runoff like area available, land use pattern, industrial, green belt, paved areas, roof top area etc.
- ✓ Hydro metrological characters like rainfall duration, general pattern and intensity of rainfall.

Calculation of RWH of project.

Based on the site plan of the project area, the computation of rainfall runoff of entire project premises has been worked out and the details are tabulated below:

Calculation of Hourly Runoff:

S. No.	Type of structure/ Surface	Area (Sq. m.)	Run off Coefficient	Intensity Rainfall (m/hr)	Total discharge(m^3/hr)
1	Plant Area	1380000	0.2	0.04	11040.00
2	Reservoir	0	1	0.04	0.00
3	Coal Stock Yard	652000	0.2	0.04	5216.00
4	Ash Dyke	570600	1	0.04	22824.00
5	Ash based Industries	0	0.85	0.04	0.00
6	Township	0	0.85	0.04	0.00
7	Green Belt	1694400	0.15	0.04	10166.4
Total		**42,97,000**			**49246.4**

Calculation of Annually Runoff:

S. No	Type of (Structure/ Surface)	Area (Sq. m.)	Run off Coefficient	Rainfall (m)	Quantum of recharge available(m^3/ annum)
1	Plant Area	1380000	0.2	1.044	288144
2	Reservoir	0	1	1.044	0
3	Coal Stock Yard	652000	0.2	1.044	136137.6
4	Ash Dyke	570600	1	1.044	595706.4
5	Ash based Industries	0	0.85	1.044	0
6	Township	0	0.85	1.044	0
7	Green Belt	1694400	0.15	1.044	265,343.04
Total		**42,97,000**			**1285331.04**

Calculation of No. of Structure.

Based on the proposed area, a total of 1285331.04 m^3 of rainwater will be collected annually from the project site. Calculations show that the coal stock yard area (652,000 m^2) will yield an annual runoff of 136,137.6 m^3, requiring a certain number of rainwater storage ponds. The open areas, including the plant area (1,380,000 m^2) and green belt area (1694400 m^2), will generate an annual runoff of 553487.04 m^3, which will be directed to rainwater percolation ponds. The remaining 595,706.4 m^3 of water will be collected in the ash dyke.

I. Coal Stock Yard

Pond Location	Area of Pond (m^2)	Depth (m)	Water Storage capacity (m3/year)
Near Coal Stock Yard	(50X50) 2500	3	7500 X 2 = 15000

Based on the calculations above, we have proposed a total of one Storage pond. This pond will be filled Two times a year.

II. Plant area & Green Belt area

As per GWRE-2022, it is assumed that total 60% of the stored water has been percolated in the ponds and which recharges the ground water. The ground water recharge by percolation ponds have been given in below table:-

Pond Location	Area of Pond (m2)	Depth (m)	Water Storage capacity (m3/year)	60% Natural Recharge (m3/year)
Near Plant Site	(80x60) 4800	3	14400 X 2 =28800	17280
Green belt area	(80x80) 6400	3	19200 X 2=38400	23040
Total			**62400**	**40320**

Based on the calculation above, we have proposed two rainwater percolation ponds, each of which will be filled twice a year.

4.3.2 IMPACT ON AIR QUALITY

As it has been described earlier in Chapter-II, the operational activities will have impacts on the air quality of the study area.

The results of the monitored data indicate that the ambient air quality of the region in general is conformity with respect to norms of National Ambient Air Quality standards of CPCB, at all locations monitored.

To determine the significance of impacts of project with reference to the baseline ambient air quality status of the study area, impact assessment has been carried out for various emission sources from project as described below.

The proposed coal-based thermal power station is anticipated to emit pollutants such as SO_2, NOx, and PM through flue gas stacks. Additionally, airborne fugitive dust from coal handling plants is expected, leading to deposition on topsoil and leaves of nearby flora. Fugitive dust poses concern for residents, nearby trees accumulating deposits on leaves, and local fauna exposed to the respirable component of these particles. Predictions have been made for stack emissions and emissions from crusher houses, taking into account the worst coal characteristics.

a. Fugitive Emission

The air borne fugitive dust from the plant is likely to be generated from coal handling plants, stockpiles and traffic movement which will be deposited on the topsoil in the immediate vicinity of the plant boundary.

However, the fugitive emission is likely to be controlled to a great extent through control measure like dust suppression system at coal transfer point, dedusting system at Crusher House by bag filter, greenbelt etc. The impact of fugitive emissions from all sources is likely to be restricted over a limited area (up to a maximum distance of 500 m from the source).

b. Process Stack Emission

The flue gas emissions from the plant units, resulting from coal combustion, are the primary contributor to increased pollution levels in the ambient air. The emissions will be kept within the specified limits of 30 mg/Nm^3 for PM and 100 mg/Nm^3 for SO_2 & NOx, adhering to TPP standards. Mercury (Hg) emissions will be insignificant and below the TPP emission standard of 0.03 mg/Nm^3 for Indian coals.

In order to quantify the maximum likely impact within buffer area around the project site, the contribution of the existing as well as proposed units of the power plant on the ambient concentration level is assessed using suitable approved dispersion model.

4.3.2.1 Air Dispersion Modeling Methodology

Modeling Approach

The assessment methodology for the air dispersion modelling exercise follows the guidance specified in the US EPA user guide for AERMOD. The model of selection is the commercially available AERMOD View dispersion model, developed by Lakes Environmental. This model is used extensively to assess pollution concentration and deposition from a wide variety of sources. AERMOD View is a true, native Microsoft Windows application and runs in Windows applications. The AMS/EPA Regulatory Model (AERMOD) was specially designed to support the EPA's regulatory modelling programs. AERMOD is a regulatory steady-state plume modelling system with three separate components:

AERMOD (AERMIC Dispersion Model), AERMAP (AERMOD Terrain Pre-processor), and AERMET (AERMOD Meteorological Pre-processor). The AERMOD model includes a wide range of options for modelling air quality impacts of pollution sources, making it a popular choice among the modelling community for a variety of applications. Some of the modelling capabilities of AERMOD include the following:

- The model may be used to analyze primary pollutants and continuous releases of toxic and hazardous waste pollutants.
- Source emission rates can be treated as constant or may be varied by month, season, hour-of-day, or other optional periods of variation. These variable emission rate factors may be specified for a single source or for a group of sources. For this project all emission rates were treated as constant.
- The model can account for the effects of aerodynamic downwash due to buildings that are nearby point source emissions.
- Receptor locations can be specified as gridded and/or discrete receptors in a Cartesian or polar coordinate system.

- For applications involving elevated terrain, the U.S. EPA AERMAP terrain preprocessing program is incorporated into the model to generate hill height scales as well as terrain elevations for all receptor locations.
- The model contains algorithms for modeling the effects of settling and removal (through dry and wet deposition) of large particulates and for modeling the effects of precipitation scavenging for gases or particulates.

AERMOD requires two types of meteorological data files, a file containing surface scalar parameters and a file containing vertical profiles. These two files are provided by the U.S. EPA AERMET meteorological preprocessor programme.

MODEL INPUTS

Source Emissions

A critical step for conducting air dispersion modelling is to quantify the emissions from the various sources at the project. Emission rates should be estimated in the following order of preference:

- Continuous emissions monitoring data
- Stack Emission Testing data
- Manufacturer's emission data
- Mass balance calculations
- Emission factors
- Engineering calculations

Table below shows the source information data determined for the proposed expansion project, while Table displays the emission rates that were calculated based on the use of manufacturer’s emission specifications:

Table 4.4: Details of Emission Rate

S. No.	Parameters	Units	Proposed 4x800 MW
1	Stack Height	m	275
2	No. of flue	No.	2

S. No.	Parameters	Units	Proposed 4x800 MW
3	Top diameter of flue	m	11.0
4	Flue gas velocity in each flue	m/s	25
5	Flue gas temperature	°K	363
6	Flow rate of gas in each flue	Nm^3/s	2375.82

Model Domain, Receptor Network and Terrain Considerations

The selected model domain was 10 km in both the east-west and north-south directions, with the centre of the domain being the centre of the proposed project site, with coordinates 23.363944, 82.045243. Figure 1 shows the model domain that was utilized in the project, including the receptor grid and the sources.

Receptor Network

The selection and location of the receptor network are important in determining the maximum impact from a source and the area where there is significant air quality impact. Impacts were assessed at locations beyond the fence line. Consequently, the receptor locations were selected as a grid that is defined by polar grids, circular in shape, and with origin at the centre of the proposed project site. A fence line grid was also included with spacing of 10-degree increase in all 36 directions from the proposed project fence line. Total 191 receptors have been selected for the 10 km buffer of the project with 21 points each side. A total of 11 discrete receptors were included in the model at the locations where baseline monitoring was conducted. Figure 4.2 illustrates the receptors selected for baseline assessment.

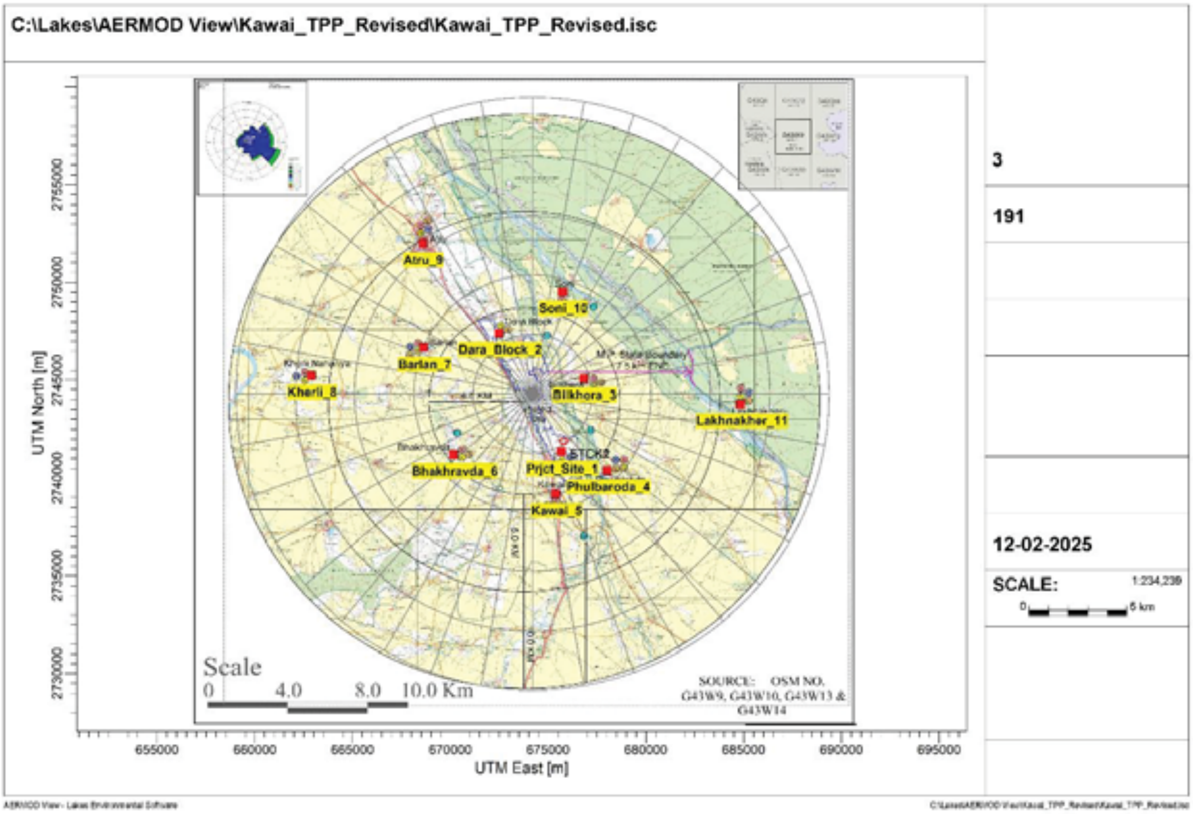


Figure 4.2: Receptor Map

Terrain Considerations

The classification of the land use in the vicinity of the proposed project is needed because dispersion rates differ between urban and rural areas. In general, urban areas cause greater rates of dispersion because of increased turbulent and buoyancy-induced mixing. This is due to the combination of greater surface roughness caused by more buildings and structures and greater amounts of heat released from concrete and similar surfaces. The USEPA guidance provides two procedures to determine whether the character of an area is predominantly urban or rural. One procedure is based on land-use type, and the other is based on population density. Both procedures require an evaluation of characteristics within a 3-km radius from the subject source, but the land-use methodology is considered more accurate. Hence, this method was applied and it was determined that the rural dispersion coefficient be selected for this modeling project.

Additionally, the topography in the region of the proposed project is defined as either simple terrain (terrain lying below the stack top elevation) or complex terrain (terrain above the top of the stack). Measurements of the terrain in the area surrounding the proposed project were made using terrain data obtained from SRTM 30 m derived from the WebGiS. It was determined that the topography in study area varies from 258 m to 425 m (see Figure 4.3).

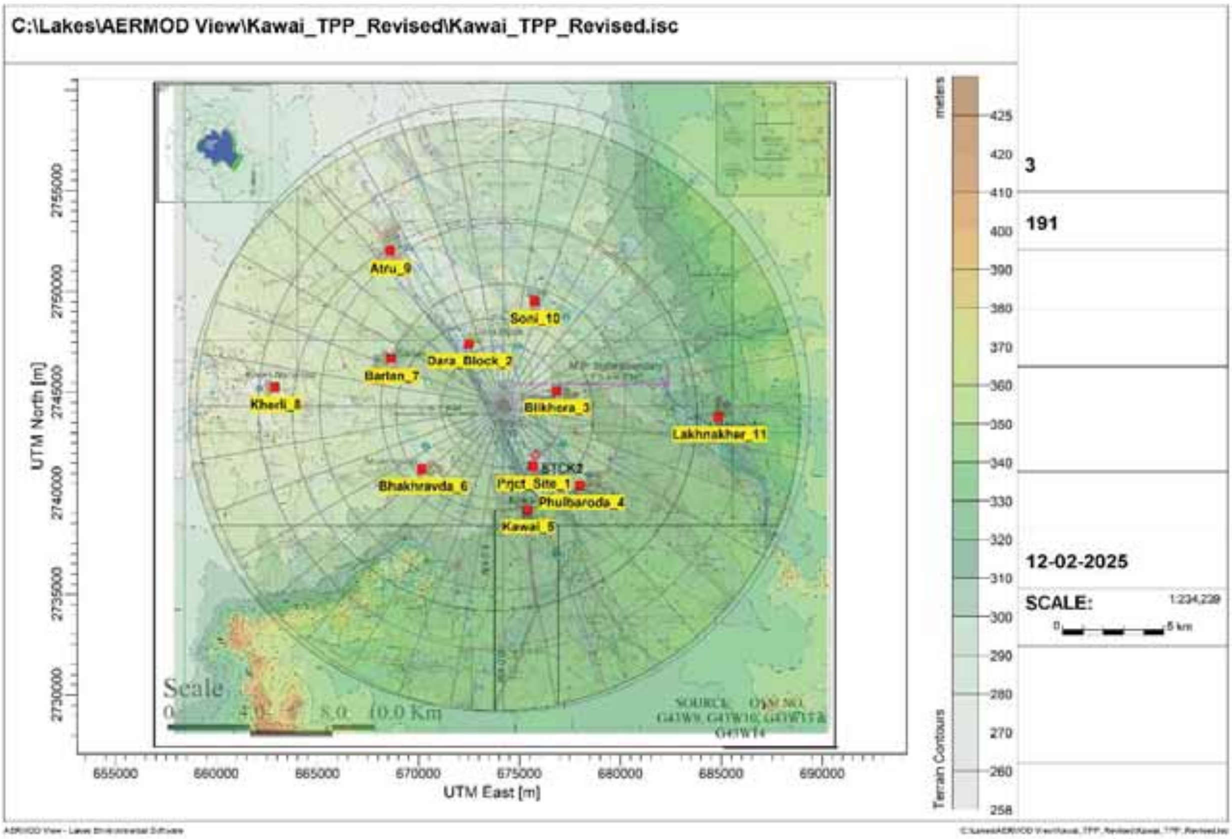


Figure 4.3: Terrain Map

Meteorological Data

The AERMOD model requires hourly surface data values for wind speed, wind direction, temperature, rainfall, relative humidity, pressure, cloud cover and ceiling height and solar radiation and at least once daily mixing height data. Surface data (temperature, rainfall, relative humidity, pressure, cloud cover and solar radiation as well as wind data (direction and speed) was utilized for the study which is collected from a local weather station located at near proposed site location.

Both data files for the surface and mixing heights were then used to generate the meteorological file required by the AERMOD dispersion model using the AERMET meteorological preprocessor programme. This AERMET programme has three stages to process the data. The first stage extracts meteorological data and assesses data quality through a series of quality assessment checks. The second stage merges all data available for 24-hour periods and writes these data together in a single intermediate file. The third and final stage reads the merged meteorological data and estimates the necessary boundary layer parameters for dispersion calculations by AERMOD.

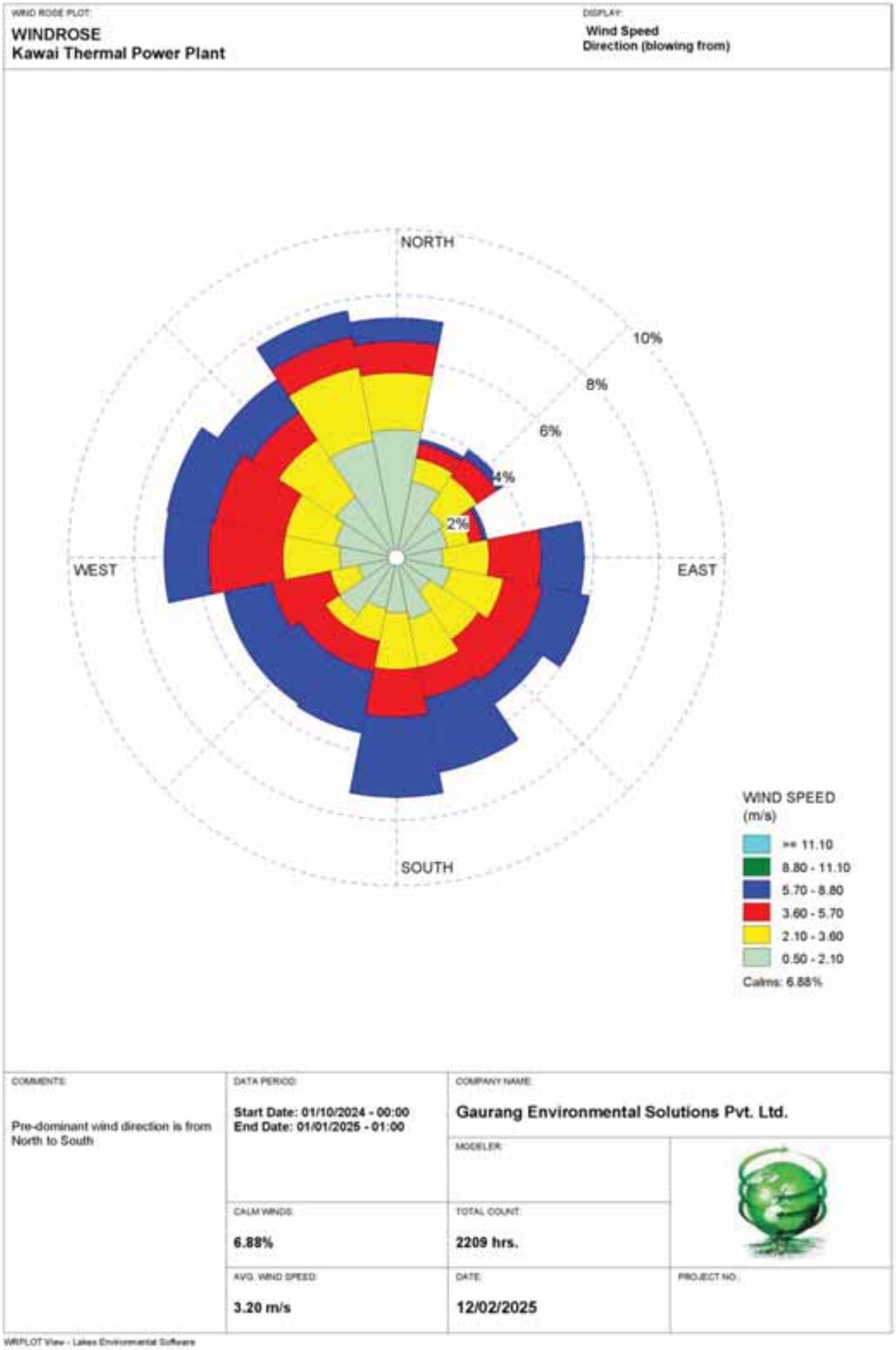
The 2024 meteorological pre-processed data (Post-Monsoon) was used to determine its corresponding Wind Rose plot. The Wind rose show that the most predominant wind direction blows from the North-west to South-east, second predominant direction is from south to north.

Table 4.5: Micrometeorological Condition

Brief Statistics	Height of Convectively-Generated Boundary Layer - PBL	Height of Mechanically-Generated Boundary Layer - SBL	Monin-Obukhov Length	Surface Roughness Length	Bowen Ratio	Albedo
	m	m	m	m		
Max	3239	3997	5972.3	1	1.62	1
Min	0	0	0	0.0001	0.45	0.14
Mean	223.7034	691.9556	217.287	0.419108	1.014431	0.680269

The table 4.5 represents various meteorological parameters for the study area, providing insights into atmospheric and surface conditions that influence air quality and pollutant dispersion. The meteorological parameters presented in the table provide valuable insights into boundary layer dynamics and surface-atmosphere interactions. The Convectively-Generated Boundary Layer (PBL) Height and the Mechanically-Generated Boundary Layer (SBL) Height exhibit maximum values of 3239 m and 3997 m, respectively, indicating significant atmospheric mixing under optimal conditions. The minimum values of 0 m suggest periods of suppressed turbulence, possibly during stable nighttime conditions or due to data limitations. The Monin-Obukhov Length, with a range from 0 m to 5972.3 m, and an average of 217.287 m, reflects varying atmospheric stability, where lower values indicate strong turbulence, and higher values signify more stable conditions.

The Surface Roughness Length, averaging 0.419 m, suggests the presence of relatively smooth terrain with minimal surface obstacles affecting wind flow. The Bowen Ratio, ranging from 0.45 to 1.62, with an average of 1.014, indicates a balance between sensible and latent heat fluxes, with values above 1 signifying drier condition where more energy is used for heating rather than evaporation. The Albedo, with an average of 0.680, highlights variations in surface reflectivity, influencing the local radiation balance and energy absorption.



MODEL RESULTS

With the various sources identified, a model domain established of 10 km in the east-west direction and centered in the middle of the proposed project, and the necessary input files created, model predictions were made for the pollutant's NOx, PM10 and NOx for averaging periods for which there are National Ambient Air Quality Standards. Model runs were conducted for the proposed project's air pollutant sources air quality impact in combination with the other defined sources in the vicinity of the proposed project.

4.3.3 IMPACT OF TRAFFIC ON EXISTING ROAD INFRASTRUCTURE

The proposed expansion project will inevitably increase traffic in the region and result in increased traffic load on the roads connecting the project site. It is essential to study the baseline traffic scenario and carrying capacity of the road infrastructure to cater to the proposed increase in traffic load due to the proposed expansion project. The study is a means of identifying and documenting any deficiencies or improvements both –operational and physical- necessary to accommodate current or projected traffic volumes. Traffic impact study can be used to help evaluate whether the development is appropriate for a site and what type of transportation improvements may be necessary. It will help: -

a. To establish the existing trips/day without the project activity;
b. To understand the increment on the traffic load due to the project activity;
c. To know the existing road will sustain or not after the commissioning of the project.

4.3.3.1 INDIAN ROAD CONGRESS (IRC) GUIDELINES

Factors for conversion of different type of vehicles into equivalent passenger car unit (PCU) based on their relative interference value as per IRC guidelines i.e. IRC 64:1990 (*Guidelines for capacity of Roads in Rural Areas*) is given below:

Table 4.6:Recommended PCU factor for various types of vehicles on Rural Roads

S. No.	Vehicle type	Equivalency factor for PCU
	Fast vehicles	
1.	Motor cycle or scooter	0.50
2.	Passenger car, Pick-up van or auto-rickshaw	1.00

S. No.	Vehicle type	Equivalency factor for PCU
3.	Agricultural tractor, Light commercial vehicle	1.50
4.	Truck or Bus	3.00
5.	Truck-trailer, agricultural tractor-trailer	4.50
	Slow Vehicles	
6.	Cycle	0.50
7.	Cycle-rickshaw	2.00
8.	Hand cart	3.00
9.	Horse-drawn vehicle	4.00
10.	Bullock cart*	8.00

*for smaller bullock-carts, a value of 6 will be appropriate.

Source: IRC 64:1990

4.3.3.2 LEVEL OF SERVICE (LOS)

Capacity standards are fixed normally in relation to the Level of Service (LOS) adopted for design. Six levels of service are recognized commonly designated from A to F. Considering the need for smooth traffic flow; it is recommended that normally LOS-C be adopted for design of urban roads. At this level volume of traffic will be around 0.70 times the maximum capacity. Capacity or Design Service volume is the maximum hourly volume at which vehicle can reasonably be expected to transfers a point or uniform section of a lane or road way during a given time period. As per IRC 64: 1990 guidelines, ratio of existing volume of PCU on roads (V) and its capacity (C) with corresponding level of services (LOS) and their performance is given below: -

Table 4.7: Referenced V/C ratio for LOS & performance of the road

V/C	LOS	Performance
0.0 - 0.2	A	Excellent
0.2 - 0.4	B	Very Good
0.4 - 0.6	C	Good / Average / Fair
0.6 - 0.8	D	Poor
0.8 - 1.0	E	Very Poor

(Note: capacity as per IRC: 64-1990)

4.3.3.3 TRAFFIC ANALYSIS AS PER IRC GUIDELINES

Traffic analysis is carried out by understanding the existing carrying capacity of the roads near to the project site and the connecting main roads in the area. Then depending on the capacity of the project, the number of vehicles that will be added to the present scenario will be compared to the carrying capacity.

4.3.3.4 METHODOLOGY

The methodology adopted for the traffic study includes

- identification and analysis of existing transport network.
- identifying traffic survey locations, conducting 24-hour preliminary traffic survey to gather base data information about existing traffic and travel pattern on surrounding roads, traffic forecast due to proposed expansion project,
- identifying impact of increased traffic on existing road network by adding increased PCU to the existing PCU to estimate the impact of increased PCU due to proposed expansion project on the Level of Service,
- preparing a traffic management plan based on internal circulation plan and these propose development projects to manage the traffic.

4.3.3.5 BASELINE DATA COLLECTION

Baseline traffic survey has been done on State Highway 8 (~5.0 Km towards North of project site) & Village road (adjacent to project site) connecting project site to state highway. Village road connecting project site to State highway will be strengthened after obtaining permissions from concerned authorities.

The LOS value is calculated as 0.0759 & 0.0379 for Village road & S.H. 8 respectively, i.e. “A” and the traffic condition is “Excellent” for both roads.

4.3.3.6 TRAFFIC IMPACT ANALYSIS DURING OPERATION PHASE

Table 4.8: Increase in traffic load due to proposed project

S. No.	Material to be transported	Quantity (TPD)	Average capacity of transportation vehicle	No. of vehicles per day	PCU factor	PCU/Day
2	Fly ash	16612	Bulker/ 55 Ton	302	3	906
3	Bottom ash	4153	Trucks / 55Ton	76	3	228
Total vehicles per day				**378**		**1,134**

Total no. of increased PCU per day =1134

No. of trips = 2

Therefore, total no. of increased PCU per day = 2268

Table 4.9: Modified Traffic Scenario and LOS- village road

Road	Existing LOS	Changed V/C and LOS after adding generated traffic from operational phase of proposed project			
		V	C	V/C	Modified LOS
Village road	A 'Excellent'	455.5 + 2268= 2,723.5	6000	0.45	B 'Very Good'

Table 4.10: Modified Traffic Scenario and LOS-State highway

Road	Existing LOS	Changed V/C and LOS after adding generated traffic from operational phase of proposed project			
		V	C	V/C	Modified LOS
S.H. 8	A 'Excellent'	569.5 + 2268= 2,837.5	15000	0.189	A 'Excellent'

4.3.3.7 OBSERVATION & CONCLUSION

The existing LOS value i.e. 'A' of State highway 8 is remains same & that of village road is reducing to B 'Very Good' due to proposed traffic increase of 2268 PCU per day. Thus, it can be concluded that the present approach road network is insufficient to handle the increased traffic load due to the proposed project and requires efforts for road upgradation by state administration as well.

4.3.3.8 MITIGATION MEASURES

In order to mitigate the impact due to increased vehicular load, it is proposed to ensure that

- Adequate parking space for trucks, cars and 2-wheelers is provided in the plant premises.
- Heavy trucks would be parked in designated parking area only and idle running would be avoided.
- Further, major fuel i.e. Coal would come by rail.
- Vehicles moving within the plant premises are speed controlled & PUC Certified.
- Roads and crossings would be suitably planned to avoid traffic congestion.
- Plant layout has been planned having all internal roads minimum 6m width and 9m turning radius with proper looping for smooth traffic flow, including fire tender as per NBC. Road network will connect all service areas in layout.
- Village road connecting project site to State highway will be strengthened after obtaining permissions from concerned authorities.
- Fugitive emission arising from vehicular movement for transportation of raw materials & finished products would be mitigated by installation of tyre washing system and using speed controlled vehicles.

4.3.4 NOISE ENVIRONMENT

IMPACT

During operation, the major noise generating sources from various units of the plant are;

- Crusher unit
- Induced draft & Forced draft fans
- Boilers feed pump
- Turbine
- Generator
- Cooling Tower
- vehicular movement

During the operation phase, the noise anticipated from the proposed expansion project shall be highest within the source area. The details of the noise generating sources are given in Table 4.13:

Table 4.11: Noise Levels for Different Sources

S. No.	Name of source	Noise level, dB (A)
1	ID & FD Fans	85
2	Crusher unit	85
3	Boilers feed pump	85
4	Turbine generator	90
5	Cooling Tower	80

MITIGATION MEASURES

Following mitigation measures are being/will be adopted:

- Acoustic enclosure shall be provided with TG set
- Compressor shall be housed in a separate room with acoustic wall panelling.
- Noise proof cabins will be provided for operators wherever possible
- Inlet and outlet mufflers shall be provided wherever required.
- Suitable isolators will be provided at required locations to avoid rattling due to vibration
- Process air blower, pneumatic valves etc., shall be provided with Silencers
- Noise shall be reduced by preventing leakages from compressed air lines and steam lines
- The high noise zones are demarcated and provided with enclosures & barriers.
- The risks of exposure to high noise levels and the appropriate control measures will be displayed at various places in the workplace.
- Design/installation will be taken as specified by the manufacturers with respect to noise control and will be strictly adhered.
- Sound attenuation panels will be installed wherever required around noise generating equipment.
- All rotating equipment / parts will be well lubricated and provided with enclosures as far as possible to reduce noise transmission.
- Regular maintenance of all the machinery and equipment shall be done

- Regular ambient noise level checks shall be carried out at the site
- Greenbelt development inside the plant premises shall be done which will serve as a buffer between the periphery and the industry, there by controlling noise level.
- In addition to this, effective ear plugs will be provided and their use will be made mandatory in specified areas where noise level is high.

Table 4.12: Proposed Noise Pollution Control Devices

S. No.	Pollution control device with noise source	Control measure
1	Compressor house	Acoustic panelling
2	start-up vent, safety valve outlets	Silencer
3	Hogging Ejector	Silencer
4	TG Set	Acoustic enclosure
5	Water pump and Compressor (Rolling Mill)	Rubber mounting

Elevated noise levels would have detrimental impact on the health of working personnel in and around the plant premises. Health effects due to noise include hearing impairment, hypertension, cardiovascular diseases and sleep disturbance. Beyond these effects, elevated noise levels can create stress, increase workplace accident rates, and stimulate aggression and other anti-social behaviours. Higher noise levels also have traumatizing effect on animals.

The monitored baseline data shows that the existing noise level for the study area are within the regulatory standards. The integrated noise mitigation measures would control the generated noise due to the proposed expansion project and there would be minimal impact due to the additional generation of noise. Apart from these measures, the peripheral greenbelt would help in containing the generated noise within the plant boundary.

4.3.5 IMPACT ON SOIL ENVIRONMENT

Major impact on the soil will be due to storage of coal, gypsum, storage, handling and transportation of solid wastes and hazardous wastes and also on the soil of nearby agricultural land due to air pollution. Impact due to air pollution has been discussed in the previous sections.

Leachate from improper storage of material, solid waste like ash, hazardous waste like used/spent oil etc. may alter the soil characteristics of the area can also contaminate soil and subsequently ground water regime.

4.3.5.1 MITIGATION MEASURES

Action Plan to avoid Leaching

- All the yards will have RCC flooring after hard surface rolling and compacting.
- Along with that, all the yards will have proper drainage system with garland drains & guard ponds.

4.3.6 SOLID WASTE GENERATION, IMPACT AND MANAGEMENT

- Fly ash and bottom ash will be main solid waste to be generated from the plant. The details of the ash generated from the proposed power plant are given in Table 4.15. 100% utilization of fly ash as per MoEF&CC guidelines is proposed.
- The bottom ash will be collected in wet form and fly ash in dry form. Fly ash will be collected in dry form to facilitate utilization.
- Ash Dyke is proposed in 57.06 Ha, which is less than **0.1 Ha./MW** (i.e. 320 Ha. for 3200 MW) allowed as per Fly Ash Notification dated 31.12.2021.
- Unutilized Fly ash and bottom ash shall be disposed via High Concentration Slurry disposal (HCSD) system to Ash dyke in case of exigencies.
- Bottom ash generated shall be supplied to the Road Mix Concrete (RMC) / brick producers / filling of low lying area / filling of mine voids as per the statutory guidelines thereby eliminating the need for separate area shall be explored.

Table 4.13: Ash generation from the Proposed Plant

S. No.	Description	Ash quantity in Million TPA	Management & disposal
1.	Fly ash	4.12	Collection in dry form, pneumatic transfer to closed silos & sent to cement manufacturing, Construction work (RMC plant, Roads, Highways), Brick Manufacturing, etc.
2.	Bottom ash	1.04	Collection in wet form & Road Mix Concrete (RMC) / brick producers / filling of low lying area / filling of mine voids
Unutilized Fly ash and bottom ash shall be disposed via High Concentration Slurry disposal (HCSD) system to Ash dyke in case of exigencies.			

IMPACT

- Improper storage, handling and disposal of solid & hazardous waste leads to contamination of soil, ground water and surface water.
- Contamination may also be caused by spillage of hazardous waste, run-off from hazardous waste storage area etc.
- Plants may take up contaminants from soil and accumulate toxic substances ultimately adversely affecting human / animal health due to ingestion.
- Hazardous waste and some industrial wastes as well by virtue of their quantity may alter soil profile affecting soil fertility and soil microbiology.
- Soaking through soil, the toxic substances may reach and contaminate ground water table / aquifer rendering it unfit for human / animal consumption.

Hazardous Waste Generation, Storage & Disposal

Table 4.14: Hazardous waste details

S. No	Type of waste	Source of generation	Schedule as per HWM Rules, 2016	Quantity	Handling & disposal
1	Used or spent oil	DG set operation & Machine operation	Schedule I, Category 5.1	90 TPA	Handed over to CPCB/SPCB approved recycler

2	Empty barrels/containers/liners contaminated with hazardous chemicals /wastes	Handling of hazardous chemicals and wastes	Schedule I Category 33.1	15 TPA	Collection, Storage, Transportation and disposal to authorized recycler
3	Contaminated cotton rags or other cleaning materials	Handling of hazardous chemicals and wastes	Schedule I Category 33.2	15 TPA	Collection, Storage, Transportation and disposal to authorized TSDF

- Hazardous waste will be handled, stored & disposed off in line with Hazardous & Other waster (management & transboundary movement) Rules 2016, amended till date.
- Separate covered storage area with impervious flooring and catch drains connecting to WTP will be provided with Hazardous waste storage area.
- E-Waste (~3.5 TPA), Battery waste (~7.0 TPA), Bio-medical waste (0.12 TPA) will be handled, stored & disposed of as per applicable rules & guidelines.
- Used batteries will be will be given back to the supplier under buy back agreement with supplier.
- Bio-medical waste generated from medical unit will be handed over to nearest CBWTF &/or hospital having BMW disposal agreement with CBWTF.

Municipal Solid waste generation & management

Improper disposal of MSW may cause contamination of soil, ground water and surface water over time. It may lead to odour nuisance as well as increased disease vectors in the area.

Table 4.15: Municipal Solid waste generation & disposal

Particulars	**Population**	**Basis**	**Quantity of waste generated (in kg/day)**
Workers	2700	@0.3 kg/day	810.0
Landscaping	714.91 acre	@0.2kg/acre/day	143.0
STP sludge (dry)	--	--	50
Total			**1003**

- MSW generated to the tune of ~1.0 TPD will be collected, segregated at source itself using color coded bin collection system placed strategically in the plant premises.

  The organic component of MSW will be segregated and composted in Organic waste converters proposed at site. The remaining waste will be handed over to contractor for final disposal to municipal waste dump site.

4.3.7 IMPACT ON BIOLOGICAL ENVIRONMENT AND MITIGATION MEASURES

Table 4.16: Impact identification

Environmental Component	Impact Type	Description of Impact	Affected Species/Groups	Magnitude of Impact	Duration
Flora	Habitat Loss	Clearing of vegetation for plant construction and associated infrastructure	Terrestrial plants, forest species, shrubs, herbs	High	Long-term
	Air Pollution (SOx, NOx, PM)	Emission of pollutants from combustion processes, affecting plant health and growth	Sensitive plant species, crops, local vegetation	Moderate	Continuous
Fauna	Habitat Fragmentation	Disruption of wildlife corridors due to plant expansion and infrastructure	Mammals, birds, reptiles, amphibians	High	Long-term
	Direct Mortality (due to accidents)	Accidental deaths of small fauna from construction machinery, vehicular movement	Small mammals, reptiles, amphibians	Moderate	Short-term
Aquatic Ecosystems	Thermal Pollution	Discharge of heated water from cooling systems, raising water temperatures in local water bodies	Aquatic life (fish, amphibians, aquatic plants)	Moderate	Continuous
	Water Consumption	High water demand for cooling and other plant operations, reducing water availability for local ecosystems	Freshwater species, aquatic plants, local fauna dependent on water	Moderate	Long-term
Soil	Soil Erosion	Disturbance of soil due to construction activities, leading to erosion and sedimentation in nearby areas	Soil flora, microorganisms, plants	Low to Moderate	Short-term
Air Quality	Air Pollution (PM, SOx, NOx)	Emission of particulate matter, sulfur oxides, and nitrogen oxides affecting	Terrestrial plants, herbivores, birds	High	Continuous

		air quality and plant/animal health			
Noise	Noise Pollution	Increased noise levels from construction, transportation, and plant operation affecting local wildlife	Birds, mammals, amphibians (sensitive to noise)	Moderate	Short-term to Continuous
Climate Change	Greenhouse Gas Emissions	CO_2 and other greenhouse gases emitted from plant operations contributing to global climate change	Global ecosystem, local flora and fauna indirectly	High	Continuous
Ecosystem Services	Disruption of Ecosystem Services	Disruption of water purification, soil fertility, pollination, and other ecosystem services	Local flora and fauna, agricultural activities	Moderate	Long-term
Endangered Species	Threat to Endangered Species	Risk to endangered species due to habitat destruction, pollution, and human disturbance	Endangered mammals, reptiles, birds	High	Long-term

Figure:4.4 Dust on tree leaves caused by intense vehicular traffic (Buffer Zone)

Dust on tree leaves caused by intense vehicular traffic can negatively impact the health and growth of vegetation. The dust can block sunlight, reduce photosynthesis, and clog stomata, which are essential for gas exchange. Additionally, accumulated dust may harbor pollutants that can damage plant tissues and inhibit nutrient absorption, ultimately stunting growth and weakening the overall health of the vegetation.

Figure: 4.5 Alag bloom in different water bodies (Buffer Zone)

Excessive nutrients, particularly phosphorus and nitrogen, cause the rapid growth of algae (algal blooms). These blooms can deplete oxygen levels in the water, creating "dead zones" where aquatic life cannot survive.

Table 4.17: Impact Evaluation & Mitigation Measures

Environmental Component	Mitigation Measures	Implementation Details	Monitoring/Follow-up
Flora	Compensatory Afforestation: Planting of native species to replace lost habitat.	Afforestation programs should follow a 1:3 ratio (1 tree cut, 3 planted). Focus on native species that are ecologically relevant.	Annual survival rate checks for planted species. Success rate of restoration programs.
	Buffer Zones: Creation of protective green buffers around the plant.	Establish buffer zones around key ecosystems to protect surrounding flora. These zones should be free from any industrial activity.	Monitoring of buffer zone integrity and effectiveness.
	Air Pollution Control Systems	ESPs to control particulate matter, De-NOx System, SOFA/SCR system, Dust suppression & Extraction system, Fogger system etc.	Regular air quality monitoring around the plant, with focus on PM, SOx, and NOx levels.
	Planting Pollution-Tolerant Species: Introduce species that can tolerate air pollutants.	Use species known to thrive in polluted environments for vegetation restoration around the plant.	Periodic monitoring of plant health and growth.

Fauna	Wildlife Corridors: Creation of wildlife corridors to maintain connectivity.	Develop corridors that link fragmented habitats. Ensure these corridors are wide enough to support a range of species.	Monitoring of wildlife movement and corridor effectiveness.
	Relocation of Species: Relocate fauna from construction zones.	Prior to construction, assess and relocate threatened species to nearby protected areas.	Success rate of species relocation and monitoring of post-relocation health.
	Wildlife Fencing: Install fencing around construction areas to prevent fauna from entering.	Fencing should be wildlife-friendly, allowing small animals to pass but preventing larger species from entering hazardous zones.	Regular wildlife mortality surveys and fencing integrity checks.
	Wildlife Monitoring and Rescue: Establish a rescue program for fauna during construction.	A dedicated wildlife rescue team should be on-site during peak construction periods to ensure quick action if animals are trapped.	Regular checks on wildlife rescue operations and mortality rates.
Aquatic Ecosystems	Cooling Towers: Use of cooling towers to minimize thermal discharge.	Cooling towers will reduce the temperature of water released into the environment.	Continuous monitoring of water temperature at discharge points.
	Water Temperature Regulation: Use of mixing zones and aeration techniques.	Aeration of discharged water and regulation of mixing zones to prevent sharp temperature gradients.	Monitoring of aquatic species' health and water temperature.
	Water Recycling: Use of treated wastewater for cooling processes.	Implement closed-loop cooling systems to minimize fresh water use.	Monitoring of water usage and availability in local water bodies.
	Rainwater Harvesting: Collection and use of rainwater to reduce dependence on local water bodies.	Install rainwater harvesting systems for non-potable uses like cooling.	Regular audits of water usage and conservation efforts.
Soil	Soil Stabilization: Use of mulching, grass planting, and erosion control techniques.	Apply erosion control measures such as silt fences, erosion mats, and seeding with native grass species.	Soil erosion monitoring during construction and after restoration.
	Minimize Soil Disturbance: Careful management of construction activities to limit soil disruption.	Limit earthworks to designated areas and use machinery with minimal soil impact.	Inspection of construction zones for soil disturbance and erosion.
Air Quality	Advanced Pollution Control: Installation of advanced filtration and scrubber systems.	Install electrostatic precipitators (ESP), De-NOx System, SOFA/SCR system, Dust suppression & Extraction system, Fogger system etc.	Regular air quality monitoring in surrounding areas, focusing on PM, SOx, and NOx.
	Green Belt Development: Planting trees around the plant to act as natural air filters.	Develop a dense green belt around the plant to absorb pollutants and reduce air dispersion.	Monitoring of green belt health and air quality improvements.
Noise	Noise Barriers: Installation of noise barriers around construction zones and plant.	Use soundproofing materials and barriers to reduce noise levels during construction and operation.	Noise level monitoring at key locations near

			the plant and construction zones.
	Scheduled Construction: Limiting construction activities during wildlife breeding seasons.	Schedule noisy construction activities outside of critical breeding periods for local fauna.	Continuous monitoring of noise levels and wildlife behavior.
Climate Change	Carbon Capture and Storage (CCS): Implement CCS technologies to reduce CO2 emissions.	Capture CO_2 emissions and store them underground or use them for other industrial processes.	Annual carbon emissions audits and verification of CCS system performance.
	Energy Efficiency: Adoption of energy-efficient technologies and processes.	Implement energy-saving measures such as optimizing plant operations and using low-carbon technologies.	Continuous monitoring of energy consumption and CO2 emissions.
Ecosystem Services	Ecosystem Restoration: Restoring ecosystem services affected by plant activities.	Planting riparian vegetation, restoring wetlands, and creating buffer zones to restore ecological balance.	Monitoring of restored ecosystem services (e.g., water purification, soil fertility).
	Pollinator Protection: Protecting pollinator populations by preserving native flora.	Establish native flowering plants and reduce pesticide use around the plant site.	Monitoring of pollinator populations and flowering plant health.
Endangered Species	Critical Habitat Protection: Identify and protect habitats of endangered species.	Prioritize the conservation of habitats for species and other endangered flora and fauna.	Regular surveys of endangered species populations and habitat conditions.
	Species Relocation: Relocate endangered species from the impact zone.	Relocate species to nearby protected areas, ensuring their survival and minimizing stress.	Success monitoring of species relocation and long-term survival rates.

Table 4.18:- Migration Range, Impact, And Mitigation Measures For Birds Due To Thermal Power Plant

Aspect	Details
Migration Range	**Birds impacted by thermal power plants can include:**
	Local residents: Species that remain in the vicinity year-round
	Short-distance migrants: Species moving within the region or country
	Long-distance migrants: Species traveling between continents, such as from Eurasia to South Asia
	Stopover species: Birds using wetlands or grasslands near thermal power plants as temporary resting and feeding grounds during migration
Impacts	**Thermal power plants can affect birds in various ways:**
	1. Habitat Loss: Construction and operation often result in the destruction or fragmentation of forests, grasslands, and wetlands.
	2. Pollution: Airborne emissions (SO_2, NO_x, particulate matter) and water pollution (effluent discharge) degrade habitat quality, affecting food sources and nesting grounds.

	3. Collision Risks: Tall chimneys, transmission lines, and cooling towers pose collision hazards, especially during migration.
	4. Thermal Pollution: Discharge of hot water into nearby water bodies can alter aquatic ecosystems, reducing prey availability for wetland birds.
	5. Disturbance: Noise, light, and human activity disrupt breeding, feeding, and resting behaviors.
	6. Prey Reduction: Changes in land use and pesticide application can reduce insect populations, impacting insectivorous birds.
	7. Climate Alteration: Local microclimate changes caused by emissions and heat can affect bird species composition.
Mitigation Measures	**Effective strategies to minimize impacts include:**
	1. Habitat Conservation: Preserve natural habitats such as wetlands, forests, and grasslands. Create buffer zones around critical areas.
	2. Pollution Control: Install advanced technologies (e.g., scrubbers, ESPs) to reduce air and water pollution. Ensure proper treatment of effluents before discharge.
	3. Collision Prevention: Mark power lines with bird diverters to reduce collision risks. Use designs that minimize impacts on birds.
	4. Thermal Management: Regulate the temperature of discharged water to avoid thermal pollution in aquatic ecosystems.
	5. Noise and Light Management: Limit noise during sensitive periods (breeding and migration). Use downward-facing, shielded lighting to minimize light pollution.
	6. Reforestation and Restoration: Reforest degraded areas and restore wetlands near the plant to compensate for habitat loss.
	7. Monitoring Programs: Regularly monitor bird populations and migration patterns to assess impacts and adapt measures.

4.3.7.1 Greenbelt development

a. Introduction

Green canopy not only absorbs some of the air pollutants but also improves the environment. Therefore, a "Green Belt Development Plan" by using the local species has been proposed around the project area, colonies and the project roads.

b. Development of Greenbelt

The development of green belts in industries refers to the implementation of sustainable practices and technologies to minimize the environmental impact of the project activities and promote eco-friendly operations. Green belt initiatives aim to address various aspects of manufacturing, including energy consumption, emissions reduction, waste management, and resource conservation. The average width of the green belt will be around 10 m, which may vary depending on the physiographic and topographic features. There would be at least 3 layers of plantation.

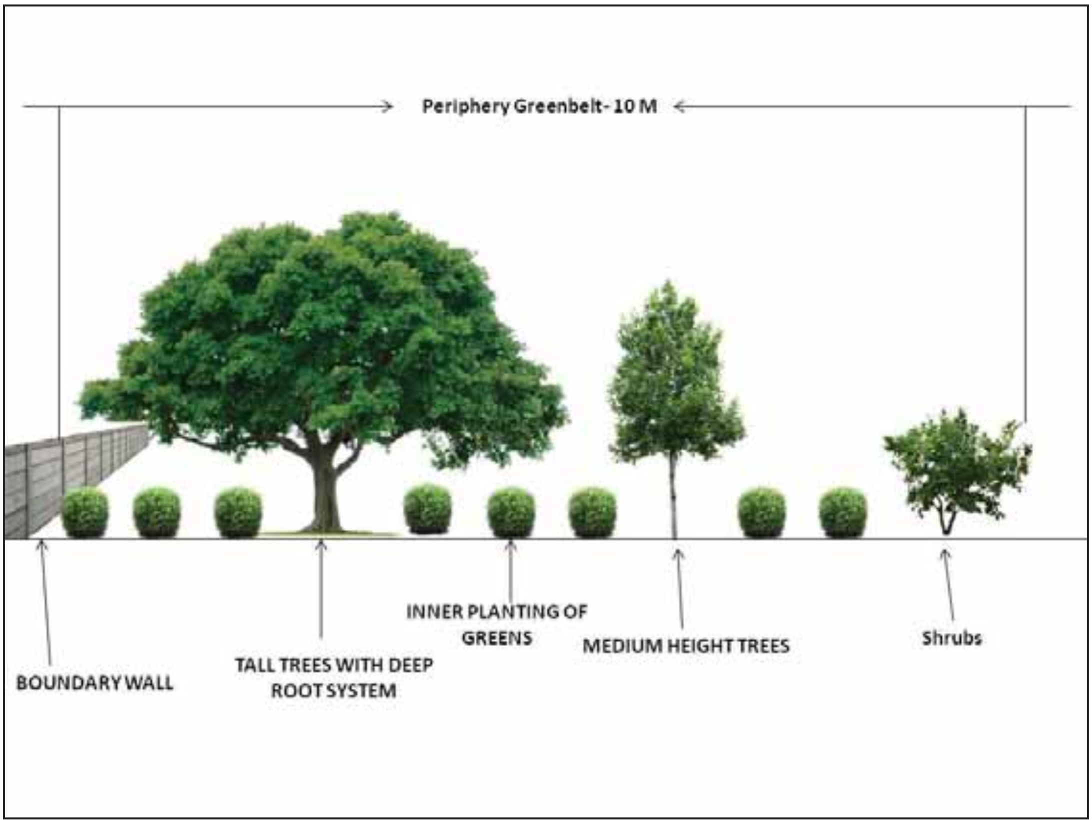


Figure 4.6: Schematic Arrangement of Greenbelt Plantation

c. Strategy for Greenbelt:

The strategy worked out for development of greenbelt consists of the following:

- The species selected should be capable of growing fast,
- The species should be wind firm and long lived.
- Broad leaf trees growing above 10 m in height should be planted along the roads, offices and infrastructure facilities.
- The species should form a dense crown cover.
- The species should form a litter in abundance on the plantation flow.
- Generally local/indigenous fast-growing trees shrubs should be planted.

- The trees should be protected by plantation of non-palatable shrub species to avoid browsing by animals.
- Placement of tree guards (metal tree guard, pre-fab RCC tree guard, Fiber tree guard etc.), should be provided to save avenue plantation.
- For protection against biotic interference thorn fencing around the plantation, circular trench around the planting pit and sown with fast growing thorny shrubs on the ridge should be followed.

d. Guidelines and Techniques for Greenbelt Development

An extensive survey of the project area was undertaken to observe the vegetation types and their density. Soil characteristics were also kept in mind. Based on the survey and environmental conditions suitable plant species have been proposed for green belt development. To meet the requirement of sapling for the development of the greenbelt, a temporary nursery with the following details is suggested.

i. Size of Greenbelt area:

The size of a greenbelt depends upon the number and type of seedlings to be produced. To produce approx a nursery of about 289.44 Ha (35%) area would be required.

ii. Greenbelt Site Selection

Lighting shading site for the greenbelt is important for the protection of the young seedlings against sun, frost, hailstorms or heavy rains.

iii. Transportation

The greenbelt site should be readily accessible round-the-year in order to facilitate transportation of materials required in the nursery and dispatch of seedling from the nursery.

iv. Fertilizer Application

The organic fertilizer produced through organic waste coupled with vermin compost can be utilized for the nursery. Farmyard manure (FYM) can also be used but chemical fertilizer should be avoided. The compost/vermin compost is proposed to be developed through solid waste management.

vii. Soil and Soil Fertility

The best site for raising the nursery is the area, which has got a thick layer of humus. The fertile and well-drained soil with sandy loam texture, pH varying from 5.5-7.5 should always the preferred for nursery sites.

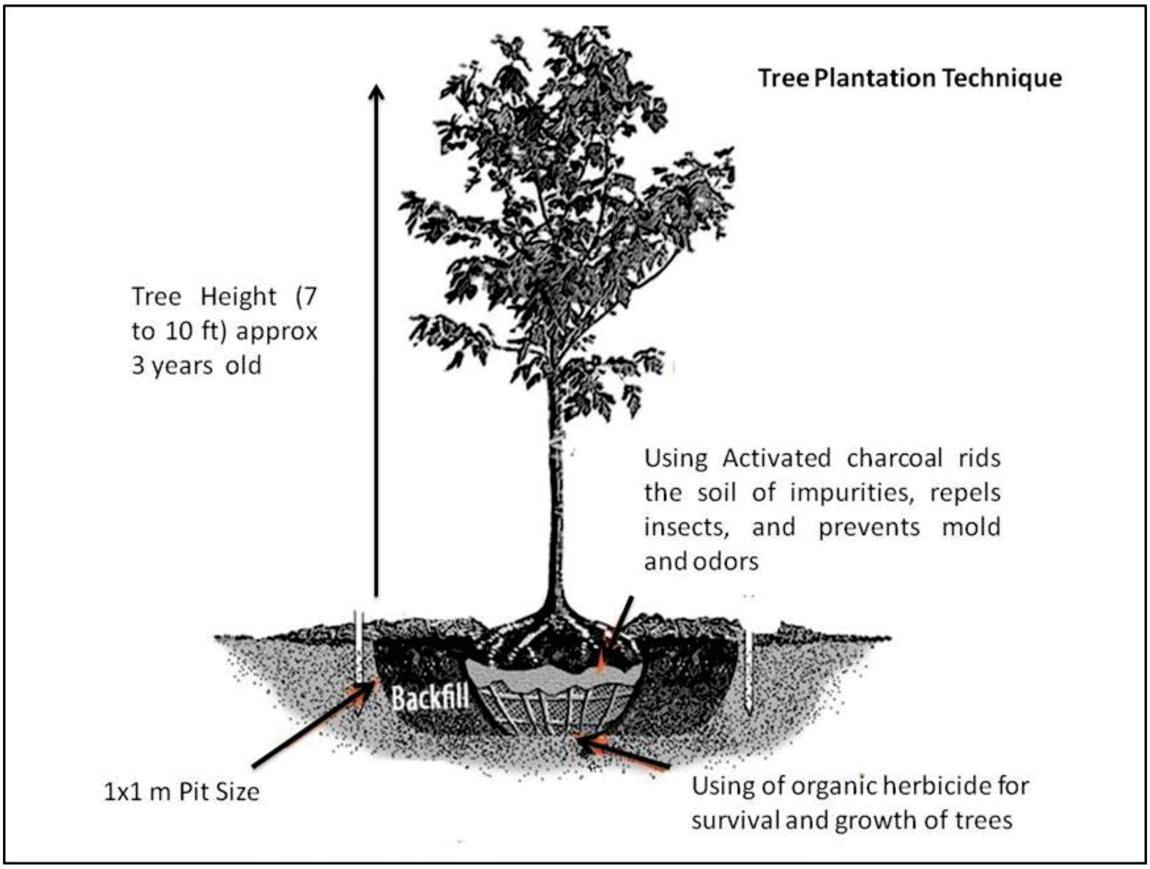


Figure 4.7: Tree Plantation Technique

viii. Water supply and Drainage: -

The site should have a perennial water supply. The drainage of soil has an important bearing on the health of seedlings.

ix. Species to be planted: -

The choice of plant species for plantation in the greenbelt is mainly governed by the natural factors of the bio-climate of the area. For efficacious removal of pollutants (gasses/fugitive dust), the plants must develop in conditions confirming an adequate supply of nutrition for their growth, and availability of water to avoid water stress i.e. to maintain openness of stomata apertures and form of epidermal structures. Besides, adequate exposure to sunlight and wind i.e. without hindrance to the free flow of air. In the project area, pollutants like SO_2 and NO_x shall result from the operation of construction/excavation machinery and the movement of vehicles besides particulate matter mostly PM10 shall result as fugitive dust emissions from movement of vehicles on project site as a primary source of quarrying activities. It is suggested that spreading/round canopy-shaped trees should be planted near the construction site like excavation sites and oblong and conical trees along the roadside. For absorption of gas pollutants, it is necessary to plant such trees, that have tolerance towards pollutants at reasonable concentrations; and have longer foliage periods and freely exposed foliage besides the large number of stomata apertures. For removal of suspended particulate matter high trees with good spread of crown with leaves firmly supported on petioles and abundance of surface area on bark and foliage should be planted. A list of indigenous trees found suitable after the identification of species for raising in the nursery and for development of greenbelt around the project area.

x. Precautions during Plantation

Some important precautions should be taken during the plantation, which are as under:

- Open grazing is practiced in general in the area; therefore, protection should be provided in advance.
- Poly-culture should be practiced. Mixture by group should be preferred over intimate mixture.
- Species mentioned should be planted in sufficient numbers so as to increase their population size in the area.
- Multipurpose species should be planted in large, to provide direct benefit to people living around.

Table 4.19: Details of Proposed Greenbelt Development Plan

Total Plot area	822.541 Ha.
Total Greenbelt area	289.44 Ha (35 % of Total Plot area)
Existing Green Area	: 120.0 Ha
Proposed Green Area	: 169.44 Ha

Tree to tree distance	: 3 m
Width of greenbelt	: 20 m
Existing tree	: 1,41,240 nos.
Trees Calculation*	: 2500 tree / ha
	: 2500/169.44 = 423600 nos.

** Detailed scheme for raising green belt of native species of appropriate width (50 to 100 m) and consisting of at least 3 tiers around plant boundary not less than 2500 tree per ha Shall be submitted.*

Table 4.20. Plan for completion of 80 % plantation in the First 5 Years with Existing Plantation*

Year	Area (Ha.)
Existing Plantation	120.0
1st Year Plantation (G-1)	16.30
2nd Year plantation (G-2)	44.00
3rd Year plantation (G-3)	40.91
4th Year plantation (G-4)	12.10
5th Year plantation (G-5)	9.50
Remaining Green area	46.63
	289.44

*Tor Point No. 1.8 PP should submit the detailed plan in tabular format (year-wise for the life of the project) for concurrent afforestation and green belt development in and around the project site. The PP should submit the number of saplings to be planted, names of native species, area to be covered under afforestation & green belt, location of plantation, target for survival rate and budget earmarked for the afforestation & green belt development. In addition to this, PP should show on a surface plan (5- year interval for life of project) of suitable scale the area to be covered under afforestation & green belt clearly mentioning the latitude and longitude of the area to be covered during each 5 years. The capital and recurring expenditure to be incurred needs to be submitted. Plantation plan should be prepared in such a way that 80% of the plantation to be carried out in first 5 years and for the remaining years the proposal for gap filling. The seedling of height not less than 2 meters to be selected and accordingly cost of plantation needs to be decided. In addition to this, plantation in the safety zone at project boundary the plantation should be planned in such a way that it should be completed within 2 years only.

Note: -

Table 4.21: List of existing plant species at the Project Site

S.No.	Scientific Name	Common Name	Family	Numbers
1.	*Ficus benghalensis*	Bargad	Moraceae	12
2.	*Acacia leucophloea*	Reonja	Mimosaceae	8540
3.	*Butea monosperma*	Palash	Fabaceae	6540
4.	*Albizia lebbeck*	Siris	Fabaceae	5850
5.	*Prosopis cineraria*	Khejri	Fabaceae	112
6.	*Acacia nilotica*	Desi babool	Fabaceae	9580
7.	*Azadirachta indica*	Neem	Meliaceae	19500
8.	*Ziziphus mauritiana*	Ber	Rhamnaceae	7500
9.	*Terminalia arjuna*	Arjun	Combretaceae	6200
10.	*Peltophorum pterocarpum*	Peela Gulmohar	Caesalpiniaceae	1300
11.	*Madhuca longifolia*	Mahua	Sapotaceae	1400
12.	*Tectona grandis*	Sagwan	Verbenaceae	8450
13.	*Ficus benjamina*	Pukar	Moraceae	3300
14.	*Pongamia pinnata*	Karanj	Fabaceae	7500
15.	*Delonix regia*	Gulmohar	Caesalpiniaceae	6040
16.	*Senna siamea*	Semia	Caesalpiniaceae	10215
17.	*Syzygium cumini*	Jamun	Myrtaceae	9000
18.	*Mangifera indica*	Aam	Anacardiaceae	6650
19.	*Psidium guajava*	Amrud	Myrtaceae	14390
20.	*Manilkara zapota*	Chiku	Sapotaceae	1821
21.	*Mimusops elengi*	Maulshri	Sapotaceae	5340
22.	*Tamarix aphylla*	Pharras	Tamaricaceae	2000
Total				**141240 nos.**

Table 4.22: List of plant species recommended for greenbelt development

Scientific Name	Common Name	Number
Ailanthus excelsa	Ardu	7000
Azadirachta indica	Neem	17500
Ficus benghalensis	Bargad	10
Ficus religiosa	Peepal	10
Shorea robusta	Sal	15500
Tectona grandis	Teak	13500
Anogeissus pendula	Kardhai	19500
Butea monosperma	Chewla	23000
Holoptelea integrifolia	Chilbil	12800
Lagerstroemia parviflora	Seja	32500
Madhuca longifolia	Mahua	6000

Mangifera indica	Aam	26500
Melia azedarach	Bakain	8128
Mimusops elengi	Molshree	40991
Neolamarckia cadamba	Kadamba	15000
Pongamia pinnata	Karanj	22500
Prunus dulcis	Badam	10000
Saraca asoca	Ashok	26500
Syzygium cumini	Jamun	77361
Tamarindus indica	Imli	22800
Terminalia arjuna	Arjun	26500
Total		**423600 nos.**

Table 4.23: List of Shrubs and Herbs Species Recommended for Greenbelt Development

Shrubs		
S.No.	**Scientific Name**	**Common Name**
1.	*Bougainvillea spp.*	Bogoonbel
2.	*Hibiscus rosa-sinensis*	China Rose
3.	*Duranta erecta*	Golden Dewdrop
4.	*Thevetia peruviana*	Yellow Oleander
5.	*Ixora coccinea*	Jungle Flame
6.	*Plumbago zeylanica*	Leadwort
7.	*Ruellia tuberosa*	Minnieroot
8.	*Tecoma stans*	Yellow Bells
9.	*Tabernaemontana divaricata*	Crape Jasmine
10.	*Codiaeum variegatum*	Croton
11.	*Acalypha wilkesiana*	Copperleaf
12.	*Nerium oleander*	Oleander
13.	*Pentas lanceolata*	Egyptian Star Cluster
14.	*Eranthemum pulchellum*	Blue Eranthemum
Herbs		
S.No.	**Scientific Name**	**Common Name**
1.	*Chrysanthemum indicum*	Chrysanthemum
2.	*Tagetes spp.*	Marigold
3.	*Petunia violacea*	Violet-flowered petunia
4.	*Zinnia elegans*	Common zinnia
5.	*Salvia splendens*	Scarlet Sage
6.	*Viola tricolor*	Pansy
7.	*Celosia cristata*	Cockscomb
8.	*Gomphrena globosa*	Bachelor's buttons
9.	*Cosmos bipinnatus*	Mexican aste
10.	*Portulaca grandiflora*	Moss rose

Table 4.24: Budgetary allocation for greenbelt development & plantation

No. of trees to be planted	Greenbelt	Budget allocation for the project	Recurring cost /year
423600 nos.	289.44 Ha (35 % of Total Plot area)	23.60 Cr.	2.3 Cr.

4.3.7.2 CONCLUSION:

The ecological and biodiversity study conducted for proposed Thermal power project has provided valuable insights into the potential impacts of the project on the surrounding ecosystems and biodiversity. The study revealed significant concerns regarding the project's effects on flora and fauna, indicating the need for careful planning and mitigation measures.

1) In conclusion, incorporating ecological and biodiversity considerations into project is crucial for achieving sustainable and responsible development. The preservation and enhancement of natural ecosystems not only contribute to the overall health of the environment but also provide a range of benefits to both local communities and the construction projects.
2) Eco-friendly practices will be adopted and by implementing biodiversity conservation measures, proponent can mitigate their impact on the surrounding environment. This includes the protection of local flora and fauna, the restoration of ecosystems, and the promotion of sustainable land use practices. Integrating green spaces and wildlife corridors into core zone and buffer zone.
3) The entire study area (Terrestrial and Aquatic) was covered in the best possible manner to enlist the flora, fauna and avian species (terrestrial and aquatic).
4) Analysis of Fauna: A number of faunal terrestrial species comprising mammals, reptiles, Birds and Amphibians were recorded from the study area. In the study area, 26 species of fauna were identified in core zone (Birds: 19; Butterfly: 03; Mammals: 02; Herpetofauna: 02), in the buffer zone 214 species of fauna were identified (Bird: 141; Mammals: 17; Herpetofauna: 14; Fishes: 09; Moths: 15, Butterfly: 18) However 15 Schedule I species as per WPAA, 2022 is present in the study area. No National Park, Wildlife Sanctuary Falls within 10 km radius study area.

5) Green belt Development and Plantation with suitable indigenous Local Fast Growing species will improve the environment.
6) In summary, a holistic approach to development that integrates ecological and biodiversity considerations is essential for fostering environmental resilience, promoting responsible stewardship, and ensuring the long-term viability of both aviation infrastructure and the ecosystems it interacts with. Through collaboration with environmental experts, local communities, and regulatory bodies, projects can strive to strike a balance between human activities and the preservation of biodiversity, contributing to a more sustainable and harmonious future.

4.4 IMPACT ON SOCIO ECONOMIC ENVIRONMENT & MITIGATION MEASURES

Critically analyzing the existing environmental status of the socio-economic profile and visualizing the scenario with the project, the impacts of the project would be varied and may generate both positive and negative impacts of the proposed project in the region that are stated below.

Sr. No.	Positive Impact	
01.	**Employment Generation:**	**Direct Employment:** The thermal power plant in Baran creates direct job opportunities for local residents, particularly in technical, administrative, and support services. Roles such as engineers, technicians, plant operators, security staff, and managerial positions are often filled by local workers, contributing to a reduction in regional unemployment. **Indirect Employment:** Apart from the plant’s core workforce, various support services also create employment opportunities. These include workers involved in logistics, maintenance, and supply of materials, catering, transport, and hospitality. Local businesses, such as shops, restaurants, and service providers, benefit from the presence of plant workers and contractors. **Skilled Workforce Development:** The thermal plant's operation requires a specialized workforce. Many local workers receive training and up skilling in fields like electrical engineering, mechanical maintenance, and control systems, which enhances their qualifications.

		This contributes to long-term skill development, enabling local workers to access better job opportunities in the future.
02	**Infrastructure Development:**	**Improvement of Transport Infrastructure:** The construction and operation of the thermal power plant require the improvement of local roads and transport systems. This includes upgrading access roads, building new routes, and enhancing transportation facilities for plant workers and the movement of goods. Improved transport infrastructure benefits local communities by providing better connectivity to other parts of Rajasthan and nearby regions. **Electricity Supply Stability:** The thermal power plant helps stabilize electricity supply in the region, not only for the plant itself but also for local industries and households. Reliable power supports business operations and contributes to the overall economic growth of the area. A stable power supply can attract more industries to the region, creating a more favorable environment for business development. **Water and Communication Infrastructure:** With the establishment of the plant, the local area may also see improvements in water supply and communication networks. While thermal plants require significant water resources for cooling, these developments often stimulate broader investments in water management and communication systems, improving local infrastructure.
03	**Boost to the Local Economy:**	**Multiplier Effect:** The presence of the thermal power plant has a multiplier effect on the local economy. The plant's expenditure on materials, goods, services, and maintenance leads to increased demand in the local economy. For example, suppliers of construction materials, food providers, and other local businesses benefit from the presence of the plant and its workers. **Increased Government Revenue:** The thermal power plant contributes significantly to local and state revenues through taxes, land lease fees, and environmental levies. These funds can be reinvested into public services, social welfare programs, health services, and education. This has a long-term positive impact on the overall socio-economic development of the area. **Growth of Associated Sectors:** Industries like transportation, real estate, and retail can also grow as a result of the power plant. The plant's workers often require housing, transportation, food, and other services, boosting local businesses and industries that cater to these needs. This, in turn, contributes to the overall economic growth of the region.

04	**Promotion of Regional Development and Industrialization:**	**Attracting Other Industries:** The availability of stable and reliable power from the thermal plant makes Baran an attractive destination for other industries, such as manufacturing, cement, textiles, and processing units. The presence of cheap and reliable electricity enhances the prospects for industrial growth and diversification in the region, which contributes to long-term economic development. **Increased Investment:** The thermal power plant's operation fosters investor confidence in the region. Its successful establishment and operation may lead to further investments in infrastructure, utilities, and related industries. The government's investment in the power sector often serves as a catalyst for investments in other sectors, including education, healthcare, and tourism.
05	**Skill Development and Education:**	**Training and Capacity Building:** Thermal power plants often run training programs to enhance the skills of the local workforce in areas such as energy production, mechanical systems, safety management, and environmental compliance. This creates a pool of highly skilled workers who are capable of taking up jobs in not just the power sector, but also in other industries requiring similar technical expertise. **Educational Opportunities:** The demand for a skilled workforce may lead to the development of educational and training institutes in and around Baran. Technical institutions that focus on courses related to power generation, electrical engineering, and mechanical maintenance can be established, benefiting both local youth and students from neighboring areas. **Technology Transfer:** Local workers and professionals involved in the plant's operation and maintenance gain exposure to advanced technologies used in thermal power generation. This facilitates the transfer of technological knowledge to the local community, boosting innovation and efficiency in other sectors as well.
06	**Social Development Initiatives:**	**Corporate Social Responsibility (CSR):** Thermal power plants often engage in CSR activities to enhance the quality of life for local communities. These initiatives include building schools, providing healthcare facilities, improving sanitation, and supporting local farmers through skill development programs. Such initiatives can contribute to improved social welfare and the overall well-being of the region. **Access to Better Healthcare:** The financial resources generated by the plant, both from operations and taxes, can support improvements in local healthcare infrastructure. Additionally, the presence of better-paid

		workers in the region might spur the construction of hospitals and medical facilities to cater to their needs.
07	**Enhanced Energy Security:**	**Contribution to National Grid:** Thermal power plants play a crucial role in contributing to India's energy security by providing a stable and reliable source of electricity. The electricity generated in Baran not only powers the local region but is also supplied to other parts of the state and the national grid, which helps in reducing power shortages and ensuring a balanced energy supply. **Supporting Rural Electrification:** By increasing the availability of power, the thermal plant can contribute to the electrification of nearby rural areas. Improved access to electricity enables better education opportunities (through lighting), access to modern communication, and support for small-scale rural industries.
	Negative Impact	
01.	**Environmental Pollution and Health Hazards:**	**Air Pollution:** Thermal power plants emit significant amounts of pollutants, including sulfur dioxide (SO2), nitrogen oxides (NOx), and carbon dioxide (CO2), and particulate matter (PM). These emissions contribute to air pollution, which can have severe effects on the local population's respiratory and cardiovascular health. **Health Impacts:** People living near the plant may experience higher rates of respiratory diseases (such as asthma, bronchitis, and lung infections), heart disease, and other chronic conditions due to exposure to air pollutants. Vulnerable groups like children, the elderly, and people with pre-existing health conditions are particularly at risk. **Water Pollution:** Thermal power plants require vast amounts of water for cooling. The discharge of heated water back into nearby water bodies can raise their temperature, which harms aquatic life by reducing oxygen levels in the water (thermal pollution). Additionally, any chemicals or toxic substances used in the plant may contaminate nearby rivers or groundwater, affecting local water supplies and agricultural activities. **Soil Contamination:** Ash and other waste materials from the thermal plant, if not disposed of properly, can contaminate the surrounding soil. This can affect agricultural productivity by altering the quality of the soil and introducing harmful chemicals that reduce crop yields.
02	**Resource Depletion and Strain on Local Resources:**	**Water Scarcity:** The thermal plant requires large quantities of water for its cooling process, which can put pressure on local water resources, especially in a dry region like Rajasthan. The diversion of water for the

		plant could lead to a scarcity of water for agriculture and local communities, exacerbating water shortages in the region. **Impact on Agriculture:** Since agriculture is an important livelihood for many people in Baran, the reduced availability of water for irrigation can harm crop production, affecting the income of farmers and the local food supply. **Increased Dependence on Non-Renewable Resources:** Thermal power plants, particularly coal-based ones, rely heavily on non-renewable resources like coal. The mining of coal and other fossil fuels can lead to environmental degradation, including deforestation, land degradation, and the destruction of local ecosystems. The region may become increasingly dependent on these finite resources, which are subject to price fluctuations and potential supply shortages.
03	**Social Displacement and Land Acquisition Issues:**	**Land Acquisition and Loss of Livelihoods:** Large-scale thermal power plants require extensive land for construction and operation. The acquisition of agricultural or residential land for the plant can displace local communities, particularly farmers and rural residents. Those who lose their land may face difficulties in finding alternative livelihoods, particularly if compensation and rehabilitation measures are inadequate. **Impact on farmers:** Farmers who lose their agricultural land face greater hardship, as they do not have the skills or resources needed to transition to new forms of employment. The loss of productive land directly reduces their income, which can lead to social unrest and potential conflict. **Social Unrest and Conflicts:** Inadequate compensation or failure to properly address the needs of displaced populations can result in social unrest, protests, and conflicts between local communities and plant authorities. Displacement can disrupt social structures and lead to resentment and mistrust among the affected populations, which can create long-term challenges in community relations.
04	**Impact on Health and Quality of Life:**	**Air and Waterborne Diseases:** The pollution from the plant can increase the incidence of diseases like respiratory illnesses, skin disorders, and waterborne diseases in the local population. Prolonged exposure to air pollutants can result in a range of chronic health conditions, such as lung cancer, cardiovascular disease, and premature death. **Noise Pollution:** The construction and operation of a thermal power plant can lead to high levels of noise pollution, particularly from machinery and generators. Continuous noise can negatively affect the

		quality of life, lead to sleep disturbances, and contribute to stress-related health issues in local communities. **Disruption of Traditional Livelihoods:** Thermal power plants may disrupt traditional livelihoods such as agriculture, fishing, or pastoral activities due to environmental degradation or land acquisition. This can lead to a decrease in local incomes and overall social stability. For example, local farmers may find it difficult to maintain agricultural activities due to soil contamination or water scarcity, leading to a loss of their traditional way of life.
05	**Economic Vulnerabilities and Regional Imbalances:**	**Dependence on Coal and Fossil Fuels:** While the thermal power plant may bring short-term economic growth, it is heavily reliant on fossil fuels like coal. This creates long-term economic vulnerabilities because these resources are finite and subject to price volatility in international markets. A sharp increase in coal prices or supply disruptions can cause the power plant's operational costs to rise, impacting the local economy. **Limited Diversification of Local Economy:** Over-reliance on a single industry such as thermal power generation can inhibit the diversification of the local economy. If the power plant shuts down or faces operational problems, the region might suffer from economic stagnation due to the lack of other industries or sources of income.
06	**Impact on Agriculture and Food Security:**	**Soil Degradation:** The disposal of fly ash and other waste materials from the power plant can lead to soil degradation. If the ash is not properly contained or treated, it can seep into the soil, affecting its fertility and making it less suitable for agricultural activities. This can reduce crop yields and harm the livelihoods of local farmers. **Impact on Water Resources for Irrigation:** As the thermal power plant consumes significant water resources, the availability of water for irrigation purposes could be compromised, particularly in an arid region like Rajasthan. This can lead to reduced agricultural productivity, affecting food security and farmers' incomes.
07	**Social Inequality and Community Displacement:**	**Marginalization of Vulnerable Groups:** While the thermal plant generates employment, it may disproportionately benefit certain social groups, such as those with the necessary skills or connections. Vulnerable groups, including women, unskilled laborers, and marginalized communities, may not have equal access to the job opportunities created by the plant, leading to social inequality. **Displacement of Indigenous and Rural Communities:** Indigenous and rural communities who depend on agriculture or traditional occupations may face the brunt of land acquisition processes, which can

		lead to their displacement. They may not have the resources or support systems to adapt to new economic activities, which can further exacerbate social inequalities.

4.5 BUDGETARY ALLOCATION FOR ENVIRONMENTAL MANAGEMENT PLAN

In order to comply with the environmental protection measures as suggested in the above sections, the project management has made budgetary provision for environmental protection and safety measures. The total capital cost towards EMP is Rs. 5992.94 Crore. The detailed breakup of estimated annual expenditure to be incurred on plantation, maintenance, monitoring and analysis of ambient air, noise, water resources, effluent water and soil etc. is given in Chapter 10 of this draft EIA/EMP report.:

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Chapter - V
Analysis of Alternatives (Technology and site)

5.1 INTRODUCTION

A comparison of alternatives helps to determine the best method of achieving the project objectives with minimum environmental impacts environmental impacts or indicates the most environment friendly and cost-effective options.

5.2 ANALYSIS OF ALTERNATE SITE

The proposed expansion is proposed in an area of 470.70 Ha adjacent to the existing Thermal Power Plant with area admeasuring 350 Ha. The total area of Thermal Power plant after expansion will be 820.70 Ha. Since the expansion is proposed of the already operational Kawai Thermal Power Plant in Village Kawai, Tehsil Atru, District Baran, Rajasthan, no alternative sites have been examined for the Thermal Power Plant.

However, alternative route analysis has been carried out for proposed Coal Conveyor Belt route to transfer coal from coal handling plant to BTG area. Details are as below:

5.2.1 PROPOSED ROUTES CONSIDERED FOR COAL CONVEYOR:

Three alternate routes were examined for Coal Conveyor belt route and suitable route has been selected with considering the following points as well after Forest dept survey; the following points were taken into consideration:

- Least/minimum forest area involvement
- Avoiding higher density tree patches
- No involvement of temples/ Cultural Habitats/ Schools & colleges
- Minimum route length

- No wildlife sanctuary / Biosphere/ Protected Areas / Protected monuments.

Figure 5.1: Selected Coal Conveyor belt route for Proposed Expansion

Figure 5.2: Selected route for Coal conveyor belt

Conclusion:

- The selected route has the least Forest area (i.e., 1.758 ha.) which is barest minimum and unavoidable and is lesser in comparison to other Alternate Routes.
- The right-of-way issue is less in comparison to other Alternate Routes.
- Relatively easier access to project site for movement of men & material.

Application for diversion of **1.758 ha.** forest land under Baran Forest Division for construction of the proposed Coal Conveyor Belt (ROW/ROU) has been submitted to MoEF&CC, New Delhi **[FC Proposal No. FP/RJ/OTHERS/467838/2024]**. The selected route has unavoidable and barest minimum forest land on comparison with other routes analysed.

5.3 ANALYSIS OF ALTERNATE TECHNOLOGY

Exploring technology alternatives is crucial as it enables informed decision-making by evaluating factors like cost-effectiveness, energy efficiency, and environmental impact. The choice of technology significantly impacts overall project performance, efficiency, and long-term sustainability. This analysis ensures that the selected technology aligns with project goals and optimizes resource utilization.

The classification of boilers into Subcritical, Supercritical, and Ultra Supercritical is based on the operating pressures and temperatures, with Ultra Supercritical boilers offering the highest efficiency and environmental performance. Mentioned below are the insight on the various types of boiler alternatives explored for the proposed project.

a. Sub critical Boiler:

Operating within a temperature range up to 374°C and under a pressure of 3,208 psi, sub-critical boilers exemplify a system with a consistent evaporation endpoint, with the drum-type steam generator being a notable example.

When the fluid undergoes natural circulation, the application range is restricted to around 190 bar as the maximum drum pressure. However, utilizing a circulating pump (forced circulation) extends this range, achieved by fixing the endpoint of evaporation in the drum. This also determines the size of the heating surface in both the evaporator and super-heater. A significant drawback of sub-critical boilers is the potential for bubble formation, resulting in increased water consumption.

The boiler's internal workings involve initiating the natural circulation of fluid by heating the risers. The resulting mixture of water and steam from these risers undergoes separation in the drum, where water is directed back to the evaporator inlet through downward corners, while steam proceeds into the super-heater chamber.

b. Super Critical Boiler

A supercritical boiler utilizes pulverized coal and operates as a once-through boiler, eliminating the need for a drum to separate steam from water. Unlike traditional boilers, which boil water to generate steam for turbine rotation, a supercritical boiler operates at extremely high pressures (3,208 psi/221.2 bar or above), causing the fluid within to transition into a state known as a "supercritical fluid."

This supercritical fluid directly drives the turbine responsible for electricity generation. During this process, the fluid, now a mix of steam and water, undergoes a transition back to its original state as it drops below the critical pressure point, subsequently entering a condenser. The efficiency of supercritical boilers surpasses that of their subcritical counterparts, leading to reduced fuel consumption.

The advantages of supercritical boilers extend to three critical areas for plant owners and operators: efficiency, emissions, and cost. Although supercritical boilers involve a higher initial investment compared to similarly sized subcritical boilers, the enhanced efficiency, reduced emissions, and lower operating costs over the technology's lifecycle offset the upfront costs. This is attributed to the higher steam temperature and pressure parameters characteristic of supercritical boilers.

c. Ultra Super Critical Boiler

The ultra-supercritical boiler operates on the principle of a "once-through type" system. In comparison to a natural circulation boiler, the volume of the evaporator system in a once-through boiler is significantly smaller. This results in a reduced amount of water in the evaporator. The smaller inventory of stored water and steam in ultra-supercritical units allows for a theoretically faster rate of response compared to drum-type units.

The use of ultra-supercritical parameters brings about an enhancement in cycle efficiency due to elevated pressure and temperatures. However, it's worth noting that for smaller units, the improvement in heat rate is relatively marginal. The advantages of ultra-supercritical boilers lie in their rapid response capability and the overall efficiency gains achieved through advanced pressure and temperature parameters.

Table 5.3: Comparison of Boiler Types: Subcritical, Supercritical, and Ultra-Supercritical

Characteristic	Subcritical Boiler	Supercritical Boiler	Ultra-Supercritical Boiler
Operating Parameters	Below the critical point	Above the critical point	Above the critical point with higher parameters
Pressure	Lower pressures	Higher pressures	Extremely high pressures
Temperature	Moderate temperatures	High temperatures	Extremely high temperatures
Efficiency	Lower thermal efficiency	Improved thermal efficiency	Higher thermal efficiency
Fluid State	Liquid and gas phases during operation	Supercritical fluid (Neither liquid nor gas)	Supercritical fluid (Neither liquid nor gas)
Boiler Complexity	Moderate complexity	Higher complexity	Higher complexity due to elevated parameters
Steam Generation Rate	Moderate steam generation rate	Higher steam generation rate	Higher steam generation rate
Response Time	Moderate response time	Faster response time	Rapid response time due to smaller evaporator volume
Fuel Consumption	Relatively higher fuel consumption	Reduced fuel consumption	Lower fuel consumption due to improved efficiency
Environmental Impact	Higher emissions	Less emissions	Lower emissions due to improved efficiency
Initial Capital Investment	Lower initial investment	Moderate initial investment	Higher initial investment due to advanced parameters
Lifecycle Costs	Moderate lifecycle costs	Reduced lifecycle costs	Optimized lifecycle costs due to improved efficiency

5.3.1 TECHNOLOGY SELECTED FOR THE PROPOSED EXPANSION PROJECT:

The proposed expansion project incorporates Ultra-Supercritical technology, offering notable advantages. Ultra-Supercritical units exhibit low thermal inertia, leading to quicker start-up times, enhanced load change rates, and reduced forced cooling time during emergency shutdowns. This technology facilitates easier pressure changes and allows for a genuine sliding pressure operation mode with efficient load change capabilities. In ultra-supercritical units, the main steam temperature is regulated through water-fuel ratio control, ensuring the achievement of rated steam outlet temperature at all loads and with various fuel types.

The utilization of ultra-supercritical parameters proves particularly beneficial for larger units, where the improvement in thermal efficiency is more prominent. Opting for ultra-supercritical steam parameters can yield efficiency gains of approximately 3 - 5% compared to conventional supercritical technology.

Beyond expedited response times, the adoption of ultra-supercritical technology enhances overall plant thermal efficiency, resulting in reduced fuel consumption per unit of electricity generated. This reduction in fuel consumption contributes to a subsequent decrease in CO_2 emissions in coal-fired power plants. Additionally, ultra-supercritical units emit lower levels of SOx and NOx, contributing to environmental benefits. The heightened thermal efficiency also leads to a significant reduction in the emission of suspended particulate matter into the environment. Finally, the improved efficiency is directly linked to lower fuel costs, further emphasizing the economic advantages associated with this advanced technology.

5.3.2 ADVANTAGES OF ULTRA SUPER CRITICAL THERMAL POWER PLANT

Ultra Super Critical thermal power plants combine high efficiency, reduced emissions, and operational flexibility, making them a compelling choice for large-scale power generation projects aiming for both economic and environmental sustainability. The same can be summarized as under:

The benefits of ultra-supercritical technology, maybe summarized as:

- Improved thermal efficiency attainable
- Reduced fuel cost
- Reduction of carbon-di-oxide emission by as much as 15% per unit of electricity generated compared to typical sub-critical units. This may attract incentive permitted as per governing CDM norms.
- Very good part load efficiency.
- Very low emissions of NOx, SO_2 and PM achievable using modern flue gas clean-up

equipment.

- Initial investment requirement marginally higher than super critical technology and less than other clean coal technology. This, however, depends on the unit size considered.

It is needless to mention that significant research and development work in the field are being carried out to optimize on:

- Cycle layout and heat rate
- Requirement of auxiliaries
- Environmental impact
- Initial cost
- Plant availability

In Indian context, the following features need special attention compared to the technologies available in other Countries:

- Dependence on imported materials for heat transfer surfaces and the turbine parts handling high temperature steam will offset the cost advantages normally available in advanced countries.
- Indian coal has high ash content, which is also abrasive in nature. This aspect may be given due attention during furnace design.
- Suitable training of O&M staff and indigenous vendors would be necessary.
- Superior water treatment along with 100% condensate polishing being essential requirement needs to be ensured.

An evaluation of steam cycle performance shows that a cycle efficiency in excess of 42% is attainable in ultra-supercritical applications compared to 38 – 40% % attainable with super-critical steam parameters. At a more specific level, improvements are possible and are being attained through:

- Increase in main and reheat steam temperatures, main steam pressure including transition to ultra-supercritical conditions.
- Changes of cycle configuration, namely, increasing number of reheat stages, feed heaters with associated increase in final feed water temperature. For example, utilizing topping de super heater (dry heater) over and above normal regenerative feed heating arrangement and utilizing LP drip pump with feed forward arrangement.

- Changes in the boundary conditions of the cycle, namely, flow and temperature of flue gas at the outlet, condenser pressure etc.
- Improvements in steam turbine efficiency through optimized flow paths & last stage blade design improvements
- Reduction in auxiliary power consumption.
- Improvement in the performance of the individual plant components, which in turn, has an effect on the other areas listed above (coal combustion, turbine efficiency, pump efficiency, condenser performance etc.).

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Chapter - VI

Environmental Monitoring Programme

6.1 INTRODUCTION

Regular monitoring of environmental parameters is of immense importance to assess the status of environment during project operation. With the knowledge of baseline conditions, the monitoring programme will serve as an indicator for any deterioration in environmental conditions due to operation of the expansion project, to enable taking up suitable mitigatory steps in time to safeguard the environment. Monitoring is as important as that of control of pollution since the efficiency of control measures can only be determined by monitoring.

Usually, as in the case of the study, an impact assessment study is carried over short period of time and the data cannot bring out all variations induced by the change of seasons or changes in the domain and nature of activities. Therefore, regular monitoring programme of the environmental parameters is essential to determine any changes in the environmental quality.

6.2 ENVIRONMENTAL MONITORING AND REPORTING PROCEDURE

Monitoring will confirm that commitments are being met. This may take the form of direct measurement and recording of quantitative information, such as amounts and concentrations of discharges, emissions and wastes, for measurement against corporate or statutory standards, consent limits or targets. It may also require measurement of environmental quality in the vicinity of a site using ecological/biological, physical and chemical indicators. The key aims of monitoring are:

i. To monitor impacts on the surrounding environment and the effectiveness of mitigation measures during the construction and operation phases.

ii. To ensure that the environmental control systems are installed and operating satisfactorily.

iii. To verify the evaluations made during the planning process, particularly with risk and impact assessments.

iv. Monitoring will also be required to meet compliance with statutory (MoEF&CC, CPCB/RSPCB) and corporate requirements.

6.2.1 OBJECTIVES OF MONITORING

The objectives of monitoring are to:

- Verify effectiveness of planning decisions.
- Measure effectiveness of operational procedures.
- Conform statutory and corporate compliance.

6.2.2 ENVIRONMENT ASPECTS TO BE MONITORED

i. Work zone monitoring.

Regular work zone monitoring will be done for PM_{10}, $PM_{2.5}$, SO_2 & NO_X. If concentrations are higher than threshold limit values the source of fugitive emissions will be identified, and necessary measures will be taken.

Presently, for existing operations, periodical work zone monitoring through NABL approved & MoEF&CC recognized laboratory is being carried out and report submitted to RSPCB & MoEF&CC. Adani Power Limited has a full-fledged NABL accredited environmental laboratory for air & water quality monitoring at its Kawai Thermal Power plant which also carries out environmental monitoring for the plant.

ii. Ambient air and stack monitoring

- Ambient air quality will be monitored for Particulate Matter (PM_{10}, $PM_{2.5}$), Sulphur Dioxide (SO_2) and Oxides of Nitrogen (NOx) within plant premises and in study area at sensitive locations through NABL approved & MoEF&CC recognized laboratory & report submitted to RSPCB & MoEF&CC.

- Presently, 3 no. of CAAQM stations are installed within existing premises of Kawai Thermal Power Plant & report submitted on six-monthly basis to RSPCB & MoEF&CC. The same practice will be continued for proposed expansion. 2 CAAQMS stations are proposed in the expansion unit.
- Regular monitoring of stack will be carried out for the parameters such as PM, SO_2, NOx, CO, Hg to assess the performance of pollution control facilities installed for the unit through third party NABL accredited & MoEF&CC recognized environmental monitoring laboratory.
- APL, Kawai Thermal Power Plant will install a 24x7 online continuous emission monitoring system at main process stacks to monitor stack emission concerning standards prescribed in Environment (Protection) Rules 1986 and connected to CPCB/RSPCB online servers and calibrate these systems from time to time according to equipment supplier specification.
- Presently, OCEMS for PM, SO_2 & NO_X connected to CPCB & RSPCB server has been installed in both flue stack of unit 1 & unit 2 for the operational 2x660 MW super critical power plant.

iii. Water and wastewater quality

The program for monitoring water and wastewater quality encompasses the examination of treated wastewater parameters before reuse, recycling, and recirculation. Additionally, it includes the monitoring of surface water and groundwater quality. The schedule for monitoring treated water derived from diverse sources, along with the specified parameters for analysis, is detailed in the monitoring plan.

Surface and groundwater quality assessment, encompassing sources like drinking and irrigation wells, ponds, tube wells, etc., in the vicinity, will be conducted on six monthly basis at various locations within 2 km radius of the power plant. The monitored parameters will include dissolved solids, oxygen levels, bacterial contamination, heavy metals and other demand parameters.

- Ground water level & quality monitoring once in six months in the plant vicinity.
- Surface water monitoring once in six months in the plant vicinity.

- The characteristics of cooling tower blow down will be analyzed periodically.
- The characteristics of inlet and outlet water of STP and ETP will be tested on a monthly basis and reports will be submitted to CPCB/RSPCB.
- Environment Statement Reports will be filed as per the schedule prescribed by the State Pollution Control Board. Regular sampling and analysis for the same shall be carried out through an NABL & MoEF&CC recognized environmental monitoring laboratory.
- Presently, 3 no. of piezometers have been installed near ash dyke for monitoring ground water quality within plant premises & report submitted on six-monthly basis to RSPCB & MoEF&CC.
- Presently, ground water quality monitoring is being carried out at 7 no. of locations within the study area , ground water level monitoring is being carried out at 3 no. of locations within 2 km radius of plant site and surface water quality monitoring is being carried out at 3 no. of locations within 2 km radius of plant site through a NABL & MoEF&CC recognized environmental monitoring laboratory & analysis reports submitted to RSPCB & MoEF&CC.

iv. Noise Levels

- Noise levels in the work zone environment are being monitored at about 9 locations & the same practice will be continued for the expansion proposal.
- The frequency will be once in six months in the work zone.
- Similarly, ambient noise levels in the plant site & plant vicinity re being monitored & the same practice will be continued for the expansion proposal. The frequency will be once in six months in the work zone

v. Soil Quality

- Soil quality will be monitored inside plant premises near the coal handling & storage area, near hazardous waste storage area, near gypsum storage area, near ash dyke, near

BTG area and near township once in six months along with soil quality monitoring in in plant vicinity once in a year.

- The parameters will include physico-chemical properties, toxic elements, nutrient profile of soil and heavy metals.
- Presently, soil quality monitoring is being carried out within plant premises and in vicinity of the operational TPP at 3 locations by NABL accredited and MoEF&CC recognized environmental laboratory and report submitted to RSPCB & MoEF&CC.

6.3 ENVIRONMENTAL MANAGEMENT DIVISION

Monitoring of pollution is as important as implementation of measures for control of pollution since the efficiency of control measures can only be determined by monitoring. The following routine monitoring program will be implemented under the post-project monitoring as per CPCB/RSPCB guidelines. The major environmental considerations involved in the construction and operation of the thermal power station are being / will be taken up by the full-fledged multi-disciplinary Environmental Management Cell headed by Sr. Manager & supported by Environmental Engineer, Officer, Chemist & Horticulturist, with key functions of environmental, safety and occupational health for management of the entire plant and surrounding environment.

A NABL certified environmental laboratory has also been set-up at Kawai Thermal Power Plant by Adani Power Limited.

Environmental monitoring schedules are prepared covering various aspects of the environment during the regular operational phase. To affect the monitoring schedule, it is responsibilities have been allocated to individuals' in the environment management cell.

The monitoring program for different parameters of environment, outlined in the following sections, is based on the findings of the impact assessment. Environment Monitoring Plan during Construction Phase & Operation Phase of the expansion proposal is as below:

6.3.1 MONITORING SCHEDULE DURING CONSTRUCTION PHASE

Table 6.1: Environment Monitoring Program during Construction Phase

S. No.	Aspect	Parameters	Frequency	Location
1	Meteorological aspects	Wind speed & direction, temperature, rainfall and humidity	Continuous hourly monitoring	At plant site
2	Ambient Air quality	PM_{10}, $PM_{2.5}$, SO_2, and NOx	Twice in a week manner	At major construction sites
3	Noise	Equivalent noise pressure level	Once in three months	At major construction sites
4	Ground water quality	Physical, chemical and biological parameters including heavy metals	Twice in Six months	Two locations
5	Surface water quality	Identification of water related diseases and curative measure, etc.	Twice in Six months	Two locations in study area likely to receive surface run-off from the site.

6.3.2 MONITORING SCHEDULE DURING OPERATIONAL PHASE

During operational stage, mainly particulate matter and flue gases are emitted from the proposed expansion unit. Following attributes which merit regular monitoring based on the environmental setting and nature of project activities are listed below:

- Source emissions and ambient air quality.
- Groundwater levels and ground water quality;
- Surface water quality;
- Water and wastewater quality (water quality, effluent & sewage quality etc.);
- Soil quality;
- Noise levels (equipment and machinery noise levels, occupational exposures and ambient noise levels);

The following routine monitoring program as detailed shall be implemented at site. Besides to this monitoring, the compliances to all environmental clearance conditions and regular permits from RSPCB and MoEF&CC will be monitored and reported periodically.

Table 6.2: Environmental Monitoring During Operational Phase of expansion

S. No.	Environmental Aspect	Parameters	Locations (Additional to existing Monitoring) & Frequency	Responsible Person/Organization
1.	Meteorology	Wind speed & direction, temperature, rainfall, and humidity	Project Site (Continuous Automatic Monitoring)	Environmental Management cell (EMC)
2.	Work Zone Air Quality	PM_{10}, $PM_{2.5}$, SO_2, NOx	Work zones inside (twice a year)	NABL Accredited Laboratory, Coordinated by EMC
3.	Ambient Air Quality	PM_{10}, $PM_{2.5}$, SO_2, NO_2, (Within and outside the plant area)	• 1 location in core zone (Twice a Week) • 1 location in core zone (CAAQMS) • 1 location in study area (Downwind direction)	Continuous Online Monitoring, NABL Accredited Laboratory Coordinated by EMC
4.	Stack	PM, SO_2, NO_2, (Continuous Emission Monitoring System at all major stacks)	Bi flue stacks (2 Nos) (Continuous Emission Online Monitoring) CEMS & Manual Monitoring (Monthly)	NABL Accredited Laboratory, Coordinated by EMC
5.	Noise	Noise	• 1 location in core zone (monthly) • 1 location in study area (Downwind direction)	NABL Accredited Laboratory Coordinated by EMC
6.	Surface Water Quality	Physical, chemical, and biological parameters including heavy metals	2 Locations Near Project Site (six monthly) • Lhasi nadi • Andheri Nadi	NABL Accredited Laboratory Coordinated by EMD
7.	Groundwater Quality	Physical, chemical, and biological parameters including heavy metals	2 locations in core zone (six-monthly) • Coal handling area • Ash handling area in Phase II expansion 1 location in study area (Six-monthly)	NABL Accredited Laboratory Coordinated by EMC, Piezometer for Long-Term Monitoring (1 Location) - NABL Accredited

S. No.	Environmental Aspect	Parameters	Locations (Additional to existing Monitoring) & Frequency	Responsible Person/Organization
			• Dara village	Laboratory Coordinated by EMC
8.	Waste water quality	Physical, chemical, and biological parameters including heavy metals	1 location in core zone, ash recovery pump house for phase-II expansion	NABL Accredited Laboratory Coordinated by EMC
9.	Soil	Physical and chemical parameters, Heavy metals with organic content	2 locations in core zone • Coal handling area • Ash handling area 1 location in study area • Dara village	NABL Accredited Laboratory Coordinated by EMC
10.	Health	Health-related parameters (e.g., air quality impact on respiratory health)	Project Site and nearby habitation (Regular Monitoring)	Health Department and EMC Collaboration
11.	Biological environment	Terrestrial ecology	• Plantation, greenbelt development in core zone • Plantation programme in study area • Implementation of wildlife conservation plan (once every 3 year)	EMC in collaboration with Forest department
12.	Socio-economic environment	Implementation status of social-welfare schemes under social-EMP (CER) & CSR	Villages in study area of Kawai TPP (Social audit once every 3 year)	APL, Kawai with coordination with Adani Foundation & EMC

Vibration levels will undergo monitoring at the interior Quality Control (QC) laboratory, which will house vibration-sensitive equipment. This will be done to assess potential impacts arising from both construction and operation activities. Mitigation measures will be implemented, such as notifying equipment operators in advance to coordinate activities when vibration levels exceed 65 dBA. Additionally, temporary relocation of sensitive equipment and the installation of isolation equipment, such as vibration-dampening mounts, may be considered as part of these measures. Regular monitoring at the QC laboratory will continue to ensure ongoing assessment of potential impacts from construction and operation, with timely coordination and appropriate measures as needed.

6.4 REPORTING SCHEDULES OF THE MONITORING DATA

Voluntary reporting of environmental performance with reference to the EMP is being undertaken at Kawai Thermal Power Plant & the same shall be continued for Phase – II expansion.

The environmental monitoring contracted laboratory will co-ordinate all monitoring programmes at site and data thus generated will be regularly furnished by Adani Power Limited to the RSPCB & MoEF&CC.

The Environmental Audit/Statement reports will be prepared for the entire year of operations and will be regularly submitted to regulatory authorities. Consistent monitoring and meticulous data analysis will be conducted, adhering to a robust documentation and reporting system. A comprehensive report, inclusive of recommendations, will be formulated and submitted to the regional offices of RSPCB/CPCB and other relevant authorities within the Ministry of Environment Forest and Climate Change (MoEF&CC) for their thorough evaluation. This entire process will be seamlessly integrated into routine contract monitoring activities. Proposals for Reporting and Monitoring Systems at various stages will be outlined to ensure the monitoring plan's timely and efficient implementation.

6.5 INFRASTRUCTURE FOR ENVIRONMENTAL MONITORING

Adani Power Limited at Kawai Thermal Power plant has established a full-fledged environmental (air & water) monitoring laboratory which is NABL accredited.

APL has also engaged third party NABL accredited environmental monitoring laboratory to carry out periodical monitoring as per statutory clearances. Also, 3 no. of CAAQM stations within core zone. OCEMS has been installed in both flue stack of existing Chimney. Similarly, a network of piezometers has been established for ground water monitoring. Continuous online environmental monitoring infrastructure & ground water monitoring network will be further enhanced for the Phase-II expansion.

6.6 DETAILED BUDGET PROVISION

The cost estimates for the monitoring plan are as detailed as under: -

Table 6.3: Budgetary Provision for Environmental Monitoring

Component	**Stage**	**Locations**	**Frequency**	**Total no. of samples annually**	**Cost per Sample (Rs)**	**Recurring cost (Rs)**
Air	Construction	2	Once in two weeks	52	3000	312000
	Operation	CEMS, CAAQMS	Continuous	4+3	125000	1500000
		2	Once in two weeks	36	3000	216000
Water	Construction	2 surface water samples	Quarterly	8	4000	32000
		2 ground water samples	Quarterly	8	4000	32000
	Operation	2 surface water samples	Quarterly	8	4000	32000
		4 Ground water samples	Quarterly	16	4000	64000
		2 wastewater quality	Once a month	24	4000	96000
		Ground water level	Quarterly	4	1000	4,000
Noise	Construction	EQMS	Quarterly	4	100000	400,000
Noise Noise	Construction	5	Quarterly	8	1000	8000
Soil	Operation	10	Monthly	6	1000	6000
Soil	Operation	3	Twice in a year	6	4000	24000
Ecology	Operation	Study Area	Once 3 years	1		-
Total Environment Monitoring Cost during Construction Phase:					Rs. 3,84,000/-	2726000
Total Environment Monitoring Cost during Operation Phase:					Rs. 2342000/-	
Total Environment Monitoring Cost:					Rs. 2726000/-	

The estimated environmental cost during the construction phase and operation phase will be Rs. 3,84,000/- and Rs. 2342000/- respectively. The Total Environment Monitoring Cost will be Rs. 2726000/-

6.7 CONCLUSION

Post project environmental monitoring is an essential step in the EIA process, if the predicted impacts, the efficiency of mitigation measures and the shortcomings of prediction methods, measures and even regulations are to be verified and EIA practice improved. Environmental indicators could contribute to designing and evaluating monitoring programs, thus improving establishment of the cause effect relationship and the reporting and communication of environmental data.

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Chapter - VII

Additional Studies

7.1 INTRODUCTION

The additional studies as suggested in Para 7 & Appendix-III of EIA Notification 2006 amended to date are (i) Public Consultation; (ii) Risk Assessment; (iii) Social Impact Assessment and (iv) Rehabilitation & Resettlement (R&R) Action Plan. No R& R is involved in the project.

The project was granted with Terms of Reference (ToR) vide TOR Identification No: TO24A0601RJ5203867N dated 29/07/2024 by the MoEF&CC, New Delhi for preparation of EIA& EMP report for the proposed project, additional studies done for the project include hydrogeology study & rainwater harvesting, water source sustainability study, need base & socio-economic assessment, land use & land cover study for land optimization, ecology & biodiversity study, etc. which help in the understanding the environmental impact of the project in better ways. A summary of all the additional studies will be presented in this chapter with the detailed report during the Final EIA & EMP report. The separate cumulative impact assessment study is considered as another Additional Study as prescribed in the ToR specific condition no.1.1 is detailed in Chapter XIII of this draft EIA/EMP report.

7.1.1 PUBLIC CONSULTATION

As per the conditions of the granted ToR and the EIA Notification 2006 & its subsequent amendments, public consultation will be held for the project based on this draft EIA & EMP report. "Public Consultation" refers to the process by which the concerns of local affected persons and others who have plausible stake in the environmental impacts of the project or activity are ascertained with a view to considering all the material concerns in the project or activity design as appropriate. Public Consultation process comprises of two parts, viz Public Hearing and written response from stakeholders. The Public Hearing will be arranged in a systematic, time bound and transparent manner ensuring widest possible public participation at the project site. The Draft EIA-EMP report will be submitted to SPCB along with other relevant documents. The Authority is expected to process the application for Public Hearing and conduct the same within 45 days of receiving the application as per EIA notification 2006 and its subsequent amendments.

The regulatory authority shall make available on a written request from any concerned person the Draft EIA & EMP report for inspection at a notified place during normal office hours till the date of the Public Hearing. All the responses received as part of this public consultation process will be forwarded to the applicant through the quickest available means. After completion of the Public Hearing, Kawai TPP, APL shall address all the environmental concerns expressed during this process and make appropriate changes in the EIA & EMP report. The final EIA & EMP report, so prepared, will be submitted to the MOEF&CC for appraisal by respective EAC for the grant of Environmental Clearance.

This draft EIA & EMP report has been prepared to facilitate public consultation concerning the Proposed Expansion of Kawai Thermal Power Plant under Phase–II by adding 3200 (4x800) MW Ultra Super Critical Thermal Power Plant to Existing 1320 (2x660) MW at Village Kawai, Tehsil Atru, District Baran, Rajasthan.

7.2 RISK ASSESSMENT, HAZARD ANALYSIS & DMP

7.2.1 Introduction

Risk assessment involves identifying potential hazards and analyzing the potential outcomes if those hazards were to occur. This process relies on the analysis of past accidents in similar projects, prior decisions, and the expertise in the field of risk analysis, particularly in accident analysis. The scope of work for the study is described below:

- Identify potential risk scenarios that may arise from the proposed project and other associated activities
- Analyze the possible likelihood and frequency of such risk scenarios by reviewing historical accident related data.
- Predict the consequences of such potential risk scenarios and if consequences are high, establish the same by through application of quantitative simulations.

- Recommend feasible preventive and risk mitigation measures as well as provide inputs for drawing up of Emergency Response Plan (ERP) for the project.
- The assessments to be based on various existing documents including Emergency Response Plan (ERP), Disaster Management Plan (DMP).
- The scope involves risk assessment of storage of chemicals, coal & ash, BTG operation at project site that may have a detrimental impact to the personnel and plant properties.

7.2.2 Objective

The primary goal of this study is to identify potential hazards associated with the proposed thermal power plant and assess their impact on people and property in the vicinity of the plant premises. The study will specifically focus on estimating the effects of accidental releases of toxic and flammable gases, as well as fuel leakages. The data obtained from analyzing these consequences will be crucial for developing preventive strategies, ranging from the design phase to operational activities.

To initiate the risk analysis process, Material Safety Data Sheets (MSDS) will be collected for each raw material/ chemical involved in the industry. MSDS will provide insights into material behavior, facilitating adherence to safety norms in both plant and process design criteria. The design of storage, handling, P&ID (Piping and Instrumentation Diagram), production processes, and disposal procedures will be meticulously crafted to ensure 100% safety at every stage of unit operations and processes.

Furthermore, this comprehensive risk analysis will contribute valuable information for creating a well-structured Disaster Management Plan (DMP). The assessment of risk factors includes the evaluation of procedures for storing, handling, shipping, and transferring hazardous materials (HAZMAT), details about the physical features and location of storm and sanitary sewer systems, site measures for managing and controlling HAZMAT releases, and the existing emergency response and preparedness programs at the base.

7.2.3 METHODOLOGY & APPROACH

Process understanding: It is imperative to understand the complete plant its processes; storage and handling of fuels / chemicals, etc.

Risk identification: identify and assess areas which might be at risk of causing serious problems.

Hazard Identification: The materials and process hazards have been discussed herewith in respect to the unit.

Frequency of Hazard Occurrence: As per the available international statistics, the frequencies of occurrence for different accident scenarios were determined.

Consequence Analysis: Consequence modelling was carried out as per the identified hazards, accident scenarios, their frequency of occurrence, for pool fires and explosions etc.

Risk Reducing Measures: Adequate measures to reduce anticipated risks have been suggested based on the consequence scenarios.

The Risk Assessment (RA) uses conventional risk assessment techniques as shown in **Figure 7.1** and described as follows:

- Identify the preliminary causes of major accidents associated with the process, and develop a list of representative potential events involving the release of hazardous materials or other events, which could lead to loss of life or damage to infrastructure.
- Model the possible scale of severity of the physical effects of each identified hazardous event. Predict the criticality of the damage that could be caused and the potential for escalation, developing rule sets and assumptions to form the basis of an analysis of the possible outcomes.
- For each identified hazard, use appropriate models and data to estimate its frequency, taking into account any site-specific features that may influence the likelihood of the scenarios. Compare the event frequency estimates with historical data to confirm the validity of the model.
- Combine the predicted consequences of each event with its frequency to estimate the risks to personnel. Assess the Individual Risk (IR) for the facilities.

- Compare the results of the study with Company Risk Tolerance Criteria to establish whether the operation of the project can be regarded as adequately safe. Consider the risk mitigation provided by other measures such as the gas detection and shutdown system.
- Propose additional Risk Reduction Measures (RRM).

The methodology is presented pictographically in the following section:

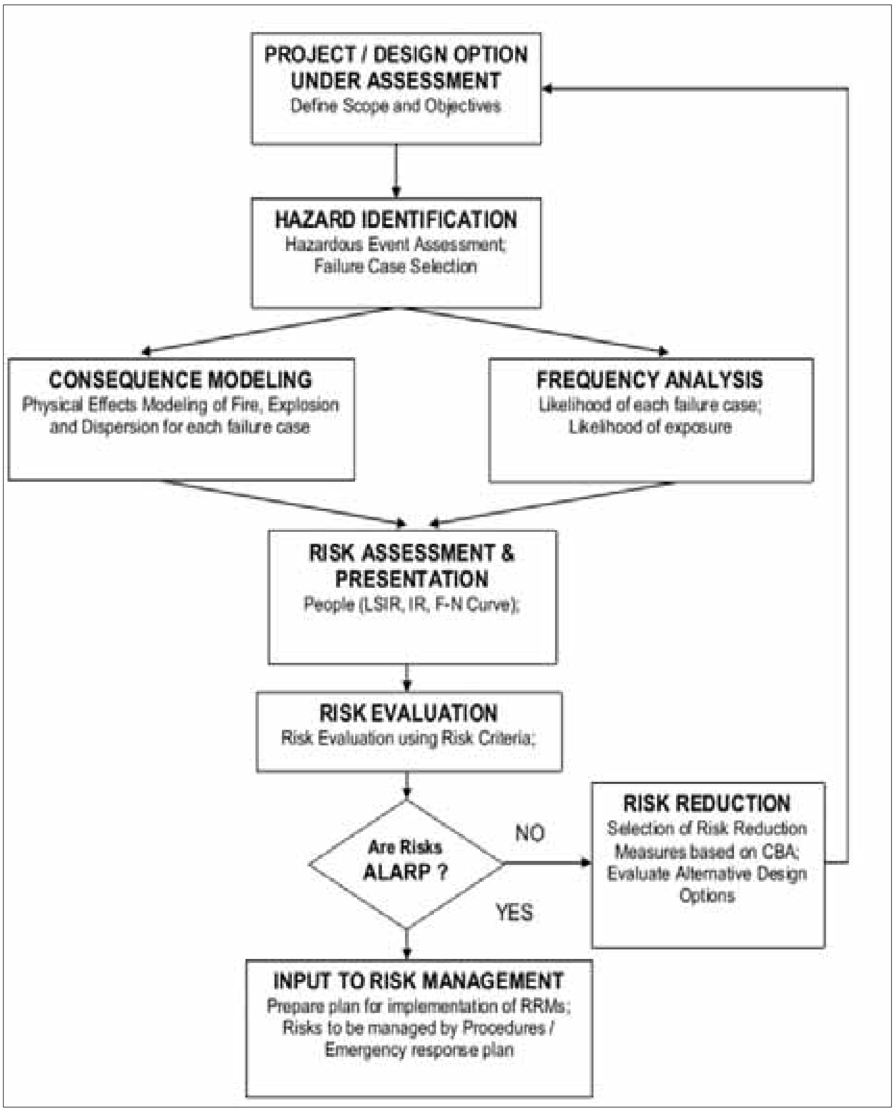


Figure 7.1: Risk Assessment Methodology

Identification of Risks

Activities/ areas such as raw material and finished product storage areas, process and operation sections might be considered as risk zones. Some of them are:

7.2.3 Risk associated with raw material

The handling, storage, and transportation of coal involve challenges such as dust emissions, potential for spontaneous combustion, and the risk of coal pile fires. Coal, being a combustible material, poses the danger of dust explosions during handling and processing stages. Additionally, the transportation of large quantities of coal to the plant raises concerns about potential spills and environmental contamination, necessitating stringent safety measures.

Similarly, the storage / usage of ammonia, chlorine and the use of LDO as a fuel source introduces its own set of risks. Ammonia is flammable as well as toxic whereas chlorine is toxic. In case of loss of containment, it poses severe threat to environment / asset / people in the site of accident. LDO is a flammable liquid, and the handling, storage, and transportation of this fuel demand strict adherence to safety protocols to prevent spills, leaks, and fire hazards. The risk of fuel spills can lead to soil and water contamination, posing environmental threats.

7.2.4 Risk associated with Process

The power generation process of an Ultra Super Critical thermal power plant involves several critical steps, each carrying specific risks that need careful consideration. Here are the process risks associated with each step:

Table 7.1: Process risks

Process	Associated risks
Coal Handling and Combustion:	• Coal Dust Explosions: Fine coal powder in the handling and pulverizing process can form explosive mixtures with air. • Conveyor Belt Issues: Risks of conveyor belt malfunctions or breakdowns during coal transportation.
Thermal-to-Mechanical-to-Electrical Energy Conversion	• Boiler Tube Failures: High-pressure, high-temperature conditions in the boiler may lead to tube failures. • Steam Turbine Issues: Potential turbine blade damage or failure during operation. • Generator Malfunctions: Risks associated with the electrical generator's operation and potential failures.

Ash Generation and Disposal	• Bottom Ash Handling: Risks in the handling, conveyance, and disposal of bottom ash. • Fly Ash Disposal: Environmental concerns related to the disposal of fly ash and potential contamination.
Flue Gas Treatment and Ash Handling	• Chemical Exposure: Risks associated with the handling of chemicals in the flue gas treatment system. • Ash Handling System: Risks in the extraction and conveyance of ash from Electrostatic Precipitators.
Fly Ash Utilization	Handling and Conveyance: Risks related to the transportation and utilization of fly ash slurry.
Steam Condensation and Reuse	• Condenser Tube Fouling: Risks associated with the fouling of condenser tubes, impacting efficiency. • Water Pump Failures: Potential failures in water pumps affecting the condensation process.
Cooling Tower Operation	• Cooling Tower Malfunctions: Risks of malfunctions impacting the efficiency of heat dissipation. • Blowdown Management: Risks associated with the controlled blowdown process and its impact on water quality.

Mechanical Hazards: Those associated with power-driven machines, whether automated or manually operated Mechanical operations

Table 7.2: Mechanical Hazards, risks and preventive measures

Hazard	Risk	Preventive measures
Rotating Equipment	Entanglement or contact with rotating parts.	Guards, barriers, and warning signs.
Conveyor Systems:	Pinch points, entrapment during material handling.	Safety guards, emergency stop buttons, training.
High-Pressure Systems	Explosions or ruptures in boilers or steam lines.	Inspection, maintenance, safety standards.
Crane and Lifting Operations	Accidents during lifting, transporting heavy loads	Qualified operators, inspection, load limits
Electrical Hazards:	Electric shock during work on electrical systems.	Lockout/tagout, insulation, PPE.
Material Handling Equipment	Collisions, overturning of forklifts or cranes	Operator training, signage, designated pathways.
Working at Heights	Falls from elevated platforms or structures	Fall protection systems, guardrails, training.
Hot Surfaces	Burns from contact with hot surfaces or equipment.	Insulation, warning signs, PPE.

Equipment Startup and Shutdown	Injuries during initiation or cessation of equipment operation.	Clear procedures, warning signals, training
Machine Maintenance	Injuries during equipment maintenance or repairs.	Lockout/tagout, training, safety equipment.

7.2.5 Risk related to Fire incidents.

- Combustible Materials Handling
- Electrical Faults and Malfunctions
- Hot Work Operations
- Equipment Overheating
- Flammable Gases and Liquids Handling
- Spontaneous Combustion Risks
- Ignition Sources Control
- Inadequate Fire Suppression Systems
- Poor Housekeeping Practices

7.3 HAZARD IDENTIFICATION

The hazard identification consists of a qualitative review of possible accidents that might occur, based on previous accident experience or judgment where necessary. There are several formal techniques for this, which are useful in their own right to give a qualitative appreciation of the range and magnitude of hazards and indicate appropriate mitigation measures. This qualitative evaluation is described in this guide as "hazard assessment". In a QRA, hazard identification uses similar techniques, but has a more precise purpose – defining the boundaries of a study in terms of materials to be modelled, release conditions to be modelled, impact criteria to be used, and identifying and selecting a list of failure cases that will fully capture the hazard potential of the facilities to be studied. Failure cases are usually derived by breaking the process system down into a larger number of sub- systems, where failure of any component in the sub-system would cause similar consequences. This can be performed by breaking the process facility into sections depending on availability of isolation valves along the line or by parameter wise or by fluid / equipment wise. Identified scenarios for risk assessment are given below:

IS No	Description
IS 01	Ammonia Bullet 1
IS 02	Ammonia Bullet 2
IS 03	Ammonia Bullet 3
IS 04	Ammonia Bullet 4
IS 05	Chlorine Vessel 1
IS 06	Chlorine Vessel 2
IS 07	LDO Tank 1
IS 08	LDO Tank 2
IS 09	LDO Tank 3

7.3.1 HAZARD/ RISK IDENTIFICATION & ANALYSIS

The proposed expansion of the thermal power plant presents various potential hazards that need careful consideration. Handling and combustion of coal pose risks related to combustible materials, while electrical faults may result in short circuits. Hot work operations such as welding introduce fire hazards, and equipment overheating can occur due to mechanical failures. The presence of flammable gases and liquids adds complexity, and spontaneous combustion risks are associated with materials like coal. Ignition sources, inadequate fire suppression systems, poor housekeeping, and the lack of emergency response planning further contribute to the overall risk profile. Identifying and addressing these hazards is crucial for ensuring the safety and resilience of the project.

Table 7.3: - Identification of Hazards

Plant Section	Activity	Emergency
Coal Handling	Transportation and Conveyor Operations	Fire Incidents, Combustible Material Handling
Boiler	Coal Combustion and Steam Generation	Boiler Malfunctions, Flammable Gas Leak
Turbine	Steam-to-Electricity Conversion	Mechanical Failures, Electrical Faults
Ash Disposal	Ash Generation, Handling, and Disposal	Fly Ash Management
Cooling Tower	Operation and Cooling Water Recycling	Overheating, Cooling Water Contamination

Electrical	Power Distribution and Electrical Operations	Short Circuits, Electrical Fires
Fuel Storage	Storage and Handling of Fuels	Fuel Leak, Fire Hazards
Water Treatment	Effluent Treatment and Water Recycling	Water Contamination, Chemical Spills
Emergency Response	Preparedness and Response Planning	Evacuation, Fire Control, Medical Emergencies

7.4 HAZARDOUS MATERIAL AND SAFETY MANAGEMENT

The hazardous material and safety management involves a comprehensive approach to identify, handle, and mitigate risks associated with potentially harmful substances. Key considerations include the safe handling and transportation of coal, implementation of proper storage and containment measures for flammable fuels, and the management of hazardous by-products like ash and flue gas. Additionally, the project emphasizes the importance of Material Safety Data Sheets (MSDS) for each substance encountered, enabling a thorough understanding of their properties and behaviors. Robust safety measures are integrated into storage, handling, production processes, and disposal, ensuring adherence to safety norms and minimizing the risk of accidents. The development of a Disaster Management Plan (DMP) further enhances preparedness for unforeseen events. Ongoing monitoring, regular inspections, and adherence to safety protocols contribute to maintaining a secure environment throughout the project's lifecycle

7.4.1 Hazardous Chemicals

Various hazardous chemicals are used in the ultra-super critical TPP like:

Aqueous ammonia: commonly used in power plants for various applications.

Chlorine: often employed in water treatment processes within power plants. It helps control microbial growth, ensuring the cooling water remains free from harmful bacteria and other contaminants. Chlorine is also used in the disinfection of water to maintain system integrity.

Light Diesel Oil (LDO): used in power plants for various purposes, including start-up operations, flame stabilization during boiler ignition, and load support for the units. It is a common auxiliary fuel that facilitates the initial phases of power generation.

Light-Diesel Oil (LDO) and Flammability Class

LDO is a vital component in the fuel inventory of a Thermal Power Plant (TPP), serving essential functions during start-up operations. LDO falls under Class B Flammable Liquids, as per its flammability classification criteria.

Flammability Classification Criteria (Class B Flammable Liquid)

Flash Point (°C): 23 > FP < 65

Being a Class B Flammable Liquid, LDO exhibits properties that categorize it as a substance with a moderate flashpoint. The flashpoint, which is the minimum temperature at which the liquid gives off vapor in sufficient concentration to ignite, places LDO within a specific range, making it susceptible to combustion under certain conditions.

Pool Fire Risk in LDO Storage

LDO handling and storage pose potential hazards, particularly concerning the risk of a pool fire. The setup includes two storage tanks, each with a capacity of 500 KL, strategically positioned within a dyke featuring a 1-meter-high wall. In the event of an inadvertent spillage resulting from minor leakage or pipeline rupture, coupled with an ignition source, a fire incident could transpire. For worst-case scenario considerations, it is assumed that the entire contents might leak out from the storage tank into the tank bund, accentuating the gravity of the potential fire hazard.

Other chemicals commonly encountered in thermal power plants may include:

Cooling Water Treatment Chemicals:

- Corrosion inhibitors
- Scale inhibitors
- Biocides

Boiler Water Treatment Chemicals:

- Oxygen scavengers
- Scale and corrosion inhibitors
- Alkalinity adjusters

Ash Handling System Chemicals:

- Dust suppressants for ash disposal
- Chemicals for ash conditioning

Emission Control Chemicals:

- Selective Catalytic Reduction (SCR) reagents for NOx reduction
- Ammonia injection for De-NOx systems
- Adequate Stack Height

Fuel Additives:

- Additives to enhance combustion efficiency
- Anti-fouling agents

Cleaning Agents and Lubricants:

- Chemicals for equipment cleaning and maintenance
- Lubricants for rotating machinery

Water Demineralization Chemicals:

- Ion-exchange resins
- Regenerants for demineralization plants

7.4.2 Storage and Handling of Hazardous Chemicals

- Maintaining a detailed inventory of all hazardous chemicals used in the project, including liquid ammonia, chlorine, and light diesel oil (LDO).
- Classifying chemicals based on their properties and risks.
- Implementing a clear segregation plan to separate incompatible chemicals and prevent cross-contamination.
- Ensuring that storage areas are marked and color-coded according to the nature of the stored chemicals.

- Designating specialized storage facilities for high-risk chemicals, such as chlorine, with enhanced safety features, including leak detection and emergency shutdown systems.
- Ensuring compliance with regulatory requirements for the storage of specific chemicals.
- Establishing a comprehensive emergency response plan specifically tailored to the hazards associated with the stored chemicals.
- Conducting regular emergency drills to ensure effective responses to different scenarios.
- Installing adequate ventilation and exhaust systems in storage areas for chemicals that emit fumes or vapors.
- Ensuring that the ventilation system is designed to handle the specific chemical properties.
- Monitoring and controlling storage temperatures for chemicals sensitive to temperature fluctuations.
- Implementing cooling or heating measures as needed.
- Implementing stringent security measures for chemical storage areas to prevent unauthorized access.
- Using access control systems and surveillance to monitor storage facilities.
- Maintaining detailed documentation for each chemical, including updated MSDS.
- Clearly labeling storage containers with information such as chemical names, hazard symbols, and handling instructions.
- Providing specialized training for personnel involved in the storage and handling of specific hazardous chemicals.
- Ensuring that personnel handling certain chemicals are appropriately certified.
- Conducting regular inspections and audits of chemical storage facilities to identify and address potential issues.
- Ensuring compliance with environmental, health, and safety regulations.

7.5 RISK ASSESSMENT

Risk assessment for the Proposed Expansion of Kawai Thermal Power Plant under Phase–II by adding 3200 (4x800) MW Ultra Super Critical Thermal Power Plant to Existing 1320 (2x660) MW at Village Kawai, Tehsil Atru, District Baran, Rajasthan involves a comprehensive analysis to identify, evaluate, and mitigate potential hazards associated with its operation. The principal objective is to ensure the safety of personnel, protect the environment, and safeguard surrounding communities. The assessment considers various phases of the power generation process, from coal handling and combustion to flue gas treatment and ash handling.

One significant risk lies in the combustion phase, where the handling and combustion of coal pose potential hazards. This includes the transportation of coal to bunkers, pulverizing it into a fine powder, and the subsequent combustion in the boiler. The release of toxic and flammable gases during this process necessitates careful strategies to prevent accidents, from design considerations to operational protocols.

Ash generation and disposal present another area of concern. The transformation of non-combustible coal parts into ash requires effective management to handle both bottom ash and fly ash.

Moreover, the operation of cooling towers and steam condensation involves managing heated cooling water and ensuring its safe reuse. Hazards related to noise, vibration, and ecological impact also require thorough assessment.

7.5.1 Identification of High-Risk Areas:

Identification of High-Risk Areas in the Ultra Super Critical Thermal Power Plant involves a meticulous examination of different sections and activities to pinpoint potential hazards that may pose significant risks to personnel, the environment, and surrounding communities. The identification process is crucial for implementing targeted safety measures and risk mitigation strategies. The key high-risk areas are:

- Coal Handling and Combustion Zone

- Thermal-to-Mechanical-to-Electrical Energy Conversion
- Ash Generation and Disposal Areas
- Ash Handling
- Steam Condensation and Reuse
- Cooling Tower Operation
- Ecological Impact and Surrounding Areas

Table 7.4: Event & causes of failure cases

Event	Causes
Boiler Tube Rupture	• High pressure and temperature fluctuations • Corrosion of boiler tubes • Material fatigue over time
Turbine Malfunction	• High-speed rotor imbalance • Blade erosion or damage • Steam quality issues
Electrostatic Precipitator failure	• Insufficient voltage supply • Accumulation of dust on electrodes • Equipment wears and tear
Cooling Tower Malfunction	• Inadequate water flow or distribution • Scaling and corrosion in heat exchangers • Mechanical failure of fans or pumps
Ash Handling Equipment Failure	• Blockage or jams in conveyors • Wear and tear in ash handling components • Failure of ash extraction systems
Steam Condenser Issues	• Scaling or fouling of condenser tubes • Loss of cooling water flow • Condenser air in-leakage
Coal Handling Equipment Breakdown	1. Conveyor belt failures 2. Blockages in coal bunkers or mills 3. Equipment wear and tear

Enhancing Operational Safety: Boiler Risk Assessment in Ultra Super Critical Thermal Power Plant

Boilers are critical components in Ultra Super Critical Thermal Power Plants (USCTPP), and assessing the associated risks is paramount for ensuring operational safety. The following table outlines potential risk areas related to boiler operation, their potential causes, and corresponding mitigation strategies.

Table 7.5: Boiler-Specific Risk Assessment

Risk Area	Potential Causes	Mitigation Strategies
Boiler Tube Corrosion and Erosion	• High-temperature fluctuations • Presence of corrosive elements in fuel or water • Poor water treatment practices	• Regular water treatment and quality checks • Installation of corrosion-resistant materials • Monitoring and controlling temperature fluxes
Pressure and Temperature Fluctuations	• Operational errors • Instrumentation failures • Control system malfunctions	• Implementing advanced control systems • Regular calibration of instruments • Operator training on proper handling and monitoring
Emergency Shutdown Procedures	• Delayed response to abnormal conditions • Inadequate training on emergency protocols	• Conducting regular emergency response drills • Providing comprehensive training on shutdown procedures Implementing automated shutdown systems

Consequence Analysis

Source Term Modelling

Source term modelling has been carried out for each identified scenario to determine the release profile and release parameters for various potential Loss of Containment scenarios. Following inputs were considered for the source term modelling.

- Stored inventory
- Representative material
- Process parameters (Pressure, Temperature, Flow rate, etc.)
- Release size & direction

These parameters are determined based on process description, plot plans, for the proposed facility. DNV SAFETI v8.71 has been used for the source term modelling. Each failure case calculation in SAFETI starts with discharge modelling. Based on release duration and release phase (gas, liquid, 2-phase), SAFETI directs the dispersion and consequence calculations to one of 4 alternate, built-in consequence outcome event trees (continuous vapour release, continuous release with rain-out, instantaneous vapour release, instantaneous release with rain-out), where each event tree branch probability carries default values, which may be re-programmed by the risk analyst.

Model Used for Consequence Analysis

The consequence analysis studies involve a large number of calculations for which established computing aids are essential. PHAST v8.71 software of DNV has been used to perform the consequence calculations. PHAST is a consequence and risk assessment software for calculation of physical effects (fire, explosion, atmospheric dispersion) of the escape of hazardous materials. PHAST software allows detailed modelling and quantitative assessment of release of pure and mixtures of liquid and gaseous chemicals.

In the risk analysis study, probable damages due to worst case scenarios were quantified and consequences were analyzed with object of emergency planning. Various measures taken by the company and findings of the study were considered for deciding acceptability of risks.

Maximum Credible Accident Analysis (MCAA)

At the TPP facility, hazardous fluid handled may be released as a result of failures or leakages during storage and handling or catastrophic rupture of equipment in unexpected situations due to any reason, causing possible fire & explosion and release of toxic gas in the atmosphere resulting damage human and property in the surrounding area. This section deals with the question of how the consequences of the release of such substances and the damage to the surrounding area can be determined by means of models. Maximum Credible Accident analysis encompasses certain techniques to identify the hazards and calculate the consequent effects in terms of damage distances of heat radiation, vapor cloud explosion, etc. Depending upon the effective hazardous attributes and their impact on the event, the maximum effect on the surrounding environment and the respective damage caused can be assessed. Ammonia, Chlorine and LDO may mainly pose flammable / explosion and toxic hazards due to unwanted release or leakage from the containment. Consequence analysis is basically a study of quantitative analysis of hazards due to various failure scenarios. It is that part of risk analysis, which considers failure cases and the damage caused by these failure cases. It is done in order to form an opinion on potentially hazardous outcome of accidents and their possible consequences. The reason and purpose of consequence analysis are many folds like:

- Estimation of consequence distances;
- Design Criteria.
- Protection of other installations; and
- Emergency Planning;

The results of consequence analysis are useful for getting information about all known and unknown effects that are of importance when some failure scenario occurs and also to get information as how to deal with the possible catastrophic events.

Consequence analysis involves the calculation of the initial "release rate" and then predicting the consequence of the release through computer modelling- it forms an important ingredient in the RA approach. Consequence analysis is a complex procedure involving numerous calculations. It must also be noted that a single starting incident could have numerous outcomes depending upon factors such as escalation, ignition and others.

Depending on the type of liquid handled and process conditions, one or more of the following potential hazards/consequences could be encountered due to loss of containment of hydrocarbons:

- Un-ignited release;
- Jet Fire;
- Pool Fire;
- Flash Fire;
- Vapour Cloud Explosion; and
- Toxic Impact (Not applicable for this project)
- Un-ignited Gas Release / Dispersion

A vapour cloud may be formed when a vaporizing liquid is released for an extended duration. If the gas cloud does not immediately ignite, it disperses based on the prevalent wind direction, speed and stability category (i.e. degree of turbulence).

The cloud dispersion simulation is carried out to provide the distance (from the leak) at which the concentration of flammable material falls below the Lower Flammability Limit (LFL).

Jet Fire

Jet fire causes damage due to the resulting heat radiation. The working level heat radiation impact will vary widely depending on the angle of the flame to the horizontal plane, which mainly depends on the location of the leak. The flame direction was considered horizontal for consequence analysis of leaks and ruptures from Piping and Tanks.

Upon accidental leakage, the pressurized fluid will disperse as a jet, initially moving forward in the spatial direction of the leak till the kinetic energy is lost and gravity slumping or lifting of the cloud occurs, dependent upon whether the fluid is heavier or lighter than air.

Source term modelling has been conducted for each identified study area at all the locations at the full stream operating pressure to determine the initial release rate. The release rates and material properties were used to calculate the flame length and distance to relevant heat radiation levels.

Two models are available for jet fire modelling in PHAST V8.71 – the cone model and the API-RP 521 model, of which the cone model is considered to be more conservative, and presents the jet fire as a tilted cone frustum, as opposed to a banana shaped plume in the API-RP 521 model, i.e. tapered at the end and bent by the wind. Thus, the cone model has been selected for jet-fire modelling.

The primary hazard associated with jet fires is thermal radiation and potential for flame impingement on adjacent pipelines/equipment, resulting in escalation. High pressure releases have the potential to cover large areas due to its relatively large flame length. However, the effects of escalation are minimized if the flame length reduces to less than the separation distance between other equipment and the jet fire source.

Pool Fire

A liquid pool is formed during a prolonged leakage if the rate of leakage exceeds the rate of vaporization. On ignition, this would result in a pool fire whose size / radius would depend on the mass flow rate, ambient temperature, and heat of vaporization of material released, vapour pressure, duration of discharge and effects of containment or dykes.

The pool fire could cause damage to equipment or injury / fatality to personnel due to thermal radiation effects.

A pool fire is usually not envisaged for liquid systems which are highly pressurized. Any leak or rupture would result in a pressurized release leading to a liquid jet fire or flash fire.

Flash Fire

The vapour/gas release from a pool would disperse under the influence of the prevailing wind; with material concentration in air reducing with distance. At a particular location downwind, the concentration will drop below its lower flammable level (LFL) value. If ignited within the flammable envelope, the mass of the material available between the LFL and ½ LFL will be likely to burn as a flash fire; rapidly spreading through the cloud from the point of ignition back to the source of release.

Although flash fire is generally low intensity transitory event, the burning velocity is quite high and escape following ignition is not possible. Flash fire often remain close to the ground, where most ignition sources are present. It is assumed that personnel caught inside a flash fire will not survive while those outside suffer no significant harm. If other combustible material is present within the flash fire it is also likely to ignite and a secondary fire could result.

Toxic Effects

Toxic dispersion model is based on Immediately Dangerous to Life and Health (IDLH) concentration of the chemical. This model gives the toxic dispersion damage radii for the IDLH value. The extent of the consequence of a Toxic Dispersion is represented by IDLH concentration in Parts Per Million (PPM).

7.5.3 Consequence Impact Criteria

The damage potential associated with the various hazardous outcomes described above is assessed based on pre-defined impairment criteria for losses.

Estimate of damage or impact caused due to thermal radiation, explosion overpressure and toxic effects is generally based on the published literature on the subject. Probit relations are used for these calculations. The actual potential consequences from these likely impacts can then be visualized by superimposing the damage effect zones on the proposed layouts and identifying the elements within the project which might be adversely affected, should one or more hazards materialize in practice. The damage criteria used in the present study is described in the following sections. Thermal Damage / Radiation Damage. As per OGP-14;

- 4.73 kW/m2- Maximum radiant heat intensity in areas where emergency actions lasting 2 min to 3min can be required by personnel without shielding but with appropriate clothing. Corresponds to of painful burns and blistering after 20 second exposure (0% lethality)
- 6.31 kW/m2 - Indicative of second degree burns after 20 second exposure (1% fatality)
- 12.5 kW/m2 - Indicative of piloted ignition for susceptible structures (50% fatality)
- 37.5 kW/m2 - Indicative of total asset loss (100% fatality)

Flash Fire

The consequence distances should be identified for the following Lower Explosive Limit:

- 50 % Lower Explosive Limit
- 100 % Lower Explosive Limit

Explosion

Blast peak overpressure from explosion for buildings should not exceed the following levels provided in Table 7.6 below. Internationally recognized and globally accepted TNO Multi energy model was used for the explosion modelling for this Project.

Table 7.6: Overpressure level criteria

Level of Concern	Type of Damage
0.02068 bar	"Safe distance" (probability 0.95 of no serious damage1 below this value); projectile limit; some damage to house ceilings; 10% window glass broken.
0.07 bar	General buildings, offices
0.2068 bar	Partial collapse of wells, concrete Block wells, not reinforced, shattered

Level of Concern	Type of Damage
1 bar	Range for 1-99% fatalities among exposed population due to direct blast effects

Meteorological Data

The consequences of material released being toxic and flammable are largely dependent on the prevailing weather conditions. For the assessment of various scenarios involving release of toxic or flammable materials, the most important meteorological parameters are those that affect the atmospheric dispersion of the leaking material. The crucial variables are wind direction, wind speed, atmospheric stability and temperature. Rainfall does not have any direct bearing on the results of the risk analysis; however, it can have beneficial effects by absorption/washout of released materials. Actual behaviour of any release would largely depend on prevailing weather condition at the time of release.

Atmospheric Stability Classes

The tendency of the atmosphere to resist or enhance vertical motion and thus turbulence is termed as stability. Stability is related to both the change of temperature with height (the lapse rate) driven by the boundary layer energy budget, and wind speed together with surface characteristics (roughness).

A neutral atmosphere neither enhances nor inhibits mechanical turbulence. An unstable atmosphere enhances turbulence, whereas a stable atmosphere inhibits mechanical turbulence.

Stability classes are defined for different meteorological situations, characterized by wind speed and solar radiation (during the day) and cloud cover during the night. The so called Pasquill-Turner stability classes' dispersion estimates include six (6) stability classes as below:

A – Very Unstable B – Unstable C – Slightly Unstable
D – Neutral E – Stable F–Very Stable

For the study purpose, following weather conditions are taken forward for modelling purposes:

- 1.5F - F stability class and wind speed of 1.5m/sec

- 5D - D stability class and wind speed of 5m/sec

Hole Size Distribution

For each isolatable section and its study areas, a range of leaks have been considered for the assessment of hydrocarbon hazards arising from facility is described in section, these leaks are defined on the basis of hole sizes.

Release Rate

The release rates were determined based on the release size and the process conditions i.e. temperature and pressure. Depending on the operating conditions, the release state of the fluid could be liquid, gas or two-phase. The release rates were estimated using the software.

Isolatable Inventory and Isolation Time

An estimate of the inventory that could potentially be released is developed for each isolatable section. The estimate of the total released inventory (IT) is the sum of IS (Static Inventory, Kg) and ID (Dynamic Inventory, kg). The static inventory is the amount of material within the isolatable section's vessels and piping, prior to leak. The dynamic inventory is calculated based on the pumped or pressurized in-flow rate and the isolation time by:

$I(T) = I(S) + I(D)$

$I(T) = I(S) + MIN(rL,rP) \times t$

Where I (T) = Total potential inventory released (kg)

I(S) = Static Inventory (kg)

I (D) = Dynamic Inventory (kg)

rL = Phast Calculated Leak rate (kg/s)

rP = Process Flow rate (kg/s)

t = Release duration (s)

For tank inventory we have considered only hold up inventory of the tank because facility carrying out batch process hence dynamic inventories for tank not taken in the calculation for tank scenarios.

Release Direction and Location:

The releases from any process equipment, process piping, and flow lines are modelled as horizontal direction as suggested by DNV SAFETI software for Quantitative Risk Assessment. This assumption gives worst case results for plume length and cloud travel distance in downwind direction.

For failure cases which are not associated with notable piping length and limited to the module area are modelled as point source vessel in QRA model.

Isolation time

The response time including time for detection and isolation considered for different categories of leak for this project is a standard value of 120 seconds.

Storage Details

The site and storage details of the chemicals at the Kawai TPP are given below

Table 7.7: Detail of storage of chemicals

Weather Data: (during baseline)	
Average wind speed; blowing from	1.3 m/s; E
Average Ambient Temperature	30 deg. C
Relative Humidity	50%
Ground Roughness	Open Country
Cloud Cover	5 tenths
Stability Class	C
SITE DATA:	
Location:	Kawai, Rajasthan-India
Building Air Exchanges Per Hour	0.40 (unsheltered single storied)

CHEMICAL DATA:	
Chemical Name:	**CHLORINE**
CAS Number:	7782-50-5
Molecular Weight:	70.91 g/mol
Ambient Boiling Point:	-30.7° F
Vapor Pressure at Ambient Temperature:	Greater than 1 atm

CHEMICAL DATA:	
Chemical Name:	**Aqueous Ammonia**
CAS Number:	7664-41-7
Molecular Weight:	17.03 g/mol
Solution Strength:	25% (by weight)
Ambient Boiling Point:	95.7° F
Partial Pressure at Ambient Temperature:	0.69 atm
Ambient Saturation Concentration:	714,073 ppm or 71.4%
Hazardous Component:	AMMONIA

Risk Modelling

Frequency Analysis

Once the potential hazards have been identified, the frequency analysis estimates how likely it is for the accidents to occur, based on the type and number of equipment components included in the defined failure cases. The component failure frequencies to be used are usually derived from an analysis of historical accident experience, or by some form of theoretical modelling.

The frequency analysis estimates how likely it is for the accidents to occur, based on the type and number of equipment components included in the defined failure cases. The component failure frequencies to be used are usually derived from an analysis of historical accident experience from IOGP Data Assessment Risk Directory.

The process release failure frequencies extracted from IOGP Risk Assessment Data Directory (Ref: Process Release Frequencies, Report No. 434-01, Sept. 2019). A gist is presented for reader's understanding).

Process Release Failure Frequencies

The process release failure frequencies extracted from IOGP Risk Assessment Data Directory (Ref: Process Release Frequencies, Report No. 434-01, Sept. 2019).

Ignition probabilities

The OGP database consists of a total of 28 different mathematical functions and lookup correlations to define the ignition probability for all types of facilities and surrounds, based on data drawn from UKOOA. For this project, ignition probabilities have been considered based on material reactivity by DNV SAFETI.

7.5.5 Risk Acceptability Criteria

Closely liaised with the consequence assessment is the impact assessment, i.e., how does the fire, explosion or toxic cloud affect human beings. When the frequencies and consequences / impact of each modelled event have been estimated, they can be combined to produce risk results. Various forms of risk presentation may be used, commonly grouped as follows:

- Individual Risk – the risk exposure by an individual person.
- Societal Risk – the risk exposure by a group of people exposed to the hazard.

Risk assessment is the process of comparing the level of risk against a set of criteria (For purpose of comparing Risk level UK HSE criteria is used for this study) as well as the identification of major risk contributors. The purpose of risk assessment is to develop mitigation measures for unacceptable generators of risk, as well as to reduce the overall level of risk to As Low as Reasonably Practical.

Individual Risk Criteria

The following criteria shall apply when judging the tolerability of risk to the personnel at the project site. The risk tolerability criteria is graphically expressed below:

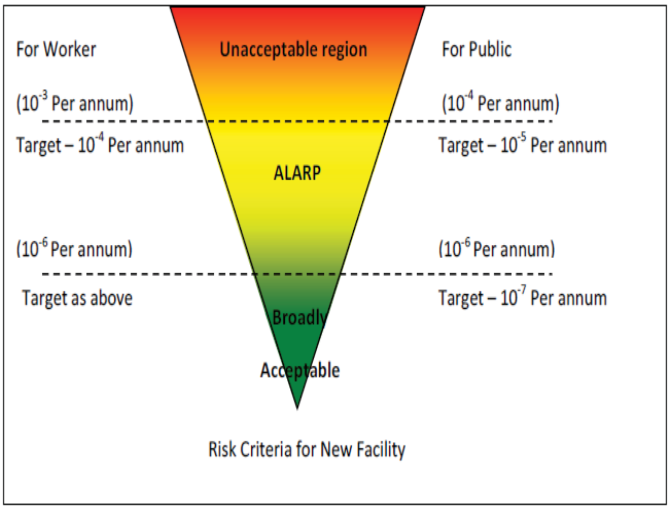


Figure: - 7.2 Risk tolerability criteria

Individual risk to any worker above 10-3 per annum shall be considered intolerable and fundamental risk reduction improvements are required.

Individual risk below 10-3 but above 10-6 per annum for any worker shall be considered tolerable if it can be demonstrated that the risks are as low as reasonably practicable (ALARP).

Individual risk below 10-6 per annum for any worker shall be considered as broadly acceptable and no further improvements are considered necessary provided documented control measures are in place and maintained.

Individual risk to any member of the general public shall be considered as intolerable if greater than 10-4 per year, broadly acceptable if less than 10-6 per year and shall be as low as reasonably practicable (ALARP) between these limits. Individual Risk Criteria is given in Table 7.8.

Table 7.8: Individual Risk Criteria

Individual Risk Criteria	Workers	Public
Maximum Tolerable Criteria	10-3 per year	10-4 per year
Broadly acceptable criterion	10-6 per year	10-6 per year

As per framework, risk criteria are usually divided into three bands, Unacceptable, ALARP and Acceptable regions.

Unacceptable Region: Band in risk criteria, where risks are intolerable except in extraordinary circumstances, and risk reduction measures are essential to be implemented. Sometimes, this zone is also denoted as the Red Zone.

ALARP Region: Band where risk reduction measures are desirable but might not be implemented if the cost of implementation is disproportionate to the benefit achieved i.e., cost of implementation is higher than the benefit achieved. Sometimes, this zone is also denoted as the Yellow Zone.

Acceptable Region: Band where no further risk reduction measures are needed. Sometimes, this zone is also denoted as the Green Zone.

These risk criteria are used to interpret numerical risk estimates as produced by a Quantitative Risk Assessment (QRA) study into a decision in the decision-making process, e.g., 10-8 per year falls in 'negligible risk'.

Societal Risk Criteria – FN Curve

When considering the risks associated with a major hazard facility, the risk to an individual is not always an adequate measure of total risks; the number of individuals at risk is also important. Catastrophic incidents with potential multiple fatalities have little influence on the level of individual risk but have a disproportionate effect on the response of society and impact on company reputation.

Societal (or Group) risk is the relationship between frequency of an event and the number of people affected. Societal risk from a major hazard facility can thus be expressed as the relationship between the number of potential fatalities N following a major accident and the frequency F at which N fatalities are predicted to occur. The relationship between F and N, and the corresponding relationship involving F, the cumulative frequency of events causing N or more fatalities, are usually presented graphically on log-log axes. Minimum criteria for Group risk based on F-N curves are presented in following Figure. These are based on historical major accident experience which indicates an F-N slope of 1. The tolerability criteria for Societal Risk for this study is taken from UK HSE guidelines as follows:

CONSEQUENCE ANALYSIS

Distance downwind to defined concentrations

The reported concentrations are defined in the respective material properties

Path	Scenario	Weather	Distance downwind to ERPG1 [m]	Distance downwind to ERPG2 [m]	Distance downwind to ERPG3 [m]
Study\Ammonia Bullet 1	5mm Leak	Category 1.5/F	702.471	223.527	96.5319
		Category 5/D	128.484	50.0657	26.1798
	25mm Leak	Category 1.5/F	3894.46	1009.15	513.661
		Category 5/D	833.052	365.299	233.005
	Catastrophic rupture	Category 1.5/F	50000	15870.3	2765.55
		Category 5/D	18024.6	5938.33	1399.12
Study\Ammonia Bullet 2	5mm Leak	Category 1.5/F	702.471	223.527	96.5319
		Category 5/D	128.484	50.0657	26.1798
	25mm Leak	Category 1.5/F	3894.46	1009.15	513.661
		Category 5/D	833.052	365.299	233.005
	Catastrophic rupture	Category 1.5/F	50000	15870.3	2765.55
		Category 5/D	18024.6	5938.33	1399.12

Study\Ammonia Bullet 3	5mm Leak	Category 1.5/F	702.471	223.527	96.5319
		Category 5/D	128.484	50.0657	26.1798
	25mm Leak	Category 1.5/F	3894.46	1009.15	513.661
		Category 5/D	833.052	365.299	233.005
	Catastrophic rupture	Category 1.5/F	50000	15870.3	2765.55
		Category 5/D	18024.6	5938.33	1399.12
Study\Ammonia Bullet 4	5mm Leak	Category 1.5/F	702.471	223.527	96.5319
		Category 5/D	128.484	50.0657	26.1798
	25mm Leak	Category 1.5/F	3894.46	1009.15	513.661
		Category 5/D	833.052	365.299	233.005
	Catastrophic rupture	Category 1.5/F	50000	15870.3	2765.55
		Category 5/D	18024.6	5938.33	1399.12
Study\Chlorine Vessel 1	5mm Leak	Category 1.5/F	2300.82	1139.22	272.68
		Category 5/D	367.644	196.355	64.8349
	25mm Leak	Category 1.5/F	12843.5	6648.65	1684.54
		Category 5/D	2373.84	1289.86	468.659
	Catastrophic rupture	Category 1.5/F	21551.6	9498.2	1587.31
		Category 5/D	8572.71	4993.19	1824.51
Study\Chlorine Vessel 2	5mm Leak	Category 1.5/F	2300.82	1139.22	272.68
		Category 5/D	367.644	196.355	64.8349
	25mm Leak	Category 1.5/F	12843.5	6648.65	1684.54
		Category 5/D	2373.84	1289.86	468.659
	Catastrophic rupture	Category 1.5/F	21551.6	9498.2	1587.31
		Category 5/D	8572.71	4993.19	1824.51

Jet Fire Results
Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Flame length [m]	Distance downwind to intensity level 1 (4 kW/m2) [m]	Distance downwind to intensity level 2 (12.5 kW/m2) [m]	Distance downwind to intensity level 3 (37.5 kW/m2) [m]
Study\Ammonia Bullet 1	5mm Leak	Category 1.5/F	4.04741	3.66214	n/a	n/a
		Category 5/D	2.93883	2.76272	n/a	n/a
	25mm Leak	Category 1.5/F	17.4808	19.3049	18.6141	n/a
		Category 5/D	12.6928	15.5928	13.7942	n/a

Study\Ammonia Bullet 2	5mm Leak	Category 1.5/F	4.04741	3.66214	n/a	n/a
		Category 5/D	2.93883	2.76272	n/a	n/a
	25mm Leak	Category 1.5/F	17.4808	19.3049	18.6141	n/a
		Category 5/D	12.6928	15.5928	13.7942	n/a
Study\Ammonia Bullet 3	5mm Leak	Category 1.5/F	4.04741	3.66214	n/a	n/a
		Category 5/D	2.93883	2.76272	n/a	n/a
	25mm Leak	Category 1.5/F	17.4808	19.3049	18.6141	n/a
		Category 5/D	12.6928	15.5928	13.7942	n/a
Study\Ammonia Bullet 4	5mm Leak	Category 1.5/F	4.04741	3.66214	n/a	n/a
		Category 5/D	2.93883	2.76272	n/a	n/a
	25mm Leak	Category 1.5/F	17.4808	19.3049	18.6141	n/a
		Category 5/D	12.6928	15.5928	13.7942	n/a
Study\LDO Tank 1	10mm Leak	Category 1.5/F	3.15555	4.82394	3.39743	n/a
		Category 5/D	2.34562	4.13771	2.87831	n/a
Study\LDO Tank 2		Category 1.5/F	3.15555	4.82394	3.39743	n/a
		Category 5/D	2.34562	4.13771	2.87831	n/a
Study\LDO Tank 3		Category 1.5/F	3.15555	4.82394	3.39743	n/a
		Category 5/D	2.34562	4.13771	2.87831	n/a

Late Pool Fire Results
Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Pool diameter [m]	Distance downwind to intensity level 1 (4 kW/m2) [m]	Distance downwind to intensity level 2 (12.5 kW/m2) [m]	Distance downwind to intensity level 3 (37.5 kW/m2) [m]
Study\Ammonia Bullet 1	Catastrophic rupture	Category 1.5/F	54.6885	62.0893	38.8243	n/a
		Category 5/D	54.534	64.1632	45.0796	n/a
Study\Ammonia Bullet 2		Category 1.5/F	54.6885	62.0893	38.8243	n/a
		Category 5/D	54.534	64.1632	45.0796	n/a
Study\Ammonia Bullet 3		Category 1.5/F	54.6885	62.0893	38.8243	n/a
		Category 5/D	54.534	64.1632	45.0796	n/a
Study\Ammonia Bullet 4		Category 1.5/F	54.6885	62.0893	38.8243	n/a

		Category 5/D	54.534	64.1632	45.0796	n/a
Study\LDO Tank 1	10mm Leak	Category 1.5/F	21.6972	43.6135	26.5319	18.9513
		Category 5/D	19.8842	44.903	26.2022	19.3468
	Catastrophic rupture	Category 1.5/F	355.485	344.111	229.322	193.044
		Category 5/D	352.153	371.294	236.158	197.117
Study\LDO Tank 2	10mm Leak	Category 1.5/F	21.6972	43.6135	26.5319	18.9513
		Category 5/D	19.8842	44.903	26.2022	19.3468
	Catastrophic rupture	Category 1.5/F	355.485	344.111	229.322	193.044
		Category 5/D	352.153	371.294	236.158	197.117
Study\LDO Tank 3	10mm Leak	Category 1.5/F	21.6972	43.6135	26.5319	18.9513
		Category 5/D	19.8842	44.903	26.2022	19.3468
	Catastrophic rupture	Category 1.5/F	355.485	344.111	229.322	193.044
		Category 5/D	352.153	371.294	236.158	197.117

Fireball Results
Distance downwind to defined radiation levels
The reported radiations are defined in the parameters

Path	**Scenario**	**Weather**	**Fireball diameter [m]**	**Distance downwind to intensity level 1 (4 kW/m2) [m]**	**Distance downwind to intensity level 2 (12.5 kW/m2) [m]**	**Distance downwind to intensity level 3 (37.5 kW/m2) [m]**
Study\Ammonia Bullet 1	Catastrophic rupture	Category 1.5/F	308.171	672.298	385.843	204.635
		Category 5/D	308.171	672.298	385.843	204.635
Study\Ammonia Bullet 2		Category 1.5/F	308.171	672.298	385.843	204.635
		Category 5/D	308.171	672.298	385.843	204.635
Study\Ammonia Bullet 3		Category 1.5/F	308.171	672.298	385.843	204.635
		Category 5/D	308.171	672.298	385.843	204.635
Study\Ammonia Bullet 4		Category 1.5/F	308.171	672.298	385.843	204.635
		Category 5/D	308.171	672.298	385.843	204.635

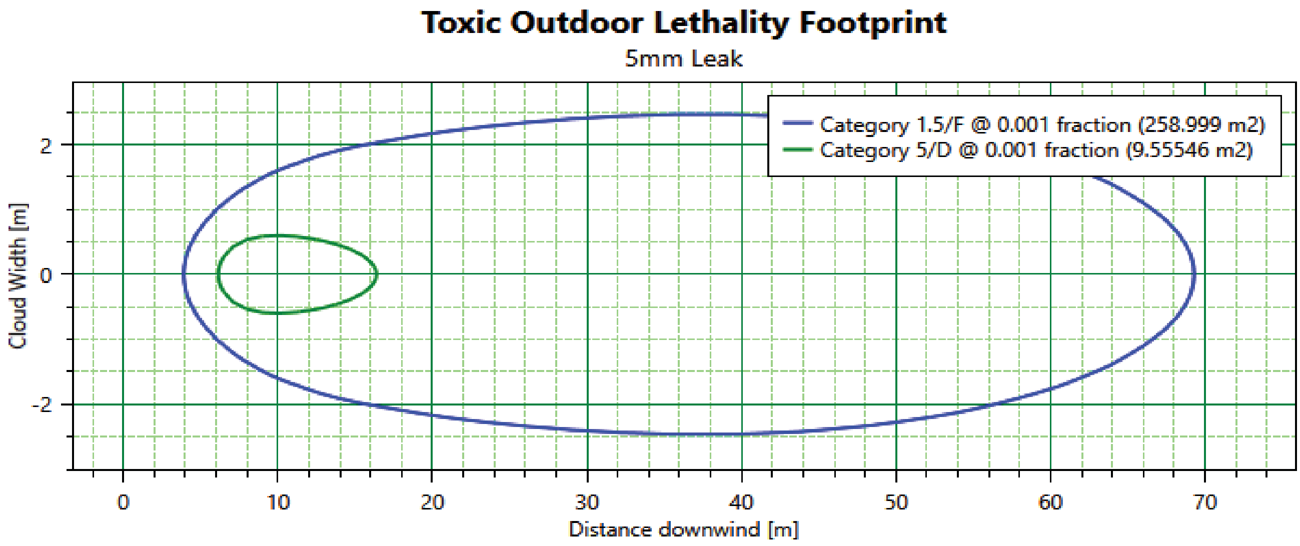
Flash Fire Results
Distance downwind to defined concentrations
The reported LFL and LFL fraction are defined in the respective material property

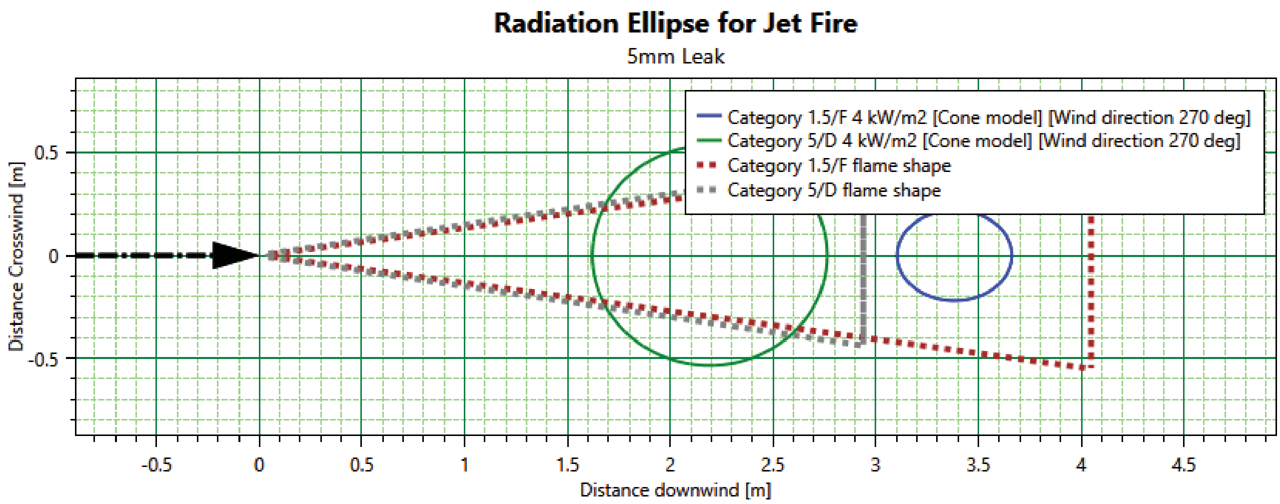
Path	Scenario	Weather	Distance downwind to LFL [m]	Distance downwind to LFL Fraction [m]
Study\Ammonia Bullet 1	5mm Leak	Category 1.5/F		
		Category 5/D		
	25mm Leak	Category 1.5/F		
		Category 5/D		
	Catastrophic rupture	Category 1.5/F	54.9082	72.5749
		Category 5/D	55.3152	74.3565
Study\Ammonia Bullet 2	5mm Leak	Category 1.5/F		
		Category 5/D		
	25mm Leak	Category 1.5/F		
		Category 5/D		
	Catastrophic rupture	Category 1.5/F	54.9082	72.5749
		Category 5/D	55.3152	74.3565
Study\Ammonia Bullet 3	5mm Leak	Category 1.5/F		
		Category 5/D		
	25mm Leak	Category 1.5/F		
		Category 5/D		
	Catastrophic rupture	Category 1.5/F	54.9082	72.5749
		Category 5/D	55.3152	74.3565
Study\Ammonia Bullet 4	5mm Leak	Category 1.5/F		
		Category 5/D		
	25mm Leak	Category 1.5/F		
		Category 5/D		
	Catastrophic rupture	Category 1.5/F	54.9082	72.5749
		Category 5/D	55.3152	74.3565
Study\LDO Tank 1	10mm Leak	Category 1.5/F		6.05216
		Category 5/D		
	Catastrophic rupture	Category 1.5/F	14.5628	28.3855
		Category 5/D	11.7109	20.4255
Study\LDO Tank 2	10mm Leak	Category 1.5/F		6.05216
		Category 5/D		
	Catastrophic rupture	Category 1.5/F	14.5628	28.3855
		Category 5/D	11.7109	20.4255
Study\LDO Tank 3	10mm Leak	Category 1.5/F		6.05216
		Category 5/D		
	Catastrophic rupture	Category 1.5/F	14.5628	28.3855
		Category 5/D	11.7109	20.4255

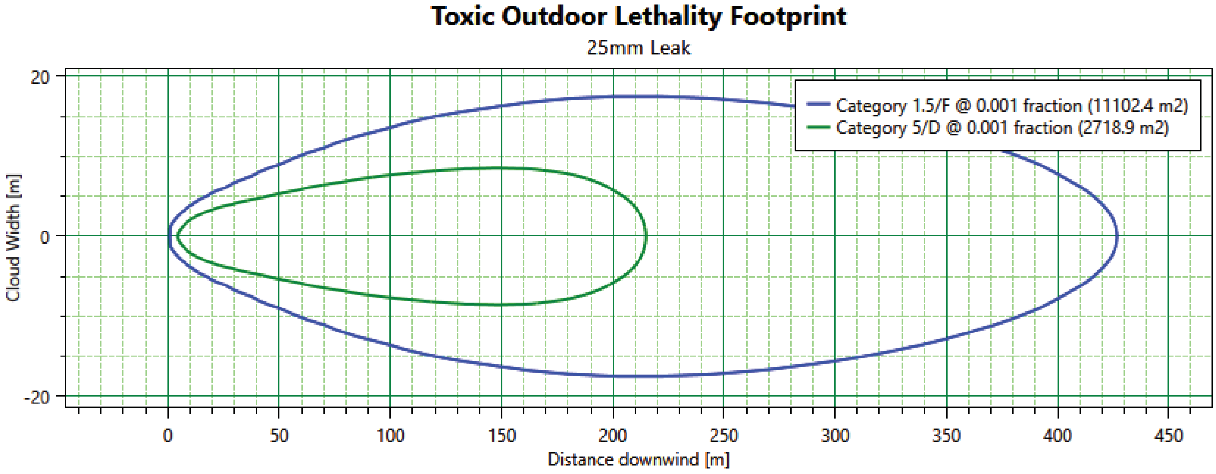
Explosion Results
Explosion scenarios for worst-case maximum downwind distance to defined overpressures.

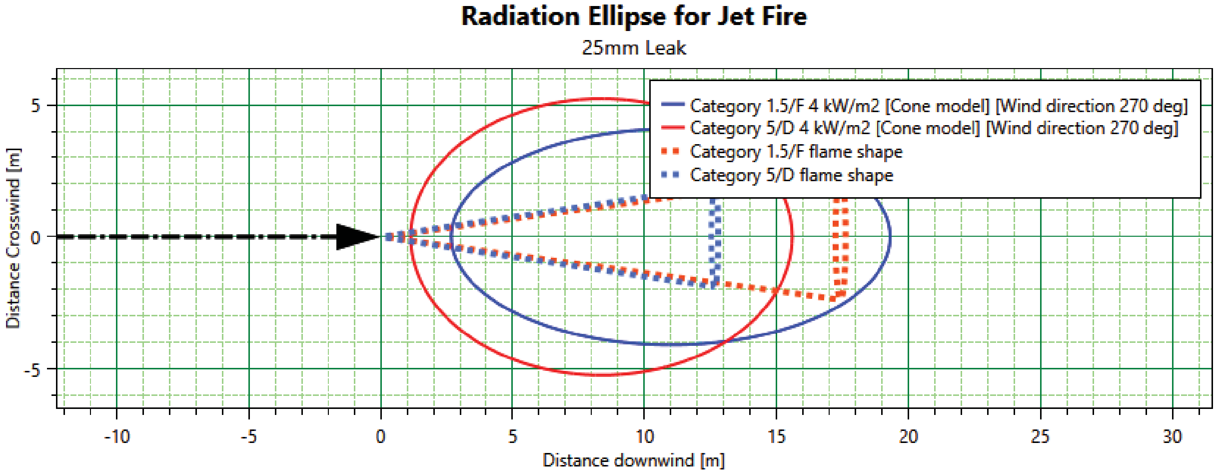
Path	Scenario	Weather	Overpressure level [bar]	Maximum distance [m]	Diameter [m]
Study\Ammonia Bullet 1	Catastrophic rupture	Category 1.5/F	0.02068 0.1379 0.2068	1007.07 244.069 198.008	1894.14 368.139 276.016
		Category 5/D	0.02068 0.1379 0.2068	1009.95 251.357 205.975	1899.9 362.714 271.949
Study\Ammonia Bullet 2		Category 1.5/F	0.02068 0.1379 0.2068	1007.07 244.069 198.008	1894.14 368.139 276.016
		Category 5/D	0.02068 0.1379 0.2068	1009.95 251.357 205.975	1899.9 362.714 271.949
Study\Ammonia Bullet 3		Category 1.5/F	0.02068 0.1379 0.2068	1007.07 244.069 198.008	1894.14 368.139 276.016
		Category 5/D	0.02068 0.1379 0.2068	1009.95 251.357 205.975	1899.9 362.714 271.949
Study\Ammonia Bullet 4		Category 1.5/F	0.02068 0.1379 0.2068	1007.07 244.069 198.008	1894.14 368.139 276.016
		Category 5/D	0.02068 0.1379 0.2068	1009.95 251.357 205.975	1899.9 362.714 271.949
Study\LDO Tank 1		Category 1.5/F	0.02068 0.1379 0.2068	84.5938 32.5543 29.4127	129.188 25.1085 18.8254
		Category 5/D	0.02068 0.1379 0.2068	52.0164 18.1662 16.1227	84.0327 16.3323 12.2454
Study\LDO Tank 2		Category 1.5/F	0.02068 0.1379 0.2068	84.5938 32.5543 29.4127	129.188 25.1085 18.8254
		Category 5/D	0.02068 0.1379 0.2068	52.0164 18.1662 16.1227	84.0327 16.3323 12.2454
Study\LDO Tank 3		Category 1.5/F	0.02068 0.1379 0.2068	84.5938 32.5543 29.4127	129.188 25.1085 18.8254
		Category 5/D	0.02068 0.1379 0.2068	52.0164 18.1662 16.1227	84.0327 16.3323 12.2454

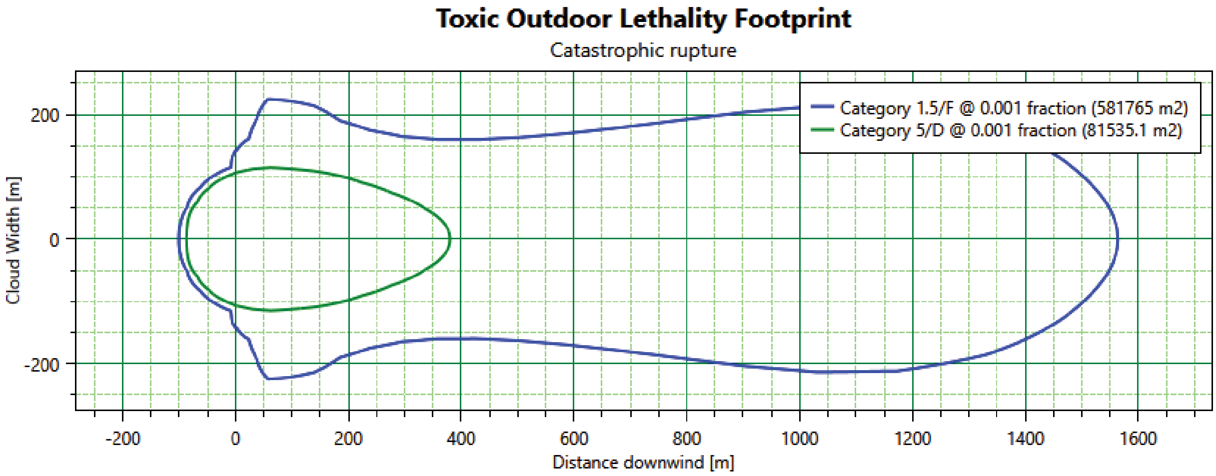
CONSEQUENCE CONTOURS
AMMONIA VESSEL

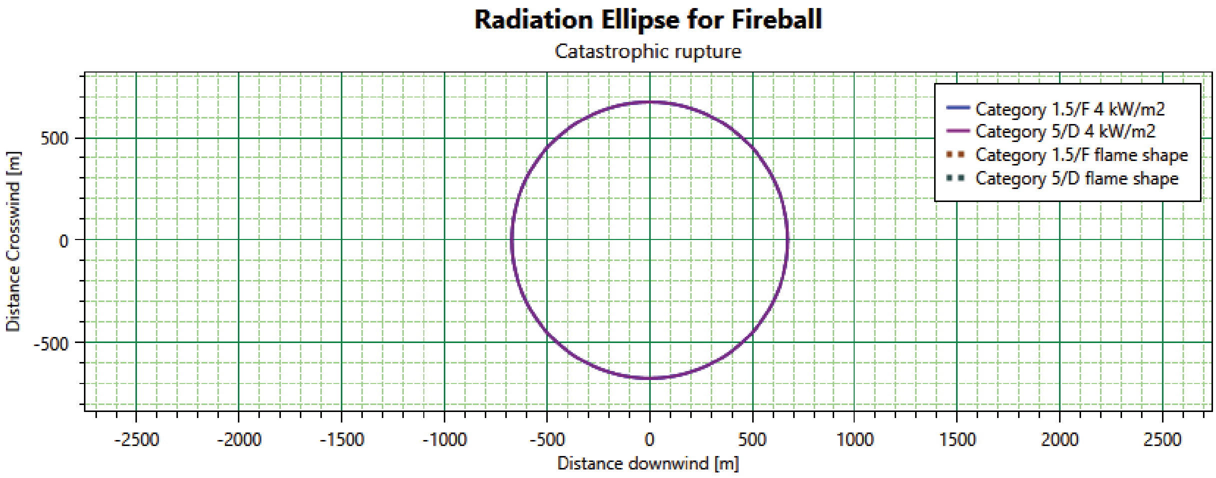





Toxic Outdoor Lethality Footprint
25mm Leak
Category 1.5/F @ 0.001 fraction (11102.4 m2)
Category 5/D @ 0.001 fraction (2718.9 m2)
Cloud Width [m]
Distance downwind [m]


Radiation Ellipse for Jet Fire
25mm Leak
Category 1.5/F 4 kW/m2 [Cone model] [Wind direction 270 deg]
Category 5/D 4 kW/m2 [Cone model] [Wind direction 270 deg]
Category 1.5/F flame shape
Category 5/D flame shape
Distance Crosswind [m]
Distance downwind [m]


Toxic Outdoor Lethality Footprint
Catastrophic rupture
Category 1.5/F @ 0.001 fraction (581765 m2)
Category 5/D @ 0.001 fraction (81535.1 m2)
Cloud Width [m]
Distance downwind [m]


Radiation Ellipse for Fireball
Catastrophic rupture
Category 1.5/F 4 kW/m2
Category 5/D 4 kW/m2
Category 1.5/F flame shape
Category 5/D flame shape
Distance Crosswind [m]
500
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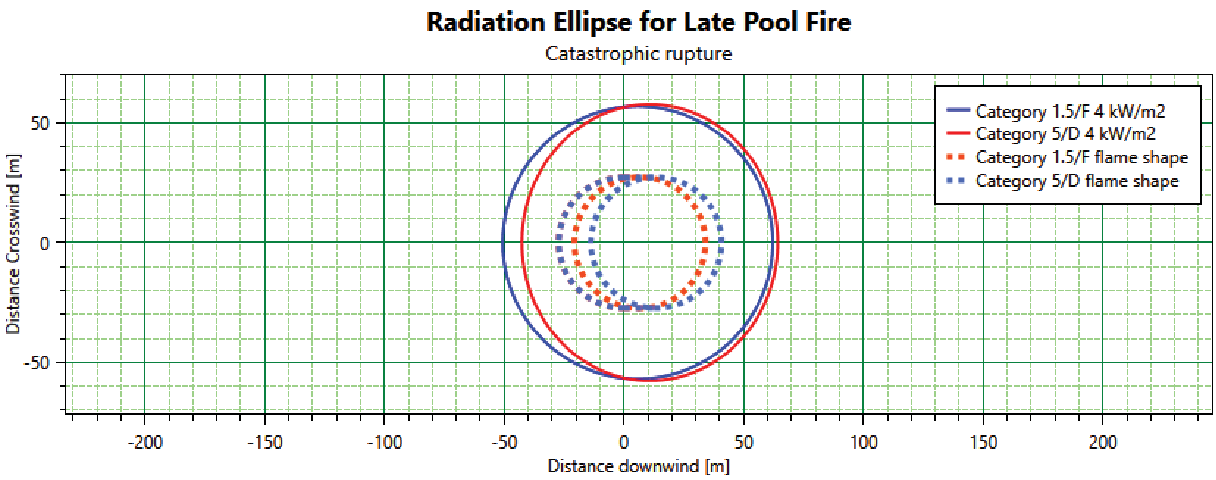
-500
-2500
-2000
-1500
-1000
-500
0
500
1000
1500
2000
2500
Distance downwind [m]


Radiation Ellipse for Late Pool Fire
Catastrophic rupture
Category 1.5/F 4 kW/m2
Category 5/D 4 kW/m2
Category 1.5/F flame shape
Category 5/D flame shape
Distance Crosswind [m]
50
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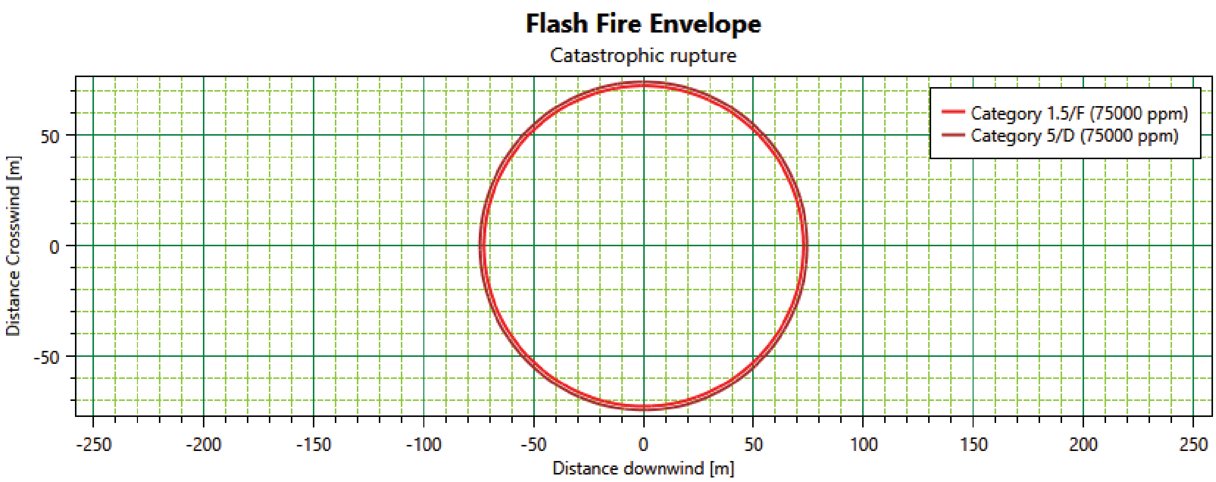
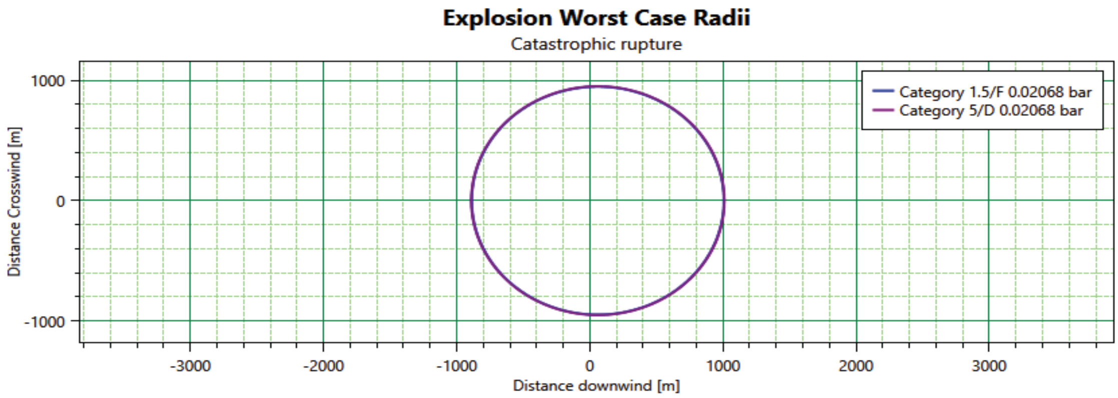
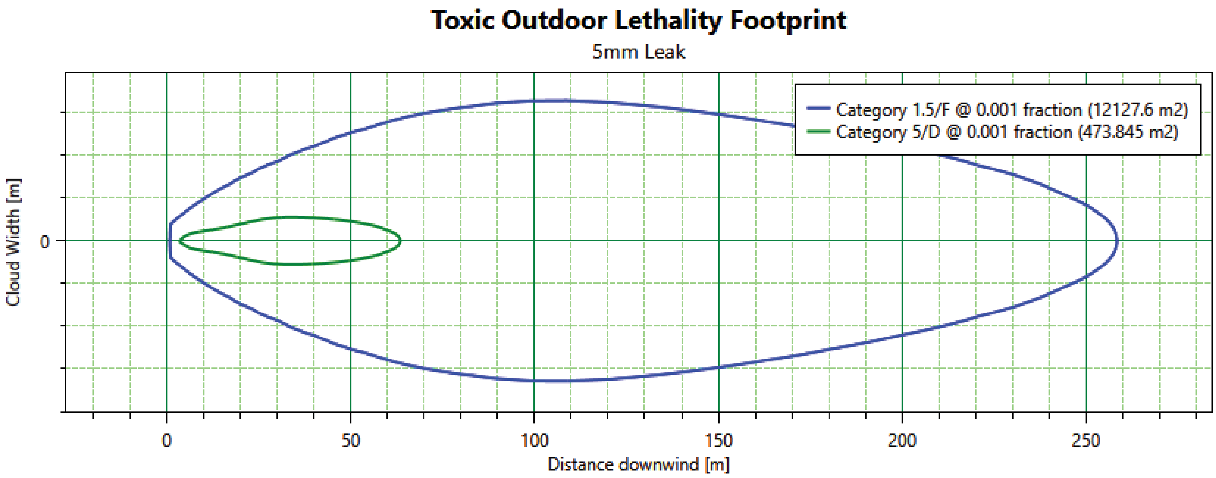
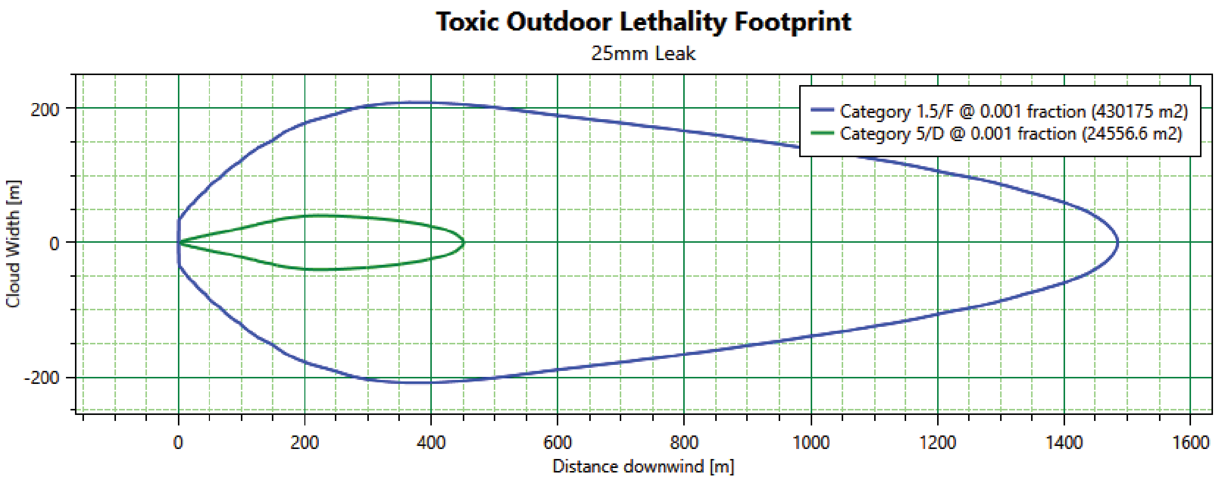
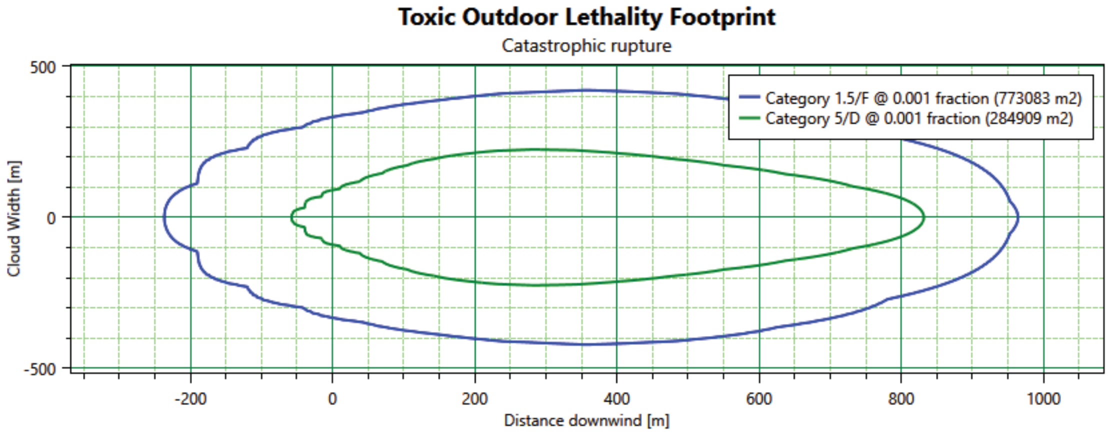
-50
-200
-150
-100
-50
0
50
100
150
200
Distance downwind [m]


Flash Fire Envelope
Catastrophic rupture
Category 1.5/F (75000 ppm)
Category 5/D (75000 ppm)
Distance Crosswind [m]
50
0
-50
-250
-200
-150
-100
-50
0
50
100
150
200
250
Distance downwind [m]

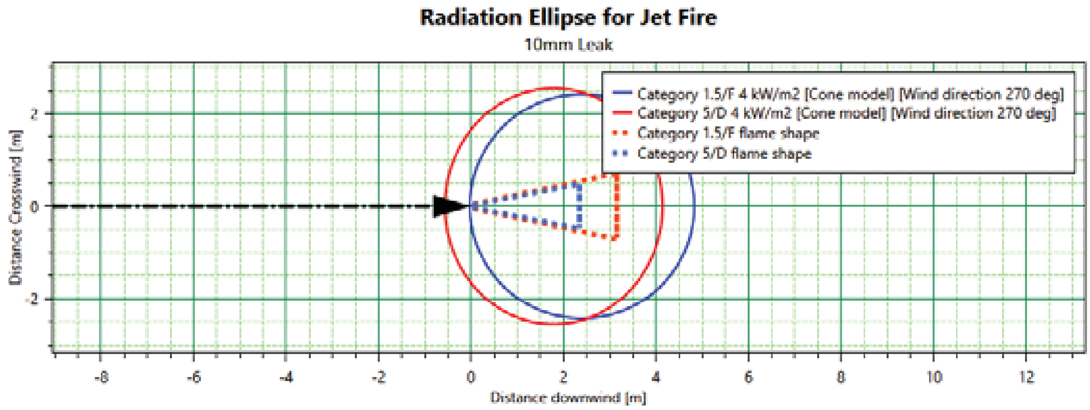

Explosion Worst Case Radii
Catastrophic rupture
Category 1.5/F 0.02068 bar
Category 5/D 0.02068 bar
Distance Crosswind [m]
Distance downwind [m]
1000
0
-1000
-3000
-2000
-1000
0
1000
2000
3000

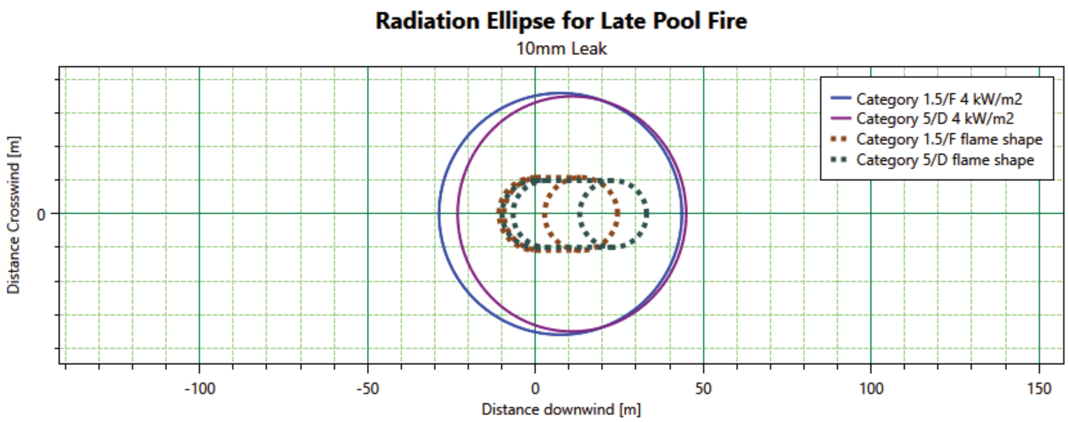

Toxic Outdoor Lethality Footprint
5mm Leak
Category 1.5/F @ 0.001 fraction (12127.6 m2)
Category 5/D @ 0.001 fraction (473.845 m2)
Cloud Width [m]
Distance downwind [m]
0
0
50
100
150
200
250

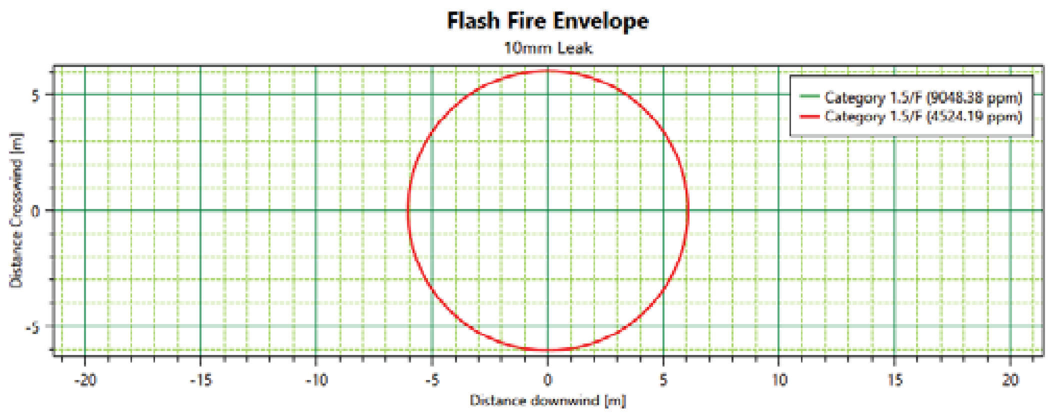

Toxic Outdoor Lethality Footprint
25mm Leak
Category 1.5/F @ 0.001 fraction (430175 m2)
Category 5/D @ 0.001 fraction (24556.6 m2)
Cloud Width [m]
Distance downwind [m]
200
0
-200
0
200
400
600
800
1000
1200
1400
1600

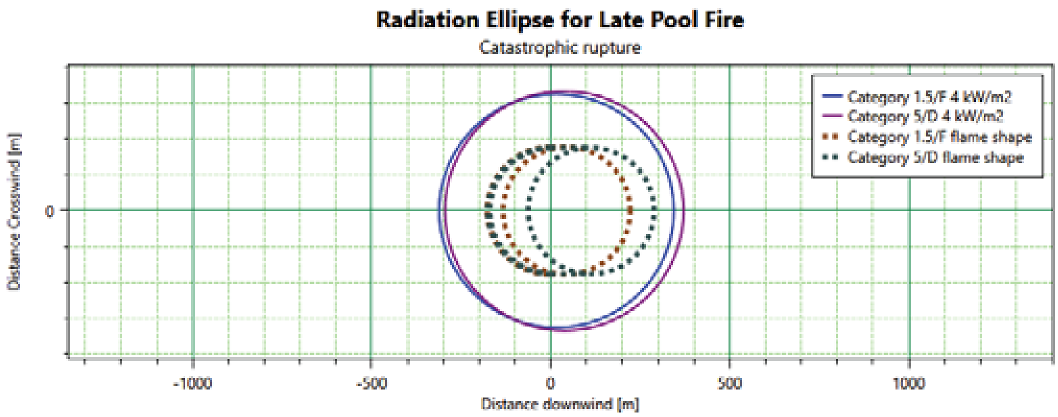

Toxic Outdoor Lethality Footprint
Catastrophic rupture
Category 1.5/F @ 0.001 fraction (773083 m2)
Category 5/D @ 0.001 fraction (284909 m2)
Cloud Width [m]
Distance downwind [m]

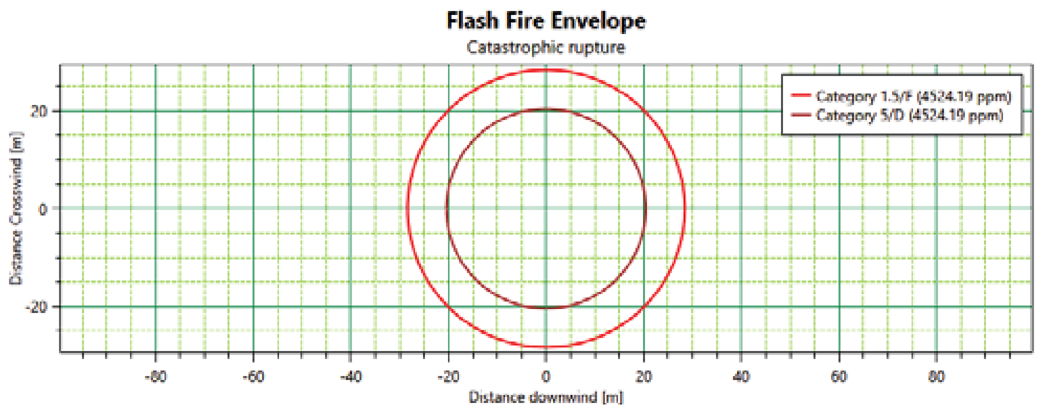
LDO TANK

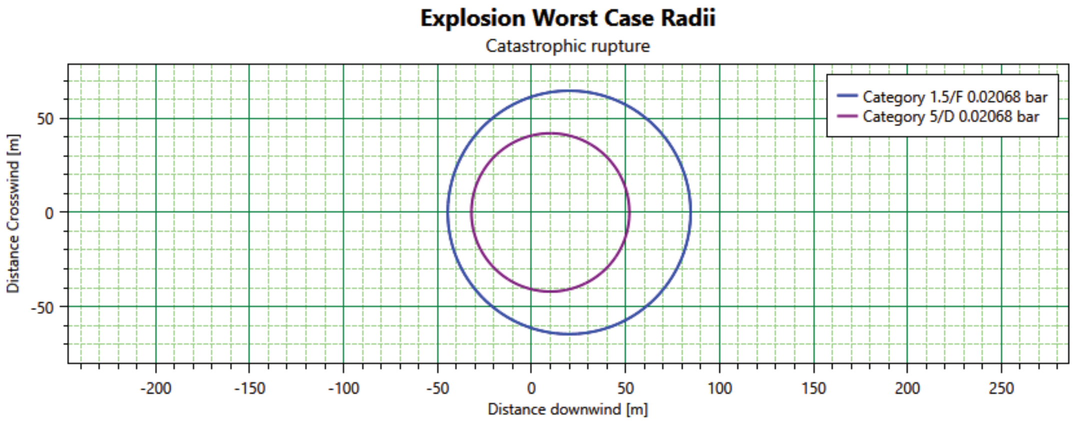

Radiation Ellipse for Jet Fire
10mm Leak
Category 1.5/F 4 kW/m2 [Cone model] [Wind direction 270 deg]
Category 5/D 4 kW/m2 [Cone model] [Wind direction 270 deg]
Category 1.5/F flame shape
Category 5/D flame shape
Distance Crosswind [m]
Distance downwind [m]


Radiation Ellipse for Late Pool Fire
10mm Leak
Category 1.5/F 4 kW/m2
Category 5/D 4 kW/m2
Category 1.5/F flame shape
Category 5/D flame shape
Distance Crosswind [m]
Distance downwind [m]


Flash Fire Envelope
10mm Leak
Category 1.5/F (9048.38 ppm)
Category 1.5/F (4524.19 ppm)
Distance Crosswind [m]
Distance downwind [m]

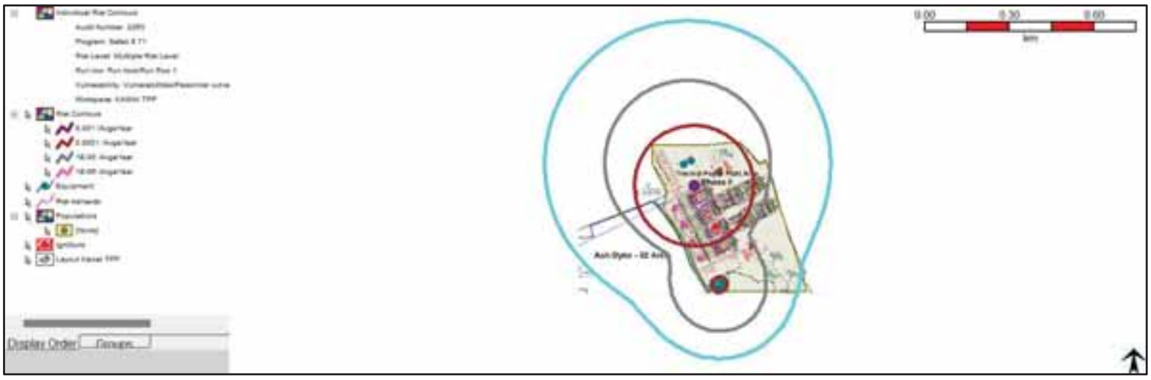

Radiation Ellipse for Late Pool Fire
Catastrophic rupture
Category 1.5/F 4 kW/m2
Category 5/D 4 kW/m2
Category 1.5/F flame shape
Category 5/D flame shape
Distance Crosswind [m]
Distance downwind [m]


Flash Fire Envelope
Catastrophic rupture
Category 1.5/F (4524.19 ppm)
Category 5/D (4524.19 ppm)
Distance Crosswind [m]
Distance downwind [m]

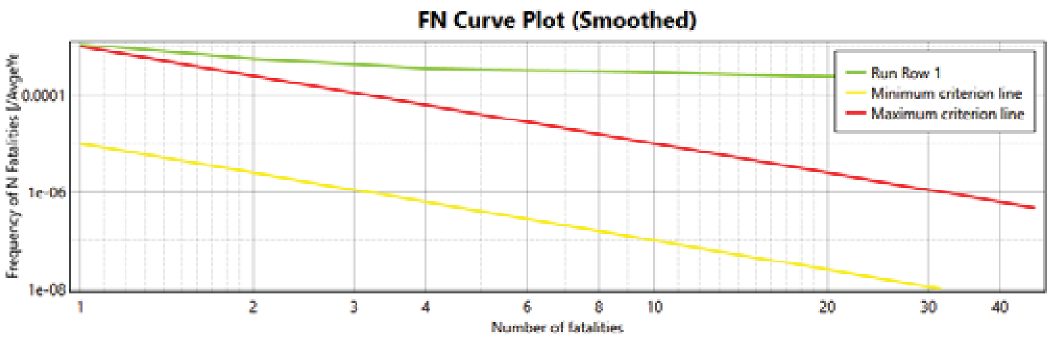


Risk Contours

LSIR Contours



FN Curve



Conclusion

From the above consequence and risk results, it can be observed that the risk due to toxic release would be more significant in the case of accidental release of ammonia / chlorine. The catastrophic rupture scenario of ammonia and chlorine causing the release of toxic gas in the surrounding disperses and reaches ERPG levels 1, 2 and 3 up to various distances as shown in the consequence summary table. The flammable results such as jet fire, pool fire, flash fire cases also presented in the consequence table and it is not reaching far beyond the accidental source but falls upto the surrounding facility area. It could be seen from the LSIR contours, that the overall risk due to flammable and toxic scenarios of 1E-06 / avg year falls around the site facility of up to 500m maximum and not reaching far away from the site. Since the considered scenarios are for the worst case, such as catastrophic rupture of total stored capacity of ammonia / chlorine / LDO the societal risk for the personnel at the site falls in the unacceptable range for the considered plant population as shown in the above FN Curve. But with the necessary safeguards such as toxic and flammable gas detectors, breathing apparatus for working personnel, fire protection systems such as fire extinguishers, water curtain, fire water hydrants in place, the untoward consequences and the major risk due to the same could be eradicated. The disaster management plan discusses the course of action to be taken in case of emergency due to the unintended incidents at the project facility.

7.6 DISASTER MANAGEMENT PLAN

7.6.1 Disaster

A disaster is a catastrophic situation in which suddenly, people are plunged into helplessness and suffering and, as a result, need protection, clothing, shelter, medical and social care and other necessities of life.

Disasters can be divided into two main groups. In the first, disasters are resulting from natural phenomena like earthquakes, volcanic eruptions, storm surges, cyclones, tropical storms, floods, avalanches, landslides, forest fires. The second group includes disastrous events occasioned by man, or by man's impact upon the environment. Examples are armed conflict, industrial accidents, radiation accidents, factory fires, explosions and escape of toxic gases or chemical substances, river pollution, mining or other structural collapses, air, sea, rail and road transport accidents which can reach catastrophic dimensions in terms of human loss.

There can be no set criteria for assessing the gravity of a disaster in the abstract since this depends to a large extent on the physical, economic and social environment in which it occurs. However, all disasters bring in their wake similar consequences that call for immediate action, whether at the local, national or international level, for the rescue and relief of the victims. This includes the search for the dead and injured, medical and social care, removal of the debris, the provision of temporary shelter for the homeless, food, clothing and medical supplies, and the rapid re-establishment of essential services.

7.6.2 Objectives of Disaster Management Plan

The Disaster Management Plan is aimed to ensure safety of life, protection of environment, protection of installation, restoration of production and salvage operations in this same order of priorities. For effective implementation of the Disaster Management Plan, it should be widely circulated and personnel trained through rehearsals/drills.

The Disaster Management Plan should reflect the probable consequential severalties of the undesired event due to deteriorating conditions or through 'Knock on' effects. Further the management should be able to demonstrate that their assessment of the consequences uses good supporting evidence and is based on currently available and reliable information, incident data from internal and external sources and if necessary, the reports of outside agencies. To tackle the consequences of a major emergency inside the plant or in the immediate vicinity of the plant, a Disaster Management Plan has to be formulated and this planned emergency document is called "Disaster Management Plan". The objective of the Industrial Disaster Management Plan is to make use of the combined resources of the plant and the outside services to achieve the following:

- Effect the rescue and medical treatment of casualties;
- Safeguard other people;
- Minimize damage to property and the environment;
- Initially contain and ultimately bring the incident under control;

- Identify any dead;
- Provide for the needs of relatives;
- Provide authoritative information to the news media;
- Secure the safe rehabilitation of affected area; and
- Preserve relevant records and equipment for the subsequent inquiry into the cause and circumstances of the Emergency. In effect, it is to optimize operational efficiency to rescue, rehabilitate and render medical help and to restore normalcy.

7.6.3 On Site & Offsite Emergency Plan

Emergency Classifications

(1) Level - I: On-Site Emergency - Plant Level Crisis

Manageable by project resources. Examples: Small fires, brief hazardous material leaks, minor equipment collapse.

(2) Level - II: On-Site Emergency - Mutual Aided / Local Level Crisis

Beyond internal control, requires external help. Handled by neighboring units or local crisis group. Examples: Significant fires, electrical issues, larger hazardous material leaks.

(3) Level - III: Off-Site Emergency - District Level Crisis

Managed by District Crisis Group. Extensive impact on project and nearby public areas. Examples: Explosions, structural collapses, external threats (terrorism, sabotage).

7.6.3.1 On-site Emergency Plan

The On-Site Emergency Control Plan is in place to address potential hazards arising from project activities or equipment failure. It is an integral part of the organization's overall loss control program, ensuring effective accident and incident management to minimize losses. The plan focuses on preventing unintentional releases of hazardous materials and highlights deficiencies in resources for an efficient emergency response. It reflects the organization's commitment to employee safety and serves as a valuable resource for all, providing clear insights into emergencies and aiding in their management. Regular updates will be made to the plan in response to technological changes or organizational shifts.

Objective

The objective of this On-Site Emergency Control Plan (EMP) at Adani Power Limited Raipur Project Phase-II is to anticipate potential emergencies during construction and ensure a quick, controlled response to minimize damage to human life, equipment, property, and the environment. Emergencies can result from natural disasters or manmade incidents, and the plan aims to provide swift, organized actions to address unforeseen events. Despite efforts to assess and minimize risks, accidents may still occur, requiring prompt action from operating staff, emergency teams, and external agencies. The plan focuses on:

- declaring emergencies,
- alerting people,
- implementing control measures,
- evacuating affected areas,
- providing treatment,
- minimizing damage,
- guiding people to safety,
- ensuring security,
- and preserving records for inquiries.

Key elements include reliable detection, resource availability, effective response actions, communication facilities, regular reviews, proper training, and an organized command structure. Speed is crucial in achieving these objectives.

Statutory Provisions: On-Site Emergency Plan of the Unit has to be developed by the occupier of the Project as per statutes given below:

- The Building and Other Construction Workers (Regulation of Employment and Condition of Service) Act, 1996 & The BOCW Central Rules 1998: Rule 36
- The Central Electricity Authority (Safety Requirement, for Construction, Operation & Maintenance of Electrical Plant and Electric Line) Regulation -2011: Rule 9 (1)

Responsibility of On-Site Emergency Plan (Emergency Management Plan)

The primary responsibility for establishing and overseeing the On-Site Emergency Control Plan lies with the Employer/Construction Manager. The Construction Manager is tasked with maintaining, distributing, and controlling the plan, ensuring its applicability through procedural implementation, and conducting annual reviews and revisions.

The HSE Manager is responsible for personnel training, ensuring that emergency response capabilities align with the plan. Additionally, the HSE Manager oversees the organization and execution of Mock Drills outlined in the On-Site Emergency Control Plan.

All employees from various departments are individually responsible for fulfilling their roles and duties as outlined in this On-Site Emergency Control Plan.

Nature of Emergencies Covered

In formulating the On-Site Emergency Control Plan, it is imperative to contemplate the worst-case scenario for potential accidents or incidents within the unit. Calculating the adverse effects of the maximum quantity of hazardous chemicals, leading to a major accident, is crucial. The nature of emergencies varies based on the chemical properties of hazardous materials and their maximum storage inventory.

Emergencies can be categorized into the following types, contingent on their nature:

- **Fire Emergency:** Arises due to the flammable properties of hazardous materials.
- **Explosion Emergency**: Occurs with explosive materials.
- **Toxic Release Emergency**: Caused by the dispersion of toxic gases into the atmosphere.

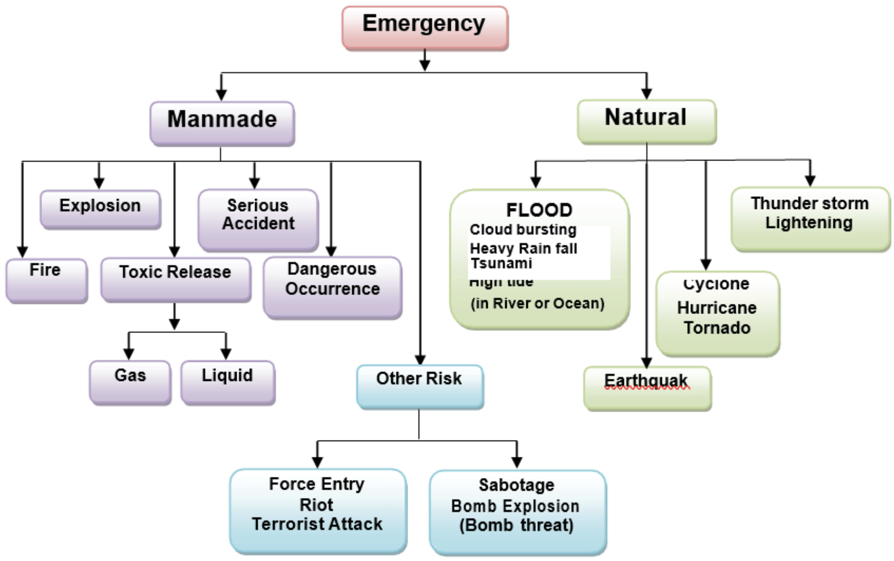


Figure . 7.3: Type of emergencies

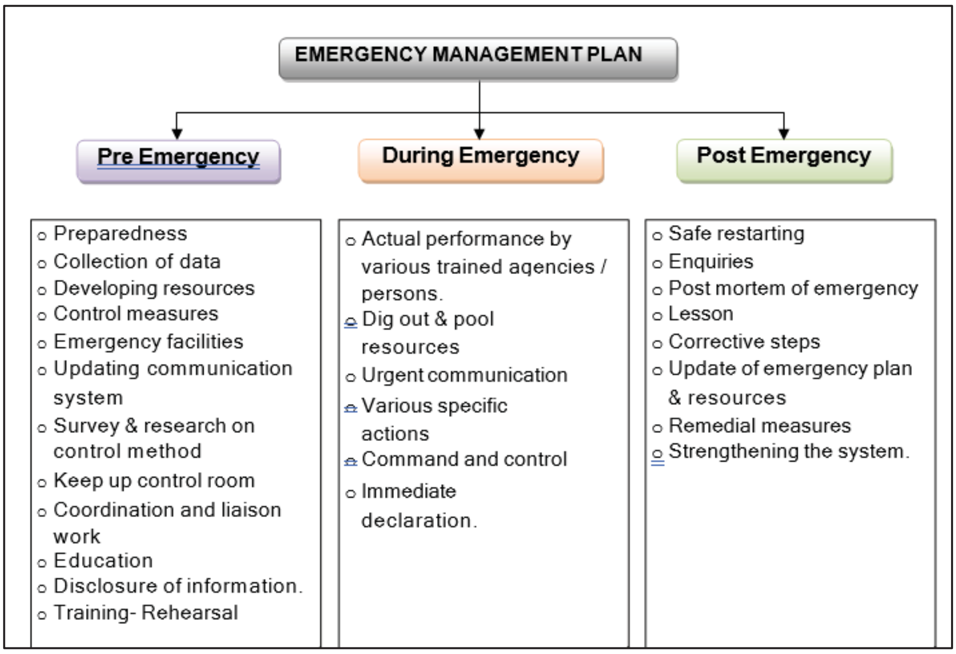


Figure 7.4: Emergency Management Plan

Methodology for On-Site Emergency Plan Preparation

a) Initial Review: Comprehensive site visit for hazard assessment.

b) Hazardous Chemicals: Detailed info on storage, processes, and equipment.

c) Documents, Maps, Facilities: Collection of layout plans, alarms, safety details, and past incidents.

d) Preparedness Details: Occupier, manager, roles, resources, and emergency room specifics.

e) Maximum Credible Scenarios: Consideration of worst-case scenarios based on risk assessments.

f) Major Accident Response System: Systematic actions during emergencies for designated personnel.

Mock Drill

The Station Head shall ensure that a Mock Drill of the On-Site Emergency is conducted at least one in a every six months as provided under Rules and a detailed report of the conducted Mock Drill shall be submitted to the Authority.

The Mock Drill / Exercise / Rehearsal on On-Site Emergency Plan are required to test adequacy of the plan. Further, it will generate self-confidence amongst the Staff / Workers / Supervisors to tackle the emergency successfully

SAFETY MEASURES

The general safety measures as provided at project site are described as below;

Project Area

1. Day to day Monitoring system.
2. Prohibition of Smoking
3. Fire Extinguishers, Fire Hydrant System, Fire protection system are provided.
4. Safe Operating Instructions are displayed
5. Provision of wind Indicator at height structure
6. Qualified Persons look after the Operations
7. Arrangement of PPEs & SCBA Set
8. Arrangement of work safety permit system
9. On Site Emergency Plan is prepared.
10. Full-flag Safety Department
11. Facilities of O.H.C.

Storage Area

1. Separate tank farm with fenced area
2. Dyke wall with acid proof lining to Hazardous chemicals' tank.
3. Water shower with eye washer arrangement.
4. Display of Cautionary Notice.
5. Colour code system for pipelines & notice is displayed accordingly.
6. Arrangement of Personnel Protective Equipment.
7. Qualified operatives are deployed.
8. Earthing for the tank containing flammable liquid
9. Fire Extinguishers, Fire Bucket Post, Hose Reel Box, Fire Hydrant are provided.
10. Flameproof Electrical Fittings in flammable zone
11. Prohibition of Smoking & Mobile Phone.
12. Emergency Communication System

On Site Emergency Plan is prepared.

The Thermal Power Project activities hazards are assessed and identified the different levels of emergences may occur in the premises, which can be classified in three levels as below.

Table 7.9: Designated personnel for Site Incident Controller

S. No.	Designated Person	Scope: Area / Locations
1	Chief Incident Controller (CIC)	All areas of Project Site
2	Dy. Chief Incident Controller (DCIC)	All areas of Project Site
3	Site Incident Controller (SIC) – CIVIL WORK	Civil Work Activities - Boilers, TG House, GT Yard, switchyard, CW Pump House, ESP, Chimney, and all other Building areas, etc.
4	Site Incident Controller (SIC) – MECHANICAL-BTG	Mechanical Work Activities - Boilers, Turbine, ESP areas
5	Site Incident Controller (SIC) – MECHANICAL-OFF SITE	Mechanical Work Activities - CHP & OFF-SITE areas
6	Site Incident Controller (SIC) – ELECTRICAL BTG	Electrical Work Activities – in GT Yard, Cable galleries, SWGR, Control Room, and all other areas

7	Site Incident Controller (SIC) – ELECTRICAL OFF SITE	Electrical Work Activities – in Switchyard, construction power, and OFF-SITE areas
8	Site Incident Controller (SIC) – C&I AREA	C&I Work Activities – in all areas
9	Site Incident Controller (SIC) – STORES	STORES Activities – in STORES and all other areas
10	Site Incident Controller (SIC) – Other areas	All Other Area of Plant
11	Dy. Site Incident Controller (SIC) – CIVIL	Area assigned to SIC
12	Dy. Site Incident Controller (SIC) – MECHANICAL-BTG	Area assigned to SIC
13	Dy. Site Incident Controller (SIC – MECHANICAL-OFF SITE	Area assigned to SIC
14	Dy. Site Incident Controller (SIC) – ELECTRICAL BTG	Area assigned to SIC
15	Dy. Site Incident Controller (SIC) – ELECTRICAL OFF SITE	Area assigned to SIC
16	Dy. Site Incident Controller (SIC) – C&I AREA	Area assigned to SIC
17	Dy. Site Incident Controller (SIC) – STORES	Area assigned to SIC
18	Dy. Site Incident Controller (SIC) – Other areas	Area assigned to SIC

Duties & Responsibilities of Designated Personnel

- **Chief Incident Controller (CIC)**

  In charge of the project site during emergencies.

  Responsibilities include communication, security, firefighting, rescue operations, station operation, shut downs, transportation, evacuation, logistics, investigations, statutory requirements, repair & maintenance, first-aid & hospitalization, public relations.

  Activates On-Site Emergency Plan, coordinates with key personnel, communicates with authorities, reviews and directs actions, coordinates with crisis groups, issues statements, investigates root causes, and authorizes termination of emergency.

  Note: Major crisis statements only by COO (Operations) / COO (Projects) / Chief Incident Controller (CIC).

- **Deputy Chief Incident Controller (DCIC)**

  Assumes CIC duties in the absence of CIC.

- **Site Incident Controller (SIC) & Deputy Site Incident Controller (DSIC)**
  - SIC takes charge at the incident site, assesses and starts remedial measures.
  - Reports to COO in CIC's absence, makes decisions on emergency operations, shutdowns, rescues, evacuations, etc.

Duties & Responsibilities of Key Personnel: Key Personnel (experienced managerial staff) follow instructions from CIC/SIC during emergencies.

- **On-Site Support Team**
  - Chief Project Coordinator: Coordinates emergency repairs, maintenance, logistics.
  - Mechanical, Electrical, C&I Coordinators: Handle system-specific repairs/maintenance.
  - Services Coordinator: Manages workshop & services system.
- **Emergency Response Team**
  - Fire & Rescue Responder: Directs firefighting, rescue operations.
  - Safety Coordinator: Ensures safe conditions.
  - Medical Responder: Establishes medical center, organizes medical help.
  - Evacuation Coordinator: Manages security, plant evacuation.
  - Environment Coordinator: Guides on environmental issues.
  - Assembly Point Coordinator: Coordinates safe assembly areas.
  - Chemical Coordinator: Manages chemical leakage.
  - Material Coordinator: Coordinates material/equipment requirements

On Site Emergency Plan Provisions

Safe Assembly Points (SAP)

Safe Assembly Points, marked in the Plant Layout-Plot Plan, serve as non-hazardous areas for personnel not involved in disaster or fire control activities. Designated points are safe for assembly during emergencies.

Emergency Exits

Emergency Exits, marked in the Plant Layout Plot Plan, are designated rescue exits during emergencies. Personnel not in disaster or fire control activities move to these exits under guidance from Department Heads.

Rehabilitation Centre

Rehabilitation Centers are non-hazardous, safe areas for temporarily relocating affected personnel from public vicinity areas during emergencies.

Emergency Control Centre (ECC)

Emergency Control Centre (ECC), marked in the Plant Layout Plot Plan, serve as command hubs during emergencies. Directed by the Chief Incident Controller, ECC oversees operations, collaborates with external agencies, and establishes a Safe Emergency Control Centre if needed.

Facilities at ECC include:

- Copies of the On-Site Emergency Control Plan
- Plot and master plans of the complex
- Layout plans indicating plants, equipment, and storage areas
- Details of hazardous substances with Material Safety Data Sheets (MSDS)
- Lists of key personnel, outside agencies, and statutory authorities with contact numbers
- Communication facilities (public address system, phones, video conferencing, etc.)
- First aid boxes, firefighting equipment, personal protective equipment (PPE), and SCBA sets
- General stationery, employee lists, and information on rare blood groups.

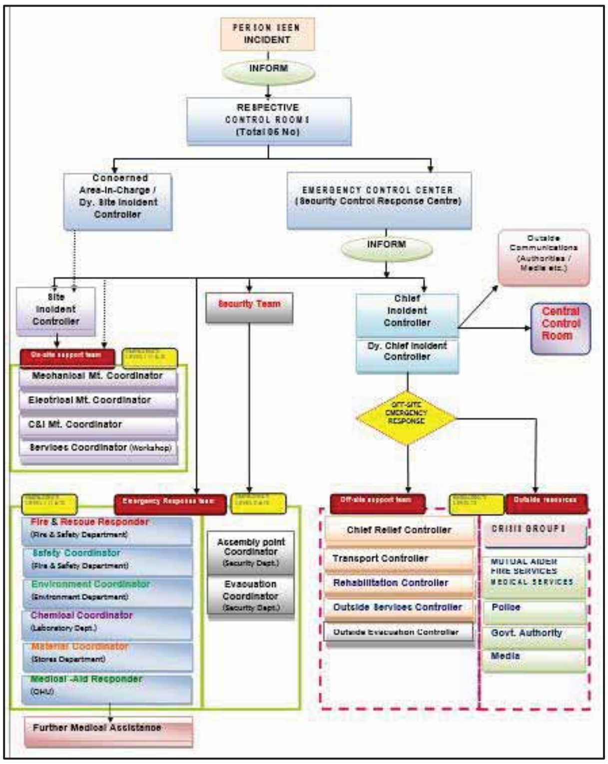


Figure. 7.6: Emergency Communication Flow Chart

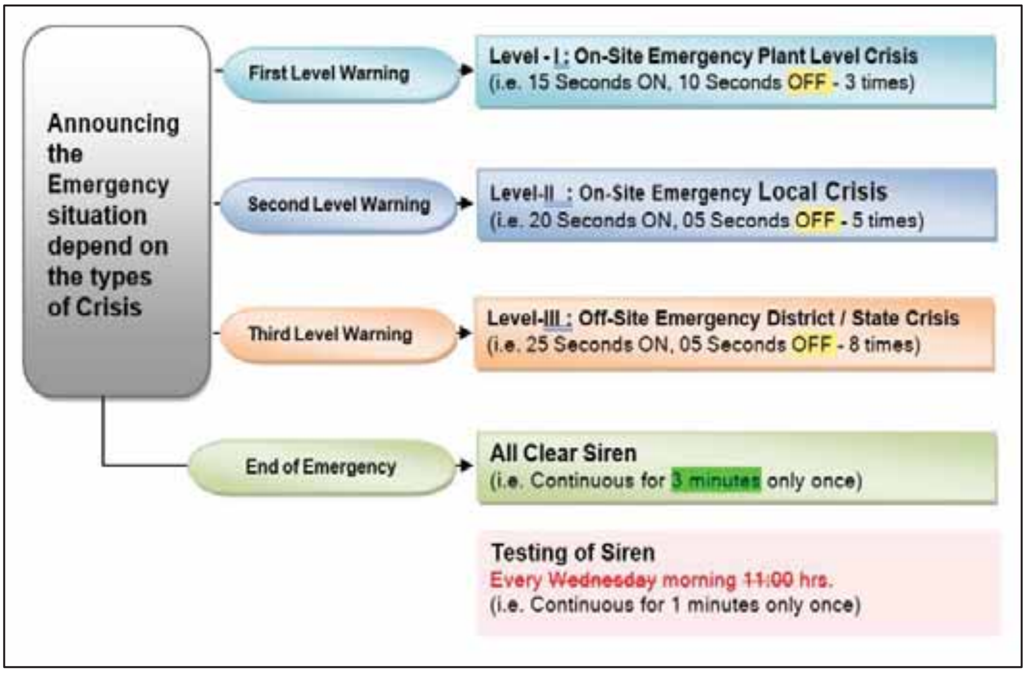


Figure 7.7: Declaring Emergency

Emergency Siren Codes:

Level - I: On-Site Emergency Plant Crisis: Managed on-site as per the Emergency Control Plan.

Level - II: On-Site Emergency Mutual Aided / Local Crisis: External resources assist in uncontrollable situations.

Level - III: Off-Site Emergency - District / State Level Crisis:

- Extends beyond internal resources; requires district-level aid.
- Escalates to State or National Crisis if necessary.

End of Emergency: All Clear Siren

Chief Incident Controller signals the end with a three-minute continuous siren.

All clear announcements conveyed to employees and the public through PA system and local authorities.

7.6.3.2 OFF-SITE EMERGENCY

An Off-Site Emergency occurs when an incident, such as explosions or collapses, extends beyond a facility's control, impacting nearby public areas, requiring external agencies like District or State Crisis Groups to manage the situation.

(A) Off Site Emergency

When an industrial disaster surpasses unit resources and impacts the surroundings, it becomes Off-Site Emergency, managed by the District Crisis Group. The unit supports with facilities, liaison, and coordination.

(B) Probability for Off-Site Emergency

Though APL Raipur Project site anticipates no Off-Site Emergencies, potential scenarios include hydrogen release, fuel tank emergencies, electrical fires, and major coal area fires.

(C) Outside Participation / Government Body

Off-Site emergency operations involve collaboration with local authorities, with local participants taking a dominant role. Industrial management provides comprehensive support, emphasizing the need for local efforts and financial assistance.

Action by Chief Incident Controller & Site Incident Controller During Off Site Emergency.

In Off-Site Emergency, the District Crisis Group assumes control, with the Chairman as Chief Incident Controller. The unit's Chief Incident Controller becomes a Site Coordinator, and the Site Incident Controller serves as the Incident Coordinator.

Fire and Explosion

- Upon noticing a fire or explosion:
- Shout "Fire, Fire, Fire" to alert nearby personnel.
- Report to the Security Control Room or Fire Station, specifying the emergency type and location.
- If safe, estimate severity, return, and await instructions.
- For fires, use appropriate extinguishers or seek trained help.
- Move to the Safe Assembly Point if not part of emergency response.
- Do not attempt heroic efforts.

First Actions for Electrical Fire

- Cut off power supply to convert it into a class "A" fire.
- For small fires, use CO2/DCP extinguishers; avoid foam or water near electrical installations.
- Prohibit entry into electrical equipment rooms after a fire outbreak.

(A) Fire Inside Cable Gallery

- Toxic smoke affects respiratory systems; entry is prohibited.
- Project/Electrical Head activates Emergency Response Plan, alerts the fire station.
- Instructs steps to stop or isolate power supply.
- Evacuate affected people, use appropriate extinguishers.
- For major fires, await firefighting team.

(B) Fire Inside Transformer Yard

- Project/Electrical Head activates Emergency Response Plan, alerts the fire station.
- Cut off power supply, attempt to extinguish with CO2/DCP.
- Use High Velocity Water Spray Systems for quick detection.
- Evacuate affected people, await firefighting team for major fires.

Toxic Gas/Chemical Release

In case of a toxic gas release:

- Run to safety, shouting "Gas, Gas, Gas."
- Report to Project Security/Project Office/Execution Engineer via phone, identifying oneself and specifying the location.
- If trained, attempt control; if not, move to the Safe Assembly Point.
- Area Manager/Laboratory staff take charge, inform the Fire Station, and ensure no one is alone.
- Fire Station sends a trained crew with Gas Emergency Kit and Safety Officers.

- Area Manager, as Site Incident Controller, informs Project Head, evacuates vulnerable persons, avoids crowding, and assists in identifying release points.
- Close isolation valves for hose pipeline or manifold gas release; for cylinder releases, place them in an open area.

Bomb Threat and Countermeasures

In case of a bomb threat:

- Remain calm and obtain details from the caller.
- Trace the caller's number if possible.
- Inform Security Control Room (SCRC), which will pass information to key personnel.
- Bomb search team, led by Plant Security Head, conducts a silent search in designated areas.
- Be cautious and follow safety protocols during the search.
- If a suspicious object is found, keep a 300-foot clear zone and contact Bomb Disposal Squad.
- Evacuate if needed; seek police assistance and follow emergency procedures.

Sabotage/Riots and Countermeasures

- Close all gates to prevent entry of anti-social elements.
- Maintain heightened security; contact Chief Incident Controller and local authorities.
- Conduct round-the-clock patrolling.
- Alert all employees about the Emergency Control Action Plan.
- Consider advising non-security employees to take leave during major disturbances.

Action Plan to Respond Specific Natural Disaster

Weather Forecast Emergency Response

- Chief Incident Controller (CIC) activates emergency teams upon weather forecast information.
- Mitigation plan is prepared with precautionary measures for cyclones, thunderstorms, floods, heavy rain, tsunamis, etc.

- Ensure communication facilities, emergency tools, PPEs, first aid, and other resources are available.
- Cyclone countermeasures include evacuation, securing buildings, and monitoring updates.
- Thunderstorm precautions involve seeking shelter indoors and avoiding electrical appliances.
- Flood response includes assessing the situation, shutting off hazardous operations, and evacuation if necessary.

Dos & Don'ts:

- Follow safe routes to shelters during floods.
- Avoid walking through flooded areas.
- Climb to higher levels if water rises.
- Inspect buildings for damage after floods.
- Do not try to return home/plant until declared safe.
- During earthquakes, take cover indoors or move into open areas away from buildings.
- Be prepared for aftershocks and help injured persons.
- Listen to emergency information and stay out of damaged buildings.

7.7 OCCUPATIONAL HEALTH AND SAFTEY

For large industries, where multifarious activities are involved during construction, erection, testing, commissioning, operation and maintenance, the men, materials and machines are the basic inputs. Along with the boons, industrialization generally brings several problems like occupational health and safety.

The industrial planner, therefore, has to properly plan and take steps to minimize the impacts of industrialization and to ensure appropriate occupational health and safety including fire plans. All these activities again may be classified under construction and erection, and operation and maintenance.

7.7.1 Occupational Health

Occupational health needs attention both during construction and erection and operation and maintenance phases. However, the problem varies both in magnitude and variety in the above phases.

7.7.2 Construction and Erection

The proposed expansion project prioritizes occupational health and safety in construction and erection activities through rigorous training, mandatory use of personal protective equipment, and strict adherence to safety protocols. The project emphasizes preventive measures, proper site planning, equipment safety, fall protection, electrical safety, emergency preparedness, health monitoring, safe material handling, effective communication, and meticulous documentation to create a secure working environment. Regular reviews and updates ensure continuous compliance with occupational health and safety regulations, fostering a culture of well-being among the workforce.

7.7.3 Operation and Maintenance

The problem of occupational health, in the operation and maintenance phase is primarily due to noise which could affect hearing. The necessary personal protective equipments will be given to all the workers. The working personnel shall be given the following appropriate personnel protective equipment’s.

1. Industrial Safety Helmet;
2. Face shield with replacement acrylic vision;
3. Zero power plain goggles with cut type filters on both ends;
4. Zero power goggles with cut type filters on both sides and blue color glasses;
5. Cylindrical type earplug;
6. Ear muffs;
7. Self-contained breathing apparatus;
8. Leather apron
9. Leather hand gloves;
10. Acid/Alkali proof rubberized hand gloves;

11. Canvas cum leather hand gloves with leather palm;
12. Electrically tested electrical resistance hand gloves; and
13. Industrial safety shoes.

All working personnel will be medically examined at least once in every year and at the end of his term of employment. Pre and Post-employment Medical check-up is being/ will be carried out. This is in addition to the pre-employment medical examination.

7.7.4 Details of occupational health surveillance program

Occupational Health Program is being developed. The Company is committed to promoting the health, safety and well-being of its workers, employees, visitors and contractors. The industry will strive to develop and implement best practices in occupational and environmental hygiene principles. The industry has developed and implemented a comprehensive Occupational Hygiene Program (OHP) devoted to the recognition, evaluation and control of those environmental factors, arising in or from the work place that may cause illness, injury, or discomfort. To help reduce the risk of hazardous exposures, ensure regulatory compliance, and improve working conditions, appropriate occupational hygiene practices will be applied to the Industrial operations. The Occupational Hygiene Program clearly defines and stipulates the responsibilities of all workplace parties involved in its development, administration and implementation of the program.

The Occupational Hygiene Program includes the following elements:

1. Organizational Commitment;
2. Occupational Hygiene Process;
3. Roles and Responsibilities;
4. Training and Education;
5. Annual Program Review;
6. Definitions; and,
7. References.

Purpose and Scope

The Occupational Hygiene Program provides information to departments, supervisors and workers to allow for informed decision-making regarding exposure to hazardous agents in the workplace. This program outlines how worker exposures hazards will be addressed in the workplace including the interpretation of technical data, conducting research, and assist in the development of guidelines and procedures that support workplace health and wellness. A hazard may be chemical, biological or physical in nature:

i. Chemical hazard - is any chemical capable of causing bodily injury or illness;
ii. Physical hazard - arises from the interaction of matter and energy related to the science of physics such as sounds, light, vibration, and radiation that could result in an occupational injury or illness.

Supporting Programmes and Standards

There are a number of occupational hygiene related hazards that have regulatory requirements. For these hazards, additional programs or standards have been developed and will work in conjunction with this program. These programs or standards include, but are not limited to the:

1. Respiratory Protection Program;
2. Indoor Environmental Quality Program;
3. Personal Protective Equipment Program;

Safety Training

Safety trainings (on Safe Material Handling, First Aid & all Safety aspects) shall be provided to Safety Officers. In addition to regular employees, limited contractor labors shall be provided safety trainings. To create safety awareness, safety films will be shown to workers and leaflets are distributed.

7.8 SOCIAL IMPACT ASSESSMENT, R&R ACTION PLAN

The project to be implemented with adequate pollution control measures will have an overall positive impact on the socio-economic aspects of the surrounding area. The socio-economic impact of the proposed project has been detailed in Chapter - IV of this Draft EIA/EMP report. The proposal does not involve any rehabilitation & resettlement.

Adani Power Limited is committed to the Social Environmental Management Plan (EMP) & a total of Rs. 66 Cr. Has been allocated to be spent under Social EMP (CER), in accordance with the Ministry's Office Memorandum (F. No. 22-65/2017-IA.III) dated 01.05.2018. The funding will be utilized for EMP Social initiatives as per the Office Memorandum dated 30.09.2020.

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Chapter - VIII

Project Benefits

8.1 PROJECT BENEFITS

The proposed 4x800 MW Ultra Super Critical Thermal Power Plant is poised to bring substantial benefits to the local and regional economy. This proposed project aims to uplift the standard of living for the local populace through increased employment opportunities and enhanced infrastructure. Additionally, it is anticipated to attract investments from high-income groups, fostering economic growth in the region. The key project benefits include:

- Infrastructure Development: The proposed expansion project will contribute to the development of physical infrastructure, including approach roads, drainage, communication, and transportation facilities.
- Direct & Indirect Employment Opportunities: The proposed expansion project will generate both direct and indirect employment opportunities, benefiting the local workforce and contributing to economic development.
- Revenue Generation to Central & State Government: The increased economic activity is expected to result in revenue generation for both central and state governments.
- Allocation of 2% of Profit towards ESC (Social-EMP) Activities: A commitment to allocate 2% of profits towards Environmental and Social Commitments (ESC) activities, ensuring a focus on sustainable and responsible practices.
- Trickledown Effect of Enhanced Profitability: The enhanced profitability of the project is expected to have a positive impact on the local population through a trickledown effect.
- Skill Development and Capacity Building: Initiatives such as vocational training, income generation programs, and entrepreneurship development programs will contribute to skill development and capacity building.
- Awareness Programs and Community Activities: Various community-centric activities, including health camps, medical aid, family welfare camps, sanitization/cleanliness

awareness programs, immunization camps, sports, cultural activities, and plantation drives, will be undertaken.

- Awareness about Waterborne and Pandemic Diseases: The project aims to raise awareness about waterborne and pandemic diseases among local villagers.

8.2 IMPROVEMENTS IN THE PHYSICAL INFRASTRUCTURE

The proposed expansion project will lead to improvements in physical infrastructure and community development. Besides power generation facilities, the project will provide the following facilities:

- Areas designated for construction-related offices and stores.
- Amenities for time management and security assurance.
- Prepared with suitable equipment for handling emergencies.
- Zones dedicated to offering meals and comprehensive welfare support.
- Sufficient sanitation facilities catering to the workforce.
- Parking provisions for both 2-wheelers and 4-wheelers.
- Specifically allocated space for skill development and training.

The improvement in physical infrastructure is expected to contribute to the overall well-being of the local population. There will be a significant improvement in the physical infrastructure at site and immediate neighborhood due to the development of proposed expansion unit. The areas of nearby vicinity of the project will see a positive change from the present scenarios.

8.3 IMPROVEMENTS IN THE SOCIAL INFRASTRUCTURE

The proposed expansion project will positively impact social infrastructure, a subset of the infrastructure sector that includes assets accommodating social services. The commissioning of the Ultra Super Critical Thermal Power Plant is expected to create a conducive environment for further urbanization in the area. The project will employ additional workers, supervisors, and engineers locally whenever possible. Medical facilities will be upgraded as part of Corporate Environmental Responsibility (CER) activities, benefiting the local residents. The influx of educated and skilled individuals from outside the area, coupled with secondary developments such as new schools and shops, is anticipated. These developments will be beneficial to the local population, contributing to improved social infrastructure.

8.4 EMPLOYMENT POTENTIAL – SKILLED; SEMI-SKILLED & UNSKILLED

The employment potential of the proposed project includes both direct and indirect opportunities. Approximately 1200 permanent & contractual employees are estimated to be required for the construction & operational phase of the 4 x 800 MW Ultra Super Critical Thermal Power Plant. Direct employment opportunities during the operational phase will be limited due to mechanized and automated processes. Skilled manpower requirements will be expected to come from outside the study area, while semi-skilled & unskilled labor may be sourced locally, depending on availability and feasibility. Indirect employment opportunities in the service sector are anticipated, along with the potential for secondary developments leading to increased family population and employment generation in the study area.

8.5 CORPORATE SOCIAL RESPONSIBILITY (CSR) ACTIVITIES

APL will continue to carry out its CSR activities, inline to the applicability of Company's Act 2013, in the field of Education, Health, Sustainable Livelihood, Community Infrastructure, Training & Skill development thereby increasing the quality life in study area. Therefore, positive impacts are anticipated on socio-economic aspects during operation phase after implementation of the proposed expansion project. Details of existing undertakings by Adani Foundation in the region are as below:

At present Adani Foundation is working in 28 villages, 14 Gram Panchayats, 2 Block of district Baran covering 8,475 households, 42,834 population, 32 Schools, 45 Aanganwadis, 1 District Hospital, 2 CHC, and 2 PHC.

All the 28 villages have been divided into 4 clusters for ease of monitoring mechanism: Adani foundation is working in the field of education, Community Health, Sustainable Livelihoods, Community Infrastructure & Stakeholder engagement to bring about improvement in the socio-economic conditions of the region.

APL is determined to work closely with the local community to deliver the project in a way which is fair to local communities and creates a legacy for the next generation. It is also important that the stakeholders are held collectively responsible and encouraged to take ownership of the development, thus promoting the agenda of sustainability for future generation.

APL will align its initiatives with Sustainable Development Goals, thus translating business growth into holistic community development & creation of sustainable livelihood opportunities.

8.6 SOCIO-ECONOMIC DEVELOPMENT (CER)

The Ministry of Environment, Forests & Climate Change (MoEF&CC) issued an Office Memorandum (OM) on CER dated 01.05.2018, superseded by a subsequent OM dated 30.09.2020. This revision directs Environmental Appraisal Committees (EAC) and State-level EACs to prescribe specific conditions for grant of prior environmental clearance instead of allocating funds under CER. A separate budget Rs. 66 crores towards CER activities (as per Ministry’s OM dated 01.05.2018) is allocated for CER activities, and efforts will be made to address concerns raised after the public consultation during the final EIA ensuring responsible corporate practices.

Activities under Socio-Economic development will be carried out under the heads Community Infrastructure Development, Education, Health, Sustainable Livelihood, Sports & Cultural etc. based on Need based assessment & socio-economic study findings & issues raised during public consultation process and recommendation of the Hon’ble EAC during appraisal for Environmental Clearance. Annual CER will be prepared inline to the actual budget planned for the financial year and implemented accordingly. APL, Kawai will be also work in resource conservation, biodiversity conservation, solid waste management, rainwater harvesting, Plantation in community areas etc. The final budgetary allocation will be submitted with Final EIA/EMP report incorporating the action plan for suggestions/comments raised during Public Hearing.

8.7 CONCLUSION

The proposed project will aid in meeting demand & supply of the power sector in India. The overall effect will improve the buying power of people and thus a higher standard of living viz. better education, improved health and sanitation facilities, housing and acquisition of consumer durables. Housing, transport, medical, educational and other civic amenities will improve in the future. This is envisaged as a major positive benefit.

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CHAPTER - IX

ENVIRONMENT COST & BENEFIT ANALYSIS

9.1 INTRODUCTION

Environmental Cost-benefit analysis provides an organizational framework for identifying, quantifying, and comparing the costs and benefits (measured in monitory values) of a proposed policy action. While this sounds logical enough, cost-benefit analysis has been causing for substantial debate when used in the environmental arena. The benefits of environmental regulations can include, for example, reduced human and wildlife mortality, improved water quality, species preservation, and better recreation opportunities. The costs are usually reflected in higher prices for consumer goods and/or higher taxes. The latter are market effects readily measured in monitory values, while the former are non-market effects for which monitory values are not available. In addition to complicating the practice of cost-benefit analysis, this raises ethical issues. Monitory values cannot be assigned with respect to undisturbed natural places, to save human and animal lives. If such things are too 'priceless' to assign monitory values, we lose the ability to use cost-benefit analysis to inform the decision.

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Chapter - X

Environmental Management Plan

10.1 INTRODUCTION

The Environmental Management Plan (EMP) is a site-specific plan developed to ensure that the project is implemented in an environmentally sustainable manner. EMP also ensures that the project implementation is carried out in accordance with the design by taking appropriate mitigative actions to and progress indicators to monitor improvements made. Also, the plan outlines roles and responsibility of the key personnel and contractors who are charged with the responsibility to manage the plant. An EMP reduces adverse environmental impacts during its life cycle. The plan will outline the short- and long-term strategies for managing a range of environmental issues prepared in accordance with rules and complying with guidelines of the MoEF&CC and RSPCB/CPCB.

10.1.1 OBJECTIVES OF ENVIRONMENTAL MANAGEMENT PLAN

The main objectives in formulating the Environmental Management Plan are:

- To encourage, support and conduct development work for the purpose of achieving environmental standards and to improve methods of environmental management.
- To promote further plantation of indigenous species of plants in the core and buffer zone of the plant.
- To ensure working conditions, devoid of air & noise pollution in order to promote employee's health and production of unit simultaneously.
- Perspective budgeting and allocation of funds for environmental management expenditure.
- Continuous development and search for innovative technologies for assurance of better management of environment problems.

10.1.2 ENVIRONMENT MANAGEMENT SYSTEM DESIGN

The unit will ensure the following activities

a. Commitment & Policy

The project management will strive to provide and implement the Environmental Management Plan that incorporates all issues related to describing quality of air, soil and water, safety of workmen.

b. Planning

This includes identification of environmental impacts, compliance to legal requirements and setting environmental objectives. The various potential impacts are discussed under **Chapter IV** of the EIA Report.

c. Implementation:

This comprises of resources available to the proponents, accountability of contractors, training of operational staff associated with environmental control facilities and documentation of measures to be taken.

d. Measurement & Evaluation

This includes monitoring, corrective actions, and record keeping. Evaluation of EMP achievements will lead to continual improvement.

10.2 ENVIRONMENTAL MANAGEMENT SYSTEM & MONITORING PLAN

It is recommended that, for the effective and consistent functioning of the project an Environmental Management system (EMS) will be established at the site. The EMS would include the following:

- Environmental management cell.
- Environmental Monitoring
- Personnel Training

- Regular Environmental audits and Correction measures.
- Documentation – standards operation procedures Environmental Management Plan and other records.

10.2.1 ENVIRONMENTAL MANAGEMENT DIVISION/CELL (EMD)

The comprehensive handling of environmental considerations during the construction and operation phases of the thermal power station will be entrusted to the dedicated and fully equipped Environmental Management Cell/Division (EMD). This division plays a crucial role in managing the overall plant and its surrounding environment, focusing on environmental, safety, and occupational health aspects.

The EMD is staffed with a proficient team encompassing environmental engineers, chemists, horticulturists, safety specialists, and well-trained personnel responsible for the operation and maintenance of pollution control equipment. Ongoing staff training programs will cover various areas, including environmental management, ambient air and water quality monitoring, solid waste management, noise abatement, safety, and health. Adequate spares and maintenance facilities will be provided for pollution control equipment, and the staff is well-trained to ensure the optimal efficiency of equipment like ESP. APL’s proposed Environmental Management Division (EMD), led by a senior manager and supported by a team of engineers, chemists, and operating staff, will assume additional responsibilities for the environmental functions associated with the proposed expansion project.

Table 10.1: Environmental Functions

Areas	Responsibilities
Operations & Maintenance Group	The O&M team, led by a senior manager, will oversee the operation and maintenance of the power station, incorporating environmental responsibilities for the proposed expansion Ultra Super Critical Thermal Power Plant. The team comprises four functional areas:
Operations	Personnel in this section will manage the Power Plant's operation, coal and ash handling systems, water treatment, switchyard, and auxiliary plant components on a three-shift basis. Shift In charges will oversee specific areas, assisted by Control Engineers.

Maintenance	This section will handle mechanical and electrical plant maintenance, control systems, building upkeep, and scheduled maintenance, working during regular shifts.
Engineering	Responsibilities include monitoring plant performance, documentation, system improvements, safety, information services, and training during regular shifts.
Administration	This area will manage spares, equipment, fuel coordination, plant security, finance, medical services, personnel, and clerical services.

10.2.2 ENVIRONMENTAL MONITORING PROGRAMME

A comprehensive environmental monitoring programme is essential to furnish scientifically sound information about the environmental quality surrounding the power station. This program ensures continuous assessment of critical pollutant levels, maintaining environmentally acceptable limits. By promptly identifying unacceptable conditions, immediate control measures can be implemented. Regular monitoring during construction and operation phases is integral to environmental mitigation efforts, evaluating pollution control equipment efficiency. For proposed 4x800 MW USCTPP, detailed in Chapter IV: Environment Monitoring Plan.

Environmental Monitoring activities will be conducted through an internal and external NABL/MoEF&CC approved laboratory, along with the in-house laboratory.

10.2.3 ASH HANDLING SYSTEM

- The bottom ash will be collected in wet form and fly ash in dry form. Fly Ash extracted in dry form and stored in storage silos for the purpose of utilization in Cement Industries & others as per the Fly Ash Utilization Notification 2021 & amendments.
- Bottom ash from the bottom ash hopper of each unit shall be removed in 2.0 hours per shift of 8 hours. Ash collected in Bottom ash hopper (B.A + Eco Ash) shall be transported to hydro bins through jet pumps and slurry pumps. Inside the hydro-bins, water shall be removed from the slurry. In case of exigencies the bottom ash from Hydrobins shall be crushed and transferred to ash mixing tank, where fly ash and water shall be mixed with

bottom ash and the resultant slurry shall be ultimately disposed to Ash Dyke via HCSD Pumps and Pipelines.

- In normal operations bottom ash from Hydrobins shall be disposed through bulker trucks to end users.
- The fly ash handling system shall be provided to remove fly ash from ESP hoppers and APH hoppers to transport fly ash to fly ash silos via pneumatic ash pipe conveying system which utilizes vacuum conveying up-to intermediate surge hopper and pressurized conveying up to main fly ash silos.
- From the fly ash silos, fly ash shall be transported in dry form through bulkers truck for possible utilization. The fly ash conveying system will be sized such that fly ash collected in 8 hours shall be evacuated in 5.5 hours. From surge hoppers fly ash will be conveyed pneumatically under pressure to ash storage silos.
- Fly ash generated from the power plant has pozzolanic properties may be utilized in the following industries:
  - ✓ Cement
  - ✓ Abandoned Mine Back filling/Low Lying Area
  - ✓ Fly ash bricks
  - ✓ Road making / paving

100% Ash will be utilized in Cement Industries, reclamation of abandoned mines, manufacturing of bricks, road construction, aggregate replacement in concrete, etc. as per Fly Ash Notification, 31.12.2021. Provision will be made for disposal of un-utilized ash in high concentration slurry form to ash dyke.

10.3 CORPORATE ENVIRONMENT POLICY

APL will set goals and objectives laid by its board of Directors. CEP prescribes for standard operating process/ procedures to bring into focus any infringement/ deviation/ violation of the environmental or forest norms/ conditions. It also constitutes the hierarchical system or administrative order of the company to deal with the environmental issues and for ensuring compliance with the environmental clearance conditions. APL has a system of reporting of non-compliances/ violations of environmental norms. The Corporate Environment Policy will be updated regularly and all the environmental laws are considered while carrying out operations in industry.

10.4 ENVIRONMENT MANAGEMENT PLAN

10.4.1 MANAGEMENT PLAN FOR CONSTRUCTION PHASE

The impacts of construction activities would be temporary and will reduce gradually with the completion of the construction activities. Various mitigation measures proposed to be implemented during construction phase are described below.
Construction phase monitoring includes:

- Monitoring of accuracy of predicted impacts during EIA study
- Monitoring on likely impacts of the project particularly on biological resources.
- Monitoring on occupational health and safety measures

Air Environment

Air quality around the project will be marginally impacted during the construction phase. Various activities related to construction are likely to generate dust and may adversely affect the air quality of the surrounding area of the project site. Following measures shall be taken to minimize such impacts:

- All the loose material either stacked or transported will be provided with suitable covering such as tarpaulin.
- For dust suppression due to vehicular movements, water sprinkling will be done from time to time.
- To minimize the occupational health hazard, proper mask will be provided to the workers who are engaged in activities that may lead to dust generation.

Water Environment

During the construction period, run-off from site shall not be allowed to stand (water logging) or enter the roadside or any surface drains. Adequate measures will be taken to avoid any adverse impact on surface or ground water during construction phase. All the wastewaters will be treated and recycled within the plant maintaining ZLD.

Noise Environment

During the construction stage, an increase in ambient noise levels is expected, which will decrease with the increase in distance. All the construction activities will be carried out during the daytime. There will be some noise generation due to the traffic movement carrying construction material, which is a temporary phenomenon. To prevent the occurrence of any occupational hazard, earmuff/earplug will be given to the workers working around and operating machinery emitting high noise levels. Careful planning of machinery operation and scheduling of operations will be done to minimize such impacts. Greenbelt will be developed to help in abatement of noise and act as barrier for noise generated from plant machinery.

Solid Waste Management

During the construction phase, the following measures shall be taken for solid waste Management:

- All metal, wooden, paper, plastic wastes, debris and metal cuttings shall be collected from site as soon as particular construction activity is over and will be provided to authorized recyclers for recycle & disposed in suitable manner as per rules & norms.
- Municipal waste generated from plant canteens will be segregated (biodegradable & non-biodegradable), collected and provided to authorized vendors and treated in OWC and manure will be utilized for greenbelt development.

Table 10.2: Mitigation measures for Construction Phase

Proposed Mitigation Measures	Targets to Achieve	Risk & consequences of Failure if any
Air Pollution Control		
Water sprinkling in vulnerable area.	Control of fugitive dust from construction areas	Increase in SPM emissions
Proper maintenance of vehicles & construction equipment.	Control of CO & NOx Emissions	Increase in gaseous pollutant

Proposed Mitigation Measures	Targets to Achieve	Risk & consequences of Failure if any
Transportation of construction material in covered trucks.	Control of fugitive dust during transportation	Increase in SPM emissions
Noise Pollution Control		
Proper maintenance of vehicles, equipment and machinery	Control of ambient and site noise levels	Increase in noise levels
Provision of acoustic covers/ enclosures on equipment and machinery.	Control of ambient and site noise levels	Increase in noise levels
Provision of earmuffs/ earplugs to the workers in high noise areas and enforcement of its use.	Protection of workers	Health effects on individual workers
Water Pollution Control		
Channelization and construction of temporary sedimentation tanks for effluents from construction area through network of drains.	Control of suspended solids in effluents from construction area	Increase in total suspended solids in effluents
Socio-Economic Environment		
Provision of environmentally safe camping area for the migrant laborers.	To provide clean & healthy living environment to work force	Unhealthy living conditions, spread of diseases
Arrangements for water supply and sanitation.	To reduce stress on surrounding population	Stress on existing utilities, conflicts with local people
Solid Waste Management		
Disposal of surplus earth and construction debris	Control of pollution	Air/ Water Pollution
Reclaiming of un-built area with appropriate vegetation/ landscaping.	Create a good visual environment. Aesthetics improvement	Unpleasant surroundings

10.4.2 MANAGEMENT PLAN FOR OPERATIONAL PHASE

The impacts of operation phase will be long term in nature. **Table 10.2** describes various mitigation measures, proposed to be implemented during operation phase. Operational phase monitoring includes:

- Regular supervision of established infrastructure e.g., open stone lined drain, fencing, Supervision of waste management.
- Supervision of safety measures and equipment.
- Supervision of regular water supply and sanitation.

10.4.2.1 ENVIRONMENT MANAGEMENT PLAN

The major air polluting plant activities and their respective mitigation measures are as under:

Table 10.3: Plant activities and mitigation

S. No.	Plant Activities	Pollution Control Measures
1	Coal Yard	Dust Suppression System
2	Coal Handling system: • Wagon Tippler • Crusher House • Coal Bunker • Coal Transfer House	Dust Suppression System Dust Extraction & Dry fog diffusion systems Dust Extraction System Dry Fog diffusion system
3	Boilers	Electrostatic Precipitators (ESPs)
4	DM Plant	ETP & Neutralization Pit.
5	Domestic Effluent	Sewage Treatment Plant (STP)
6	Fly Ash Storage Silos	Dust Extraction System (Bag Filters)
7	Fly Ash & Bottom Ash Disposal	100% Ash will be utilised in Cement Industries, Road Construction, etc as per the MoEF&CC, Fly ash Utilisation Notification. Bottom ash generated shall be supplied to the Road Mix Concrete (RMC) / brick producers / filling of low lying area / filling of mine voids as per the statutory guidelines thereby eliminating the need for separate area shall be explored
8	Vehicle Movement	Concrete Road & Road Sweeping
9	Dispersion of Emission	275 m Height Chimney with bi-flue stack
10	Reduction of Gaseous Emission	Low NOx Burners Selective Catalyst Reactor (SCR)/ SOFA

10.5 ENVIRONMENT ENHANCEMENT MEASURES

Water Saving:

- To the possible extent water is saved at each point of use by taking proper care in maintenance of drainpipe, tap etc from leakage. There should be a display board for optimum use of water in washroom, toilet or at other appropriate locations.
- Use of recycled water, if possible, in cleaning of toilets or gardening after proper treatment and testing for its intended use.
- Use of sprinkler or drip irrigation method in Greenbelt/Plantation purpose.
- Rainwater harvesting is proposed
- Adoption of machinery– equipment, methods, if possible and economically viable, for manufacturing.

Maintenance of the recharging system

Periodic maintenance is required for reliable and higher quality water supply. During raining season, the entire system to be checked before and after rains and cleaned after every dry period. Before first shower storage tanks should be cleaned and flushed of all sediments and debris. Also, the roof top will be cleaned before monsoon and coarse mesh is used to prevent debris on the entrance of the water at roof. The first shower should be flushed so the any sediment can be washed away.

Solar Power Harnessing

For harnessing solar power, Solar Street Lights will be provided. In addition, the building structures will be so designed that daylight enters the shops through roofs. Daylighting can be especially helpful in industrial environments where natural light is often non-existent, presenting a prime opportunity for implementation.

Windows and Skylights

Incorporating windows and skylights is the most popular option for introducing natural light into a building. But, for windows and skylights to be effective, they must be properly placed. The selection and placement of windows and skylights should be determined by the amount of light needed, regional climate, security requirements and the design of the building.

Tubular Daylight Devices (TDDs)

Tubular daylighting devices are a versatile alternative to traditional skylights because they can be used to provide light to areas that are not in a direct line of sight with the sun. TDDs use a rooftop dome to capture the sun's light, which then travels through a reflective tube. TDDs are more effective than traditional skylights or windows because of the reflective tubing, delivering maximum daylight with minimal heat transfer.

10.6 ENVIRONMENTAL ACTION PROGRAMME

The management of "Adani Power Limited" is quite conscious of its responsibility for maintaining clean and a healthy environment and it will adopt a comprehensive Environmental Management Plan (EMP) which will cover several environmental protection measures, not only for abatement of environmental pollution resulting from the project, but also for the improvement in the ambient environment. The various components of the EMP are outlined in relevant sections. Adequate funds for pollution control measures are provided as a part of overall project financing to ensure the availability of proper treatment facilities before the commissioning of the unit.

10.7 BUDGET FOR IMPLEMENTATION OF ENVIRONMENTAL MANAGEMENT PLAN

M/s Adami Power Limited will incur the following expenditure to implement the Environmental Management Plan for the proposed 4x800 MW Ultra Super Critical Thermal Power Plant, Phase II expansion of Kawai Thermal Power Plant.

Table 10.4: EMP Budget

S.No	Item Description	Cost (Rs. In Crores)
1	Electrostatic Precipitator	1,085.60
2	Chimney	718
3	Cooling Tower including civil works	378.31
4	Ash Handling including ash water recirculation	450.76
5	Ash disposal civil work	59.00
6	Dust extraction & suppression system	16.52
7	DM Plant Waste Treatment System	110.00
8	Sewerage collection, treatment & disposal	3.54
10	Green Belt, afforestation & land scaping	23.60
11	SCR/SOFA	3,097.95
12	Rainwater harvesting	14.38
13	Solar power harnessing	6.37
14	Environmental Laboratory & Environmental Monitoring (Capital + Recurring)	10.03
15	CEMS, CAAQMS, EQMS monitoring system & Main gate display board	11.80
16	Wind Breaking Wall, Dry Fog System & RCC Flooring in Coal Storage Area.	7.08
Total in Rs in Crores		**5,992.94**

A separate budget Rs 66 crore towards CER activities (as per Ministry's OM dated 01.05.2018) is allocated for Social EMP (CER) activities, and efforts will be made to address concerns raised after public consultation during the final EIA ensuring responsible corporate practices.

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CHAPTER-XI
SUMMARY AND CONCLUSION

11.1 INTRODUCTION

Adani Power Limited (APL), a part of the diversified Adani Group, is the largest private thermal power producer in India. Having thermal power plants generation capacity of 17,510 MW comprising coal based thermal power plants in Gujarat, Maharashtra, Karnataka, Tamil Nadu, Rajasthan, Chhattisgarh, Madhya Pradesh, Jharkhand states of India.

Adani Power Limited (APL), Kawai has proposed Expansion of Kawai Thermal Power Plant under Phase–II by adding 3200 (4x800) MW Ultra Super Critical Thermal Power Plant to Existing 1320 (2x660) MW at Village Kawai, Tehsil Atru, District Baran, Rajasthan.

The proposal for Terms of Reference (ToR) was considered & appraised in 9th meeting & 11th meeting of Expert Appraisal Committee (Thermal Power Projects), MoEF&CC held on 07.05.2024 & 27-28. 05. 2024. The project was granted with Terms of Reference (ToR) vide F no. J-13012/154/2008-IA.II (T) dated 29.07.2024 by the MoEF&CC, New Delhi. Copy of ToR Letter for proposed expansion project of APL is enclosed as **Annexure 1.**

11.2 DESCRIPTION OF THE PROJECT

The salient features of the project are given below: -

Table 11.1: Salient features of the project

S. No.	Particular		Details		
1.	Project sector & category	:	1(d), Thermal Power Plants & Category "A"		
			Existing	**Proposed**	Total
2.	Plant capacity	:	1320 MW (2 x 660) MW	**3200 MW** **(4 x 800) MW**	4520 MW (1320+3200) MW
3.	Land requirement (In Hectare)	:	350	472.45 *(includes 1.758 Ha. Forest Area outside power plant premises for Coal Conveyor*	822.45

				after Forest dept. inspection)	
4.	Greenbelt & Plantation (In Hectare)	:	120	**169.44**	289.44 Ha (35%)
5.	Technology	:	Super-critical	**Ultra Super-critical**	Super-Critical & Ultra Super-Critical
6.	Coal requirement in (Million MTPA)	:	5.50	**12.9**	19.35
7.	Source of fuel	:	Coal from Coal Mines of Jitpur, Rampia, Ujheni & e-auction for proposed project.		
8.	Coal transportation	:	Through Rail.		
9.	Ash Generation (Million MTPA)	:	5.16		
10.	Project Cost (Crores)	:	8264.59	**36,600**	44864.59
11.	Water requirement & Water allocation	:	34	**56**	90
			WRD permission for 34 MCM has already been obtained and the application for additional water allocation of 56 MCM has been submitted to WRD, Jaipur.		
12.	Water Source	:	From Parwan River/Dam through water pipeline		

Table 11.2: Details of Environmental Setting & Site Connectivity

S. No.	Particular	Particulars with Aerial distance & Direction
1.	Project Address	Village Kawai, Tehsil Atru, District Baran, Rajasthan
2.	Geographical Coordinates	

S.NO.	Latitude	Longitude
1	24°48'49.45"	76°43'52.90"
2	24°49'52.57"	76°43'13.78"
3	24°49'18.09"	76°43'9.64"
4	24°50'16.91"	76°42'16.70"
5	24°50'17.26"	76°41'49.49"
6	24°48'52.21"	76°42'36.87"
7	24°48'12.53"	76°43'23.90"
8	24°48'7.23"	76°43'44.16"
9	24°47'20.05"	76°43'34.43"
10	24°47'17.07"	76°43'58.42"
11	24°47'2.40"	76°44'42.01"

S. No.	Particular	Particulars with Aerial distance & Direction		
		12	24°45'43.52"	76°44'29.90"
3.	SOI Toposheet	G43W9, G43W10, G43W13 & G43W14		
4.	Site elevation	Average site elevation – 315 m AMSL		
1.	Areas protected under international conventions, national or local legislation for their ecological, landscape, cultural or other related value.	There are no protected areas under international conventions in study area for their landscape & cultural value. There are 15 no. of PF & R.F. within 10 km of the project site.		
2.	Areas which are important or sensitive for ecological reasons - Wetlands, watercourses or other water bodies, coastal zone, biospheres, mountains, forests.	**Particulars**	**Distance (In km)**	**Direction**
		Reserve Forest (R.F), Protected Forest (P.F)		
		Kheldi birdagaddiyan block forest	Adjoining	E
		Kawai kalan block forest	Adjoining	SSE
		Dara block forest	Adjoining	W
		Bir daranimoda block (R.F.)	Adjoining	N
		Kawai block forest	0.12	W
		Bir sunda umriwala block (R.F.)	0.4	E
		Baldevpura block	0.55	N
		Chhatarpura block forest	0.85	WNW
		Bir parlya block forest	3	WSW
		Ratan block forest	3.1	NNW
		Dilod block (P.F.)	3.2	N
		Narsinghpura (P.F.)	3.2	ENE
		Ugrapura (P.F.)	6.3	WSW
		Bir govindpura block	7.8	NNW
		Sigri block (P.F.)	7.9	N
		Rivers, Nala, Water Bodies		
		Particulars	**Distance (in km)**	**Direction**
		Lhasi nadi	0.35	SSE
		Andheri nadi	0.55	E
		Rhupsi nala	5	WSW
		Kukar talav	6.9	WSW
		Ghoghra nala	7.5	W
		Prabati canal	7.7	NNW

S. No.	Particular	Particulars with Aerial distance & Direction
3.	Areas used by protected, important or sensitive species of flora or fauna for breeding, nesting, foraging, resting, over wintering, migration.	None in 10 km radius
4.	Inland, coastal, marine or underground waters.	List of water bodies within the 10 km radius is given above.
5.	State, National boundaries	Rajasthan-Madhya Pradesh inter-state boundary at a distance of about 7.5 km in East direction.
6.	Nearest highway/major road/routes or facilities used by the public for access to recreation or other tourist, pilgrim areas	See table below (item 6)
7.	Défense installations	None in 10 km radius
8.	Densely populated or built-up area / Major Town	There is no densely populated habitation that exists near the proposed site. Atru town is located about 4.10 km in the NNW direction.
9.	Nearest habitation	See table below (item 9)
10.	Major industries / manufacturing units	None in 10 km radius
10.	Areas occupied by sensitive man-made land uses *(hospitals, schools, places of worship, community facilities)*	See table below (item 10)

Item 6:

Particulars	Distance (in km)	Direction
SH 37A	0.2	West
SH51	1.0	SW
MDR 4	4.9	NW

**Source: Distance taken from Google earth imagery.*

Item 9:

Habitation /Village	Distance (Km)	Direction
Kawai	1.0	SW
Phulbaroda	1.4	ESE
Bilkhera	2.0	E
Barlan	2.0	WSW

**Source: - Distance taken from Google earth imagery.*

Item 10:

Particulars	Distance (in km)	Direction
Education Facilities		
Government primary school Atru,	4.0	NW
Govt. Sr. Sec. School, Atru	5.6	NW
Govt. upper primary school Barawda	8.2	WSW
Govt. School Nayagav	2.8	E
Worship Places		
Hindu temple, Kawai	1.1	SW
Radhe krishna mandir, Kawai	0.9	WSW
Narbadeshvar mahadev, Kawai	0.3	W
Hanuman mandir, Dilod	4.6	ENE
Health Facilities		
Govt. Hospital Atru	5.4	NW

S. No.	Particular	Particulars with Aerial distance & Direction		
		Govt. Hospital, Kolukhera	1.8	ENE
		Govt. Hospital Kawai	0.9	WSW
		**Source: - Distance taken from Google earth imagery*		
16.	Areas already subjected to pollution or environmental damage.	The project area of APL does not comes under any CPCB declared Critically or Severely Polluted Areas.		
17.	Areas susceptible to natural hazard which could cause the project to present environmental problems.	The project falls in Baran district of Rajasthan. The entire Baran District of Rajasthan falls under Seismic Zone II, low damage risk zone as per BMTPC, Vulnerability atlas Seismic Zone of India IS: 1893-2002.		
Site Connectivity ***(aerial distance as per google earth imagery from project boundary and direction from centre of project)***				
S. No.	**Description**	**Details**		
1.	Nearest Highway / Major Road	**Particulars**	**Distance (in km)**	**Direction**
		SH 37A	0.2	West
		SH51	1.0	SW
		MDR 4	4.9	NW
		**Source:-All distances are taken with respect to S.O.I. Toposheet*		
2.	Nearest Railway Station	**Particulars**	**Distance (in km)**	**Direction**
		Salpura Railway Station on Katni-Bina line	Adjacent to the plant boundary	SW
3.	Nearest Airport	**Particulars**	**Distance (in km)**	**Direction**
		Jaipur International Airport	238	NNE

11.2.1 Process & Methodology

The proposed expansion project of 4x800 MW capacity power plant is mooted to deploy the state-of-art technology and accordingly four units of 800 MW are being considered with ultra-supercritical steam parameters to attain high cycle efficiency.

MAIN TECHNICAL FEATURES OF THE PROPOSAL

Power Generating Unit	:	Four units of 800 MW turbine generator sets fed by steam from coal fired P.F. boiler operating at Ultra Super-Critical range.
Cooling System	:	Closed recirculating condenser cooling system with induced draft cooling tower.
Coal Handling System	:	Coal handling facility, which comprises receipt of coal through Indian Railway, with in-plant coal handling system and finally feeding the bunker level conveyors.

Ash Disposal System	:	The Fly Ash will be collected in dry form in silos for all efforts will be made for 100% utilization of ash. Ash will be used for Cement manufacturing industries, abandoned mine, filling of low-lying area, manufacturing bricks, road construction, aggregate placement in concrete, etc. in compliance of Fly Ash Notification, 31.12.2021 and amendments. Provision will be made for disposal of un-utilized ash in high concentration slurry form to ash dyke.
Power Evacuation	:	At 400 kV level to State Transmission Unit (STU) or Central Transmission Utility (CTU)
Environmental Aspects	:	Elaborate arrangements for adequately designed electrostatic precipitator with more than 99.99% efficiency and Selective Catalytic Reduction (SCR)/SOFA systems complying with emission norms as per latest MoEF&CC are envisaged. Wastewater quality to be maintained as per MoEF&CC notification. Zero Plant Discharge facility shall be present since the cooling water, blow down water, wastewater and ash water would be recycled back to the system for Ash Handling after suitable treatment for reuse.

11.2.2 Ash Handling System

For each unit, Bottom ash will be collected in wet form; while fly ash will be collected in dry form to facilitate utilization. Fly ash and bottom ash shall be disposed via lean slurry /High Concentration Slurry disposal (HCSD/MCSD) system to Ash dyke in case of exigencies; Ash extraction system is unitized basis and ash disposal systems will be common for 4x800MW. Provision for truck disposal of both bottom and fly ash is provided.

For the design of the Ash Handling System, the following data has been considered for each Unit. Necessary design margin shall be considered while selecting the equipment capacity.

Table 11.3: Quantum of Ash Generation

Parameter	4x800MW
Hourly coal (3,200-4300 kCal/kg GCV) firing rate at TMCR condition based on 85% PLF, per Unit (Approx.)	368.15 TPH
Total ash content	40%
Bottom ash (BA + Eco. Ash) generation @ 20% (T/day)	2,828
Fly ash (ESP + APH Ash) generation @ 80% (T/day)	11,308
Total Ash generation (T/day)	14,136
Annual ash generation @ 85% PLF (MMTPA)	5.16

An MoU has been signed between APL and Ashtech (India) Private Limited, Mumbai, India for utilization of Fly ash for the proposed project.

11.3 DESCRIPTION OF THE ENVIRONMENT

The baseline environmental quality of air, water, soil, noise, socio-economic status, and ecology has been assessed during the period of October to December 2024 in the study area of project site.

11.3.1 Baseline data

Ambient air quality:

Eleven ambient air quality monitoring stations were selected in and around the project site. The results of the monitored data indicate that the ambient air quality were well within the prescribed limits by CPCB.

- PM10: The maximum value for PM10 was 69.5 µg/m3 and minimum value for PM10 was 42.5 µg/m3.
- PM2.5: The maximum value for PM2.5 was 48.3 µg/m3 and minimum value for PM2.5 was 24.2 µg/m3.
- SO2: The maximum value for SO2 was 10.9 µg/m3 and minimum value for SO2 was 2.1 µg/m3.
- NOx: The maximum value for NOx was 23.8 µg/m3 and minimum value for was 5.9 µg/m3.
- CO: The maximum value for CO was 0.9 mg/m3 and minimum value for CO was 0.3 mg/m3.
- Hg: Mercury levels were below detection limit at all the locations.

Water quality:

The baseline water quality status in the region is established by analyzing samples at nineteen locations consisting of eight ground water samples and seven surface water samples. It was found that both ground water and surface water quality is well within prescribed limits.

Results

Ground Water

Parameters	:	Results

PH	:	7.65 to 7.76
TDS	:	1038 mg/l – 1214 mg/l
Total Hardness	:	408 mg/l –477 mg/l
Total Alkalinity	:	160 mg/l –176 mg/ l

Surface Water

Parameters	:	Results
PH	:	6.78 to 7.11
DO	:	5.2 mg/l – 6 mg/l
BOD	:	2 mg/l -4 mg/l
COD	:	6 mg/l – 12mg/l

Noise levels:

The observed noise levels adhere to CPCB standards, indicating acceptable noise pollution levels in the monitored locations.

Daytime Noise Level Leq(day)

Day time (Leqday) noise level is observed within the prescribed limit and standards.

Night time noise level Leq(night)

Night time (Leq night) noise level is observed within the prescribed limit and standards.

Soil Quality:

Samples collected from identified locations indicate that the soil is slightly alkaline with pH ranging from 7.41 to 7.65. The organic matter in the soil ranged from 0.73 % to 0.94%. The texture of soil observed in the study area is mostly sand.

Parameters	:	Results
PH	:	7.41 to 7.65 (Slightly alkaline)
Organic Carbon	:	0.73 % to 0.94%
NPK	:	10.4 to 12.6 mg/kg 10.8 to 14.8 mg/kg 160 to 210 mg/kg

Biological environment:

Core Zone: Flora:

Flora:

Core zone has been reported 22 trees, 9 shrubs, 14 Common Herb, Grasses and Climbers' species were found in core zone during field survey.

Fauna:

2 Mammalian species, 19 avifaunal, 2 herpetofauna, 3 butterflies, were observed.

Buffer zone:

Flora:

Buffer zone of the project area has been reported 110 trees, 42 shrubs & herbs, 13 Grasses, 12 climbers & 24 medicinal species.

11 agricultural species, 9 vegetable species & 10 fruits species were found in buffer zone during field survey.

About 13 aquatic flora, 13 phytoplankton species were reported.

Fauna:

17 Mammalian species, 141 Birds, 14 Herpetofauna, 18 butterflies', 15 moths and 09 aquatic species were observed in the 10 km buffer study area of the project.

Socio-Economic Environment:

Total population

In the study area, there are 20,014 households. The total population falling in the project area is 1,01,964 in 10 km radius. The total male population consists of 51.89% and female population accounts to be 48.11% of the total population. The sex ratio of the 10.0 km study area is 927 females over thousand males. There are approx 4 to 5 members in a family. The 0-6 population comprises of 14.82% of the total population of the study area. The sex ratio of 0-6 population is 898 females over thousand males. Fig. 3.30 shows the sex ratio of total population.

Literacy

Persons aged seven years and above, who can both read and write with understanding in any language, are considered literate. In the study area, the literate people are 1,03,634 which is 57.80% of the total population. The male literates are 69.49% of the total male population, and female literates are 45.18 % of the total female population.

In the study area, the illiterate people are 75,670 which is 42.20 % of the total population. The male illiterates are 30.50% of the total male population, and female literates are 54.81% of the total female population. Fig. 3.3 literates & illiterates within 10.0 km of the study area.

Working population

The work participation in the study area is 84,002 which accounts to be 46.85 % of the total population. The male work participation is 52.17 % with respect to male population and female work participation accounts to be 41.11 % with respect to female population in the study area. Fig. 3.3 shows the Total work participation population over the total population.

11.4 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

During Construction Phase:

No significant impact is envisaged on the soil quality of the project area. Construction activities would be confined to the plant boundary. Therefore, no impact on the soil quality of the study area located beyond the plant boundary has been envisaged.

During Operational Phase:

11.4.1 Air Environment

PM from boilers will be controlled by the installation of ESP Dust suppression and bag filters for the coal handling systems will control PM emissions. De-NOx systems shall be provided to effectively control emission levels. Ash silos will be provided for collection of fly ash in dry form for further transportation to utilities.

Mitigation measures

APL, Kawai will comply as per the norms of MoEFCC, CPCB/SPCB standards for SO2, Nox & PM. Electrostatic Precipitator (ESP), De NOx system of SCR/ SOFA with low NOx burner, adequate Stack height is proposed with these controls, Hg emission is expected to be brought below the emission limits as measured in various other TPPs in India.

Necessary dust suppression arrangement and bag filters will be used in railway siding and coal handling plant. The top surface of coal wagons will be adequately sprinkled to reduce fugitive emissions during transportation. Belt conveyors will be covered to minimize the fugitive dust emissions. Auxiliary fuel transportation will be occasional; hence its impact will be for a limited time period. The fly ash silos will be provided with bag filters to control emission. Regular housekeeping will be done at plant roads, platforms, and storage area.

11.4.2 Water Environment

Total wastewater from the project will be recycled, focusing on effluents from CW blowdown, WT plant, coal pile area runoff, and plant drains. Domestic sewage will be treated in the STP will be utilized in greenbelt/ plantation. Total Annual Recharge to Ground Water Regime of the area through rainwater harvesting structure would be **1,349,537.04 m^3/ annum**. No groundwater extraction, ensuring minimal impact on water resources.

The water requirement of 56 MCM/Year for makeup to the closed cycle re-circulation system of condenser cooling will be drawn from Parwan River/ Dam to plant site through existing water pipeline of about 18.4 km in length. The water drawl permission from WRD Jaipur, Rajasthan for 34 MCM/Year vide letter no. CEWR/TA (W)/1482 dated 11.08.2009 has already been obtained for 2x660 MW TPP. The application for additional water allocation of 56 MCM /annum has been submitted on 03.06.2024 to WRD, Jaipur (R.J) and will be obtained. It is proposed to utilise the power plant wastewater for plant reuse to achieve the Zero Liquid Discharge (ZLD) concept. It is envisaged to utilize cooling water blow down for ash handling purposes and treated wastewater will be used for plantation and gardening activities.

11.4.3 Noise Environment

- Noise reduction measures include insulation, damping pads, and acoustic enclosures.
- Regular equipment maintenance and safety gear for workers will be provided.
- Noise levels will comply with regulations, not exceeding 75 dB (A) at 1 m distance.
- Extensive oiling, lubrication, and preventive maintenance will minimize noise generation.
- Earplugs will be provided in areas where noise levels may exceed permissible limits.
- Supervisors will ensure machinery conditions and silencers are maintained.
- Adequate greenbelt will be developed within the project premises and around the plant boundary.

11.4.4 Socio-Economic Environment

The company will take various steps for social & environmental development for the villagers in more then one ways. The details of the various activities undertakto be taken by the company's CSR activities are described in detail in Chapter 8 of "Project Benefits" of the report. The company will continue to work for development of the society in future also. The additional economic opportunities for local population will create a long term positive impact in the society. Project also does not involve discharge of any pollutant and follows zero discharge, thus the environment will not be negatively impacted. All due care will also be taken to manage the odour as per present practices and the same will be improved to match the best industry practices.

11.4.5 Solid & Hazardous Waste

- Fly ash and bottom ash will be main solid waste to be generated from the plant. The details of the ash generated from the proposed power plant are given in Table 4.16. 100% utilization of fly ash as per MoEF&CC guidelines is proposed.
- The bottom ash will be collected in wet form and fly ash in dry form. Fly ash will be collected in dry form to facilitate utilization.
- Ash Dyke is proposed in 57.06 Ha, which is less than **0.1 Ha./MW** (i.e 320 Ha. for 3200 MW) allowed as per Fly Ash Notification dated 31.12.2021.
- Unutilized Fly ash and bottom ash shall be disposed via High Concentration Slurry disposal (HCSD/MCSD) system to Ash dyke in case of exigencies.

- Bottom ash generated shall be supplied to the Road Mix Concrete (RMC) / brick producers / filling of low lying area / filling of mine voids as per the statutory guidelines thereby eliminating the need for separate area shall be explored.

Table 11.5: Ash generation from the Proposed Plant

S. No.	Description	Ash quantity in Million TPA	Management & disposal
1.	Fly ash	4.12	Collection in dry form, pneumatic transfer to closed silos & sent to cement manufacturing, Construction work (RMC plant, Roads, Highways), Brick Manufacturing, etc.
2.	Bottom ash	1.04	Collection in wet form & Road Mix Concrete (RMC) / brick producers / filling of low lying area / filling of mine voids
Unutilized Fly ash and bottom ash shall be disposed via High Concentration Slurry disposal (HCSD/MCSD) system to Ash dyke in case of exigencies.			

IMPACT

- Improper storage, handling and disposal of solid & hazardous waste leads to contamination of soil, ground water and surface water.
- Contamination may also be caused by spillage of hazardous waste, run-off from hazardous waste storage area etc.
- Plants may take up contaminants from soil and accumulate toxic substances ultimately adversely affecting human / animal health due to ingestion.

Hazardous Waste

- Hazardous waste will be handled, stored & disposed off in line with Hazardous & Other waster (management & transboundary movement) Rules 2016, amended till date.
- Separate covered storage area with impervious flooring and catch drains connecting to WTP will be provided with Hazardous waste storage area.
- E-Waste (~2.0 TPA), Battery waste (~3 TPA), Bio-medical waste (0.02 TPA) will be handled, stored & disposed of as per applicable rules & guidelines.
- Used batteries will be will be given back to the supplier under buy back agreement with supplier.

- Bio-medical waste generated from medical unit will be handed over to nearest CBWTF &/or hospital having BMW disposal agreement with CBWTF.

Municipal Solid waste generation & management

Improper disposal of MSW may cause contamination of soil, ground water and surface water over time. It may lead to odour nuisance as well as increased disease vectors in the area.

Table 11.6: Municipal Solid waste generation & disposal

Particulars	Population	Basis	Quantity of waste generated (in kg/day)
Workers	2700	@0.3 kg/day	810.0
Landscaping	714.91 acre	@0.2kg/acre/day	143.0
STP sludge (dry)	--	--	50
Total			**1003**

MSW generated to the tune of ~1.0 TPD will be collected, segregated at source itself using color coded bin collection system placed strategically in the plant premises.

The organic component of MSW will be segregated and composted in Organic waste converters proposed at site. The remaining waste will be handed over to contractor for final disposal to municipal waste dump site.

11.5 ANALYSIS OF ALTERNATE SITE & TECHNOLOGY

The proposed expansion is proposed in an area of 470.70 Ha adjacent to the existing Thermal Power Plant with area admeasuring 350 Ha. The total area of Thermal Power plant after expansion will be 820.70 Ha. The Forest Area outside plant boundary (1.758 Ha.) is involved in the Coal Convey System for Proposed Project. Since the expansion is proposed of the already operational Kawai Thermal Power Plant in Village Kawai, Tehsil Atru, District Baran, Rajasthan, no alternative sites have been examined for the Thermal

Power Plant. However, alternative route analysis has been carried out for proposed Coal Conveyor Belt route to transfer coal from coal handling plant to BTG area.

Ultra Super Critical thermal power plants combine high efficiency, reduced emissions, and operational flexibility, making them a compelling choice for large-scale power generation projects aiming for both economic and environmental sustainability.

11.6 ENVIRONMENTAL MONITORING PROGRAMME

Environmental Management Division

Monitoring is as important as that of control of pollution since the efficiency of control measures can only be determined by monitoring. The following routine monitoring program will be implemented under the post-project monitoring as per CECB/CPCB guidelines. The major environmental considerations involved in the construction and operation of the thermal power station will be taken up by a full-fledged multi-disciplinary Environmental Management Division (EMD) with key functions of environmental, safety and occupational health for management of the entire plant and surrounding environment. It is predicted that socio-economic impact due to the proposed expansion project will positively increase the employment opportunities for local inhabitants. The project infrastructure will be of use to the people of the area. The contribution to the revenue of the State Govt. will be put in public welfare and augmented growth. The entire project area is devoid of any endangered flora and fauna. Thus, the proposed project is not likely to affect the environment or adjacent staff etc. This EMD will take up additional responsibility of environmental functions related to proposed mega power plant.

Operation Head would represent the Company's interest in the operation & maintenance of the power station and would oversee the functioning of O&M Cell.

Green Belt:-

The greenbelt development will be as per the CPCB guidelines with re-densification of existing greenbelt.

EMP costing

The heads for EMP are: Electrostatic Precipitator, Chimney/Stack, Cooling Tower including civil works, Ash Handling including ash water recirculation, Ash disposal civil work, Dust extraction & suppression system, DM Plant Waste Treatment System, Sewerage collection, treatment & disposal, Green Belt & landscaping, SCR/SOFA, Rainwater harvesting, Solar power harnessing, Enhancing Environmental Laboratory & Environmental Monitoring, CEMS, CAAQMS, EQMS monitoring system & Main gate display board and Wind Breaking Wall, Dry Fog System & RCC Flooring in Coal Storage Area.

A cost provision of Rs. 5,992.94 Cr. has been earmarked towards environmental measures.

11.7 ADDITIONAL STUDIES

Risk Assessment, Hazard Analysis: Risk associated with process and raw materials (LDO/HSD) was anticipated and proper mitigation measures provided.

Hazard due to toxic release of Chlorine and Aqueous Ammonia has been assessed with the help of ALOHA software and the threat zone marked on google earth.

Within the plant: Personnel working in the plant during the operational phase.

Outside the plant: There are no major habitation within 1.0 km of project site.

However, by implementing all the possible risk mitigation measures the same could be minimized

Disaster Management Plan: On Site & Offsite Emergency Plan with level I, II and III emergency has been prepared and detailed in chapter 7 of this EIA/ EMP report.

11.8 PROJECT BENEFITS

Adani Foundation is the CSR arm of Adani Group of companies implementing CSR projects and activities at different locations in India. A separate budget Rs 66 crore towards CER activities (as per Ministry's OM dated 01.05.2018) is allocated for CER activities, and efforts will be made to address concerns raised after the public consultation during the final EIA ensuring responsible corporate practices.

11.9 CONCLUSIONS

It is predicted that socio-economic impact due to the proposed expansion project will positively increase the employment opportunities for local inhabitants. The proposed expansion project will be within the existing plant premises. The project infrastructure will be of use to the people of the area. The contribution to the revenue of the State Govt. will be put in public welfare and augmented growth. The entire project area is devoid of any endangered flora and fauna. Thus, the proposed expansion project is not likely to affect the environment or adjacent ecosystem adversely.

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CHAPTER: XII

DISCLOSURE OF CONSULTANT ENGAGED

Declaration by Experts contributing to the Project: **Proposed Expansion of Kawai Thermal Power Plant under Phase–II by adding 3200 (4x800) MW Ultra Super Critical Thermal Power Plant to Existing 1320 (2x660) MW at Village Kawai, Tehsil Atru, District Baran, Rajasthan.**

Applicant: **Adani Power Limited (APL)**

Disclosure of Consultants Engaged

<table>
<tr><th colspan="4">Name of the Project: Proposed Expansion of Kawai Thermal Power Plant under Phase–II by adding 3200 (4x800) MW Ultra Super Critical Thermal Power Plant to Existing 1320 (2x660) MW at Village Kawai, Tehsil Atru, District Baran, Rajasthan</th></tr>
<tr><th colspan="2">Nature of consultancy</th><th>Name and address of the Consultant/expert/Agency</th><th>Approvals, if any from (NABL/DGMS/IBM/NRBPT/ MOEF/CPCB/others etc) *, give reference</th></tr>
<tr><td colspan="2">EIA/ EMP Organization</td><td>Gaurang Environmental Solutions Pvt. Ltd. (GESPL) #102, SNG, Shri Ratna Apartment, Peetal factory, Bani Park, Jhotwara road, Jaipur-302016
Ph:0141-4029115
E-mail:gaurangenviro@gmail.com</td><td rowspan="5">Accreditation Certificate No.-NABET/EIA/23-26/RA 0338 dated 16.07.2024 valid upto 07.12.2026.</td></tr>
<tr><td rowspan="4"></td><td>Env. Coordinator</td><td>Dr. Ratna Kumar Mudliar</td></tr>
<tr><td>FAE-LU</td><td>Vinod Kumar Verma</td></tr>
<tr><td>FAE-AP</td><td>Dr. Sanjay Palnitkar (FAE Cat. A)</td></tr>
<tr><td>FAE-AQ</td><td>Jayesh Y Makwana
Ginni Barotia-TM</td></tr>
</table>

	FAE-WP	Vipul Khandelwal Pooja Yadav	
	FAE-EB	Mr. Abhishek Gautam Mahendra Singh-TM	
	FAE-NV	S. Chandrasekhar Babu	
	FAE-SE	Gajendra Singh Rathore	
	FAE-HG	Mukesh Suroliya	
	FAE-RH	Dr. Sanjay Palnitkar (FAE Cat. A) Ginni Barotia (FAE Cat. B)	
	FAE-SHW	Dr. Ratna Kumar Mudliar (FAE Cat. A) Ginni Barotia (FAE Cat. B)	
	FAE-GEO	Mukesh Suroliya	
	FAE-SC	Dr. Ratna Kumar Mudliar	
Environmental Monitoring & analysis		Newcon Consultants & Laboratories, Uttar Pradesh.	
Hydro geological study		Mukesh Suroliya Shivam Joshi	
Rainwater Harvesting		Mukesh Suroliya	

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Chapter: XIII

Cumulative Assessment Study

13.1 INTRODUCTION

In this chapter, the proposed industries within a 10 km radius are identified and a Cumulative Study is done for the industries, existing and proposed, to check whether the proposed industries can be allowed over and above the existing industries as per Specific Terms of Reference for (Thermal Power Plants) condition no. 2.24: *"A Cumulative Environmental Impact Assessment study of all the existing and proposed projects in the 10-km radius of the proposed project shall be conducted and the same shall be included the in EIA/EMP report. Details of industrial units present in 10 Km radius of the power plant shall be submitted.* Details of industrial units present in 10 Km radius of the power plant shall be submitted."

Cumulative impacts occur when a Project activity acts together with other projects or third-party activities to impact the same environmental or social resource or receptor. The cumulative impact is defined as impacts that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted. Significant cumulative impacts can result from individually minor but collectively major actions taking place over a period of time

Cumulative Impact Assessment (CIA) is an approach to environmental impact assessment (EIA) that aims to consider the effects of multiple actions or impacts on the environment of proposed and ongoing activities located within a given area. CIAs are conducted across the actual and potential impacts of several activities or projects that may combine over time and/or space with appropriate limitations by reference to the action being assessed and its foreseeable impacts.[1]

Unlike an Environmental and Social Impact Assessment (ESIA), a Cumulative Impact Assessment (CIA) focuses on Valued Environmental and Social Components (VECs) as receptors of impacts from different projects and activities and not on a project as a generator of impacts on various environmental and social receptors. While VECs may be directly or indirectly affected by a specific development, they often are also affected by the cumulative effects of several developments. VECs are the ultimate recipient of impacts because they tend to be at the ends of ecological pathways.

To be included in this CIA, an environmental and social component must first be demonstrated to be valued by some identifiable stakeholder group, be it the scientific community or any group of national, regional and local stakeholders. Second, the VEC must be reasonably expected to be affected by both the projects under evaluation (here, the Power Plant) and some combination of Other Projects and External Drivers.

[1] *Cumulative Environmental Impact Assessment Industry Guide, Mineral Council of Australia, July 2015.*

Figure 13-1: Difference in ESIA & CIA

Source: ifc.org

Other projects: The APL, Kawai Thermal power plant coming up in Village Kawai, Tehsil Atru, District Baran, Rajasthan has mostly rural surroundings. There are no major industries in the 10 km radius area. Some stone quarries are scattered in the study area, however, carrying out cumulative assessment considering these is limiting due to non-availability of data sets. Hence cumulative impact assessment has not been carried out.

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File No: J-13012/154/2008-IA.II (T)
Government of India
Ministry of Environment, Forest and Climate Change
IA Division
***

Dated **29/07/2024**

To,

Sh. Santosh Kumar Singh
Adani Power Ltd.
Adani House, Nr Mithakhali Circle Navrangpura, Ahmedabad. Pin- 380009. Adani House, Nr Mithakhali Circle Navrangpura, Ahmedabad. Pin- 380009., Ahmedabad , AHMADABAD, GUJARAT, ACH, Shantigram, Vaishnaodevi Circle, SG Highway, 382421
E-mail: santosh.singh1@adani.com

Subject: **Expansion of Kawai Thermal Plant under Phase – II by adding 3200 (4x800) MW Ultra Super Critical Thermal Power Plant to existing 1320 (2x660) MW located at village-Kawai, Tehsil-Atru, District-Baran, State-Rajasthan by M/s Adani Power Limited. – Grant of Terms of Reference - regarding**

Sir/Madam,

This is with reference to your online application number IA/RJ/THE/467570/2024 dated 13/04/2024 submitted to the Ministry for Grant of Terms of Reference for the proposed project Expansion of Kawai Thermal Power Plant under Phase–II by adding 3200 (4x800) MW Ultra Super Critical Thermal Power Plant to Existing 1320 (2x660) MW at Village Kawai, Tehsil Atru, District Baran, Rajasthan by Adani Power Limited, Kawai, under the provision of the EIA Notification 2006

2. The particulars of the proposal are as below :

(i) TOR Identification No.	TO24A0601RJ5203867N
(ii) File No.	J-13012/154/2008-IA.II (T)
(iii) Clearance Type	TOR
(iv) Category	A
(v) Project/Activity Included Schedule No.	1(d) Thermal Power Plants
(vi) Sector	Thermal Projects
(vii) Name of Project	Proposed Expansion of Kawai Thermal Power Plant under Phase–II by adding 3200 (4x800) MW Ultra Super Critical Thermal Power Plant to Existing 1320 (2x660) MW at Village Kawai, Tehsil Atru, District Baran, Rajasthan by Adani

	Power Limited, Kawai
(viii) Name of Company/Organization	M/s Adani Power Ltd.
(ix) Location of Project (District, State)	BARAN, RAJASTHAN
(x) Issuing Authority	MoEF&CC
(xii) Applicability of General Conditions	no
(xiii) Applicability of Specific Conditions	no

3. M/s Adani Power Limited has made an application online vide proposal no IA/RJ/THE/467570/2024 dated 13.04.2024 in the prescribed format (Form-I) and submitted a pre-feasibility report for undertaking a detailed EIA study as per the EIA Notification, 2006 for grant of Terms of Reference (ToR) to the proposed project Expansion of Kawai Thermal Plant under Phase – II by adding 3200 (4x800) MW Ultra Super Critical Thermal Power Plant to existing 1320 (2x660) MW located at village-Kawai, Tehsil-Atru, District-Baran, State-Rajasthan.

4. The project/activity is covered under category A of item 1(d) 'Thermal Power Plants' of the Schedule to the Environmental Impact Assessment (EIA) Notification, 2006, as amended as the power generation capacity of proposed expansion is beyond the threshold capacity of 500MW i.e. 4x800 MW and requires appraisal at Central level.

5. The instant proposal was earlier considered by EAC in its 9th meeting held on 07.05.2024, wherein the proposal was deferred for the want of requisite information. The PP has submitted the ADS reply vide letter dated 13.06.2024. The Proposal was further considered in the 11th EAC (Thermal) meeting held on 27-28th June 2024. The minutes of the meeting and all the project documents are available on PARIVESH portal which can be accessed at https://parivesh.nic.in.

Details submitted by the project proponent

i. APL, Kawai proposes to set up an Ultra Super-Critical Thermal Power Project, under Phase-II expansion, with configuration of four units of 800 MW each deploying the state-of-the-art technology in the field, to have an installed capacity of 3200 MW. The proposed project is envisaged as an expansion of the existing 1320 (2x660) MW capacity catering total capacity of 4520 MW.

ii. The Ministry had issued EC earlier vide letter no. J-13012/154/2008-IA.II(T) dated 04.05.2011 to the existing project i.e. 1320 (2x660) MW Coal based thermal power plant situated at village Kawai, in Atru the existing Taluk, in Baran District in Rajasthan in favour of M/s. Adani Power Rajasthan Limited (APRL) and subsequently, EC amendment was granted on 13.03.2014 and EC was transferred from Adani Power Rajasthan Limited (APRL) to Adani Power Limited (APL, Kawai) on 24.04.2023 by MoEF&CC.

iii. Subsequently, Consent to Operate (CTO) for operation 1320 (2x660) MW issued with validity up to 28.02.2029 from Rajasthan State Pollution Control Board (RSPCB), Jaipur, Rajasthan. APL, Kawai (2x660) MW units are operational Unit-1 from 31.05.2013 and Unit – 2 from 31.12.2013.

iv. The salient features of the project are as under: -

• EAC Meeting Details:

Date of earlier EAC meetings	9^{th} EAC Meeting held on 07^{th} May'2024 Fresh ToR of Proposed Expansion of Kawai TPP

• Category details:

Category of the project	A
Capacity	**3200 (4x800) MW** (expansion of TPP under Phase - II)
Attracts the General Conditions (Yes/No)	No
Additional information (if any)	-

• Project details:

Location of TPP Village : Taluk : District : State : Co-ordinates of all four corners: a) TPP site; b) Ash pond site; c) township etc. Average height of (a) TPP site, (b) ash pond site etc above MSL (m)	Kawai Atru Baran Rajasthan Site Coordinates of TPP including Ash Pond, Township etc. **Latitude** / **Longitude** 24°48'49.45" / 76°43'52.90" 24°49'52.57" / 76°43'13.78" 24°49'18.09" / 76°43'9.64" 24°50'16.91" / 76°42'16.70" 24°50'17.26" / 76°41'49.49" 24°48'52.21" / 76°42'36.87" 24°48'12.53" / 76°43'23.90" 24°48'7.23" / 76°43'44.16" 24°47'20.05" / 76°43'34.43" 24°47'17.07" / 76°43'58.42" 24°47'2.40" / 76°44'42.01" 24°45'43.52 / 76°44'29.90" a) 309 m above MSL. b) 310 m above MSL. The average altitude of site is ranging 308m to 313m above MSL.
Accredited Consultant and certificate no.	Gaurang Environmental Solutions Pvt. Ltd. NABET Accreditation No.: NABET / EIA / 2023/SA0203
Inter- state issue involved	Yes Rajasthan-Madhya Pradesh inter-state boundary at about 7.5 km in East direction
Seismic zone	Zone-II as per IS 1893.

• Land Area Breakup:

Land Requirement: a) TPP Site b) Ash Pond c) Township d) Railway Siding/Coal conveyor belt & Others e) Raw Water Reservoir f) Green Belt g) others Total (if expansion state additional land requirement)	**822.541** (*Includes 1.8414 Ha. Forest Area outside power plant area for proposed Coal Conveyor*) 208 117.06 30 1.8414 (*Forest Area outside power plant area for proposed Coal Conveyor)* 65 289.44 111.2 (105.2+6) 822.541 ha (Existing-350+ Proposed 470.7)
Status of Land Acquisition:	For proposed expansion, land is already under possession with Adani Power Limited.
Status of the project: If under construction phase: please specify the reasons for delay, works completed till date and balance works along with expected date of completion. If under operation phase, date of commissioning (COD) of each unit. Whether the plant was under shutdown since commissioning, details and reasons.	**Phase-I:** 1320 (2x660) MW is commissioned and operational. **Phase-II:** Proposed Expansion of Kawai Thermal Power Plant by addition of 3200 (4x800) MW Ultra Super Critical Thermal Power Plant.
Break-Up of land-use of TPP site:	**Total Project Land:822.541 ha**

a. Total land required for project components. b. Private land c. Government land Forest Land	· Private Land: 820.7 ha · Forest Land: 1.8414 ha (Forest Land is *Outside power plant area for proposed Coal Conveyor* - [FC Proposal No. FP/RJ/OTHERS/467838/2024]
Whether the project is in the Critically Polluted Area (CPA) or within 10 km of CPA. If so, the details thereof:	No, the district doesn't fall under CPA.
CRZ Clearance	Not Applicable
Whether the project is in the Critically Polluted Area (CPA)/Severally Polluted Area (SPA) or within 10 km of CPA. If so, the details thereof:	No, the district doesn't fall under CPA.

• Presence of Environmentally Sensitive areas in the study area:

Forest Land/ Protected Area/ Environmental Sensitivity Zone	**Yes/No**	**Details of Certificate/letter/Remarks**
Reserve Forest/Protected Forest Land	Yes	RF (Kheldi Birdaggiyan) is Adjacent to Plant Boundary. PF (Dense Mixed Jungle) is about 0.23 km in SE direction. No National Park, Sanctuary, Elephant/Tiger Reserve, or migratory routes/wildlife corridor exists within 15 km of the power station.
National Park	No	
Wildlife Sanctuary	No	
Archaeological sites monuments/historical temples etc	No	
Names & distance of National parks, Wildlife sanctuaries, Biosphere reserves, Heritage sites Rivers, Tanks, Reserve Forests etc. Located within 10 Km from the plant boundary:	No	
Availability of Schedule-I species in study area	No	-
Additional information (if any)	-	-

• Project description:

If expansion, the details of ECs (including amendments and extension of validity) of existing Units etc.	Environmental Clearance (EC) was granted by MoEFCC, New Delhi vide File no. J-13012/154/2008-IA.II(T) dated 04.05.2011 to Kawai Thermal Power Plant at Baran District, Rajasthan. Subsequently, EC amendment was granted on 13.03.2014 and EC was transferred from Adani Power Rajasthan Limited (APRL) to Adani Power Limited (APL, Kawai) on 24.04.2023 by MoEFCC.
Chronology of the Project	· APL, Kawai owns and operates 1320 (2x660) MW Coal based thermal power plant situated at village Kawai, in Atru the existing Taluk, in Baran District in Rajasthan. · Environmental Clearance (EC) was granted by MoEFCC, New Delhi vide File no. J-13012/154/2008-IA.II(T) dated 04.05.2011 to Kawai Thermal Power Plant at Baran District, Rajasthan. Subsequently, EC amendment was granted on 13.03.2014 and EC was transferred from Adani Power Rajasthan Limited (APRL) to Adani Power Limited (APL, Kawai) on 24.04.2023 by MoEFCC. · Subsequently, Consent to Operate (CTO) for operation 1320 (2x660) MW issued with validity up to 28.02.2029 from Rajasthan State Pollution Control Board (RSPCB), Jaipur, Rajasthan. APL, Kawai (2x660) MW units are

<table>
<tr><td></td><td>operational Unit-1 from 31.05.2013 and Unit – 2 from 31.12.2013.</td></tr>
<tr><td>Amendments granted, if Yes details</td><td>EC amendment was granted on 13.03.2014</td></tr>
<tr><td>Expansion / Green Field (new):
(IPP / Merchant / Captive):</td><td>Expansion – 3200 (4x800) MW
(IPP)</td></tr>
<tr><td>If expansion, the date of latest monitoring done by the Regional Office (R.O) of MoEF&CC for compliance of the conditions stipulated in the environmental and CRZ clearances of the previous phases.</td><td>EC Certified by Integrated Regional Office of MoEFCC, Jaipur vide File No. IV/ENV/R/THE-44/821/2011 dated: 26.05.2013.</td></tr>
<tr><td>Specific webpage address where all EC related documents (including monitoring and compliance related reports/documents) of the specific project under consideration are/will be available. Also contact details of PP's officer responsible for updating this webpage/information.</td><td>https://www.adanipower.com/
&
https://parivesh.nic.in/</td></tr>
<tr><td>Co-ordinates of all four corners of TPP Site:</td><td>Site Coordinates of TPP including Ash Pond, Township etc.
<table>
<tr><th>Latitude</th><th>Longitude</th></tr>
<tr><td>24°48'49.45"</td><td>76°43'52.90"</td></tr>
<tr><td>24°49'52.57"</td><td>76°43'13.78"</td></tr>
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</table></td></tr>
<tr><td>Average height of:
(a) TPP site,
(b) ash pond site etc. above MSL</td><td>a. 309 m above MSL.
b. 310 m above MSL.
The average altitude of site is ranging 308m to 313m above MSL.</td></tr>
<tr><td>Cost of the Project (As per EC and revised):
Cost of the proposed activity in the amendment:</td><td>Rs. 7000 Cr.
Rs.36,600 Crores</td></tr>
<tr><td>Employment Potential for entire project/plant and employment potential for the proposed amendment (specify number of persons and quantitative information).</td><td>Employment during construction phase (4 x 800 MW) is estimated to be around 8000 Nos. (Direct employment approx. 500 Nos and approx. 7500 Nos Indirect). Employment required for operation of 4 x 800 MW Units in addition to existing O&M staff is estimated around Approx. 550 Nos Direct and 1500 Nos Indirect.</td></tr>
<tr><td>Benefits of the project (specify quantitative information)</td><td>The proposed expansion project will improve the power supply position in the state as well as in India, which is vital for economic growth as well as improving the quality of life.
· Infrastructure development.
· Direct & indirect employment opportunity.
· Revenue generation to central & state government.
· Trickledown effect of enhance profitability to the local populace.
· Skill development and capacity building like vocational training, income generation programmes and</td></tr>
</table>

	entrepreneurship development program · Awareness programme and community activities, like health camps, medical aides, family welfare camps, sanitization/ cleanliness awareness programme, immunization camp, sports & cultural activities, plantation, etc. · Awareness about water borne diseases and pandemic diseases etc. will be done to local villagers. · The project will also attract the high-income groups to invest in the region and thus bring about economic growth of the region.
Status of other statutory clearances	APL has already applied for Forest clearance/approval for Land Diversion of 1.8414 Ha
R&R details	Not applicable

• Details of fuel and Ash disposal:

Fuel to be used:	Coal and Auxiliary Fuel
Quantity of Fuel required per Annum:	For the Proposed Power Project of 3200 MW, the annual fuel requirement is estimated at about 12.9 MTPA at 85% plant load factor with Design Coal GCV of 3200-4300 KCal/kg. Auxiliary liquid fuels, viz. LDO/HSD requirement per annum is about 30000 kilo liters.
Coal Linkage / Coal Block: (If Block allotted, status of EC & FC of the Block)	Coal from Commercial Coal Mines (GCV 3200-4300 Kcal /Kg) – Jitpur Coal Mines (>1200 km), Rampia Coal Mines (>900 km) & Gondbahera Ujheni Coal Mines (>700 km) & e-auction.
Details of mode of transportation of coal from coal source to the plant premises along with distances	Coal shall be received from Mine to TPP through Rail.
Fly Ash Disposal System Proposed a. Ash Pond / Dyke: (Area, Location & Co-ordinates) Average height of area above MSL (m) Space left in ash dyke area	Fly ash will be collected in dry form for utilization, while bottom ash will be collected in wet form. There would be provision for dry disposal of fly ash from storage silos to closed tankers for utilization in cement industries, abandoned mine reclamation, road construction, aggregate replacement in concrete, for manufacturing bricks, etc. as per Fly Ash Notification, 31st December'2021 and amendments. Provision would be kept for HCSD disposal of both bottom and fly ash to ash pond in case of exigency. In this case, both bottom ash and fly ash will be disposed through HCSD system to the proposed ash dyke.
Quantity of a. Fly Ash to be generated. b. Bottom Ash to be generated:	6.2 MMTPA 16,057 T/day 4,014 T/day
Fly Ash Utilization percentage with details in last 5 years:	(MoU with Cement/Brick Manufactures/ Others) MoU for 100% Utilization of Ash will be provided along with EC application.
Stack Height (m) & Type of Flue	120 (m) (new) Bi Flue

• Water Requirement:

Source of Water:	Parwan River/Dam
Quantity of water requirement:	56 MCM

Distance of source of water from Plant:	18.4 Km (as proposed from existing intake water system.)
Whether barrage/ weir/ intake well/ jack well/ others proposed:	No. After engineering & re-evaluating the existing infrastructure facilities for water withdrawal for proposed expansion of 4x800 MW, the existing infrastructure will be adequate.
Mode of conveyance of water:	Pipeline
Status of water linkage:	WRD Permission
(If source is Sea water) Desalination Plant Capacity	Not Applicable
Mode / Management of Brine:	Not Applicable
Cooling system	Induced draft

• Court case details/violation:

Any litigation/ Court Case pertaining to the project	Regulatory & Non-regulatory Court Cases are under hearing & Consideration and reserved for judgement.
Is the proposal under any investigation? If so, details thereof.	No.
Any violation case pertaining to the project on following: i. The Environment Protection Act, 1986 ii. The Forest (Conservation) Act, 1980. iii. The Wild Life (Protection) Act, 1972	No.
Additional information (if any)	-

v. The estimated project cost is Rs. 44864.59 Cr (proposed expansion- 36,600 Cr.) including existing investment of Rs 8264.59 crores. Total capital cost earmarked towards environmental pollution control measures is Rs. 5,992.94 Cr. and the Recurring cost (operation and maintenance) will be about Rs. 5. 2 Cr per annum considering EMP.

vi. Total Employment will be 850 persons as direct & 350 persons indirect after expansion. Industry proposes to allocate Rs 100 Cr. @ of 0.27 % towards CER (as per Ministry's OM dated 01.05.2018 & 30.09.2020).

vii. There are no national parks, wildlife sanctuaries, Biosphere Reserves, Tiger/Elephant Reserves, Wildlife Corridors etc. within 10 km distance from the project site. River Parbati is flowing at 2.93 km in NE direction.

viii. Effluent of 2000 KLD quantity will be treated through STP & ETP. The plant will be based on Zero Liquid discharge system.

ix. Power requirement after expansion will be 22000 KVA including existing 7000 KVA and will be met from self-generation, i.e AUX consumption. Existing unit has no DG sets of capacity, additionally no DG sets are used as standby during power failure. Stack (height-movable DG sets) will be provided as per CPCB norms to the proposed DG sets.

x. Existing/Proposed unit has 467 TPH Coal fired boiler. Additionally, 585 TPH Coal fired boiler will be installed. Electrostatic precipitator (ESP), Nox Control system and Flue gas desulphurisation system (FGD) with a stack height of 120 m will be installed for controlling particulate emissions within the statutory limit of 30 mg/Nm3 for proposed boilers.

xi. Details of Solid waste/Hazardous waste generation and its management:

Name of the waste	Source	Quantity (TPA)	Mode of Disposal	Mode of Transportation
Used/Spent oil	Plant Operation	90	Registered Recyclers/ Preprocessor with SPCB	Road
Wastes or residues containing oil	Plant Operation	15	Send to authorized recyclers	Road
Empty barrels/container/contaminated liners	Plant Operation	15	Send to authorized recyclers	Road

xii. Details of Coal Linkage: Coal for Proposed TPP Expansion will be Domestic coal from commercial Coal Mines - Jitpur Coal Mines, Rampia Coal Mines, Gondbahera Ujheni Coal Mines & e-auction.

xiii. Details of Coal Sourcing: Coal (proposed expansion) will be sourced from commercial coal mines - Jitpur Coal Mines & Rampia Coal Mines, Gondbahera Ujheni Coal Mines & e-auction. (GCV-3200-4300 Kcal/Kg).

xiv. Details of Certified compliance report submitted by RO, MoEF&CC: EC Certified by Integrated Regional Office of MoEFCC, Jaipur vide File No. IV/ENV/R/THE-44/821/2011 dated: 26.05.2013 & 09.10.2015. MoEFCC, Lucknow Office had visited the Kawai TPP dated 23rd and 24th November in 2020.

xv. Status of Litigation Pending against the proposal, if any.

Court name	Bench	Case Category	Status	Orders Directions
Apellate Tribunal for Electricity (APTEL)	Apellate Tribunal for Electricity (APTEL)	Appeal	Reserved for judgement	Regulatory and Non-Regulatory court cases are under hearing & consideration
Status of Court cases of Kawai TPP is enclosed.				

xvi. Ash Pond area: As per MoEF&CC Notification S.O. 5481(E) dated 31.12.2021 and amendments stipulated ash pond area for thermal power plant 0.1 hectare per Mega Watt (MW). The proposed power plant has total ash pond area 117.06 Ha i.e. 14.2 % of the total project area 822.54 Ha (for proposed expansion - 57.06 Ha.).

Deliberations of the Committee

6. The EAC noted the following:

i. Environmental Clearance (EC) was granted to existing 1320 MW TPP (2x660 MW) by MoEFCC, New Delhi vide File No. J-13012/154/2008-IA. II(T) dated 04.05.2011 to Kawai Thermal Power Plant at Baran District, Rajasthan. Subsequently, EC amendment was granted on 13.03.2014 and EC was transferred from Adani Power Rajasthan Limited (APRL) to Adani Power Limited (APL, Kawai) on 24.04.2023 by MoEFCC.

ii. Total land involved in the project is 822.541 ha (Existing-350+ Proposed 470.7), this Includes 1.8414 Ha. Forest Area outside power plant area for proposed Coal Conveyor. PP has submitted the application vide proposal number FP/RJ/OTHERS/467838/2024 for diversion of Forest Land outside power plant area for proposed Coal Conveyor.

iii. EAC also noted that No National Park, Sanctuary, Elephant/Tiger Reserve, or migratory routes/wildlife corridor exists within 15 km of the power station.

iv. For the Proposed Power Project of 3200 MW, the annual fuel requirement is estimated at about 12.9 MTPA at 85% plant load factor with Design Coal GCV of 3200-4300 KCal/kg. Coal linkage is proposed from Commercial Coal Mines (GCV 3200-4300 Kcal /Kg) – Jitpur Coal Mines (>1200 km), Rampia Coal Mines (>900 km) & Gondbahera Ujheni Coal Mines (>700 km) & e-auction.

v. There are total 17 court cases as on February, 2024 which are pending against the projects including one court case pending at Hon’ble Supreme Court.

vi. The Committee is of the view that a site visit is planned for the said plant and the same may be seen during the visit. However, till that time PP shall carry out extensive plantation activities during the coming monsoon.

vii. The Committee therefore is of the view that PP shall get the detailed study done to accommodate the ash from the proposed expansion project to existing ash pond area to avoid setting up of a new pond near habitation.

viii. The Committee observed that 10-year data wrt forest area, land use and land pattern of 10km radius from the plant boundary is not analyzed properly. PP has to submit the same.

ix. The EAC observed that the total water consumption for thermal power plants as per MoEF&CC vide Notification S.O.

3305 (E) dated 07.12.2015 for all existing CT based plants is upto maximum of 3.5 m3/MWh and for new plants installed after the 1st January, 2017, as per MoEF&CC Notification GSR 593 (E) dated 28.06.2018 water allocated to the thermal power plant is 3 m3/MWhr. The total water requirement for the project is 2 m3/MWh (56 MCM/Annum) for proposed expansion which will be well within the stipulated norms of Notification dated 07.12.2015/28.06.2018.

Recommendations of the Committee:

7. The EAC after detailed deliberation on the information submitted and as presented during the meeting **recommended** the proposal for grant of ToR for conducting an EIA study with Public Consultation (Public Hearing and Written submission) to the project for the construction of the expansion of Kawai Thermal Power Plant by addition of 3200 (4x800) MW Ultra Super Critical Thermal Power Plant to Existing 1320 (2x660) MW in an area of 822.54 Ha located at Village Kawai, Sub District Atru, District Baran (Rajasthan) by **M/s Adani Power Limited**, under the provisions of the EIA Notification, 2006, as amended with the specific ToRs in addition to generic/standard ToR (**Annexure-1**).

8. In accordance with the provisions contained in the Environment Impact Assessment (EIA) Notification, 2006 & further amendments thereto and based on the recommendations of the EAC, the Ministry hereby accords Terms of Reference (ToR) to **M/s Adani Power Limited** for the expansion of Kawai Thermal Power Plant by addition of 3200 (4x800) MW Ultra Super Critical Thermal Power Plant to Existing 1320 (2x660) MW in an area of 822.54 Ha located at Village Kawai, Sub District Atru, District Baran (Rajasthan) under EIA Notification, 2006 (as amended) with the specific ToRs in addition to generic/standard ToR as per **Annexure 1**.

9. The EIA/EMP report should contain the information in accordance with provisions & stipulations as given in the specific and standard ToR.

10. You are required to submit the final EIA/EMP prepared as per TORs to the Ministry within 4 years as per this Ministry's Notification vide dated 25.07.2022 for considering the proposal for environmental clearance.

11. The consultants involved in the preparation of EIA/EMP report after accreditation with Quality Council of India/National Accreditation Board of Education and Training (QCI/NABET) would need to include a certificate in this regard in the EIA/EMP reports prepared by them and data provided by other organization(s)/laboratories including their status of approvals etc.

12. The Ministry reserves the right to stipulate additional ToR, if found necessary.

13. The Terms of Reference to the aforementioned project is under provisions of EIA Notification, 2006. It does not tantamount to approvals/consent/permissions etc. required to be obtained under any other Act/Rule/regulation. The Project Proponent is under obligation to obtain approvals /clearances under any other Acts/ Regulations or Statutes, as applicable, to the project.

14. This issues with the approval of the Competent Authority.

Yours faithfully,

(Sundar Ramanathan)
Scientist 'E'/Additonal Director
Tel: 011- 20819378
Email- r.sundar@nic.in

Copy To

1. The Secretary, Ministry of Power, Shram Shakti Bhawan, Rafi Marg, New Delhi 110001.
2. The Chairman, Central Electricity Authority, Sewa Bhawan, R.K. Puram, New Delhi-110066.
3. The Chairman, Central Pollution Control Board, Parivesh Bhawan, CBD cum-Office Complex, East Arjun Nagar, Delhi-110032.
4. The Deputy Director General of Forests (C), Integrated Regional Officer, Ministry of Environment, Forest and Climate

Change, A-209 & 218, Aranya Bhawan, Mahatma Gandhi Road, Jhalana Institutional Area, Jaipur – 304002, Rajasthan.
5. The Chairman, Central Ground Water Authority, Ministry of Water Resources, Curzon Road Barracks, A-2, W-3 Kasturba Gandhi Marg, New Delhi.
6. The Member Secretary, Rajasthan State Pollution Control Board, 4, Jhalana Institutional Area, Jhalana Doongri, Jaipur (Rajasthan).
7. The Member Secretary, Central Ground Water Authority, Jamnagar House, 18/11, Man Singh Road Area, New Delhi, Delhi 110001
8. The District Collector, Baran, Rajasthan.
9. Guard File/Monitoring File/PARIVESH Portal

Annexure 1

Specific Terms of Reference for (Thermal Power Plants)

1. [C] Socio-economic Study

S. No	Terms of Reference
1.1	The Public Health Delivery Plan including the provisions for drinking water supply for the local population shall be in the EIA/EMP Report. The status of the existing medical facilities in the project area shall be discussed. Possibilities of strengthening of existing medical facilities, construction of new medical infrastructure etc. will be explored after assessing the needs of the labour force and local populace.
1.2	Public consultation (Public Hearing and Written submission) shall be conducted as per the provisions of EIA Notification, 2006 and as amended. As per the Ministry's OM dated 30.09.2020, to address the concern raised during the Public Hearing, the Project Proponent is required to submit the detailed activities proposed with year-wise budgetary provision (Capital and recurring) for 10 years. Activities proposed shall be part of EMP. Tentative no. of project affected families (if any) shall be identified and accordingly appropriate Rehabilitation &Resettlement plan shall be prepared. The recommendation Socio-economic study may also be considered while planning the activities & budget.
1.3	Demographic details in 10 km area shall be submitted.
1.4	PP shall prepare budget wise time bound action plan for relocation of Govt School and Health Center of village falling in proximity of the proposed TPP to a suitable location at a safer distance and details of the same shall be included in EIA/EMP report.
1.5	To ascertain the need of the local people a need based assessment to be done and an action plan on its recommendations may also be submitted with budgetary provisions.

2. [A] Environmental Management And Biodiversity Conservation

S. No	Terms of Reference
2.1	PP is advised to implement the 'Ek Ped Maa Ke Naam' Campaign which was launched on 5th June 2024 on the occasion of the World Environment Day to increase the forest cover across the Country. This plantation drive is other than Green belt development. An action plan in this regard shall be submitted.

S. No	Terms of Reference
2.2	Radioactivity studies along with coal analysis to be provided (sulphur, ash percentage and heavy metals including Pb, Cr, As and Hg). Details of auxiliary fuel, if any including its quantity, quality, storage, etc should also be given.
2.3	A comparative chart shall be prepared with changes observed from the previous baseline study and present baseline study.
2.4	PP should submit the detailed plan in tabular format (year-wise for the life of the project) for concurrent afforestation and green belt development in and around the project site. The PP should submit the number of saplings to be planted, names of native species, area to be covered under afforestation & green belt, location of plantation, target for survival rate and budget earmarked for the afforestation & green belt development. In addition to this, PP should show on a surface plan (5-year interval for life of project) of suitable scale the area to be covered under afforestation & green belt clearly mentioning the latitude and longitude of the area to be covered during each 5 years. The capital and recurring expenditure to be incurred needs to be submitted. Plantation plan should be prepared in such a way that 80% of the plantation to be carried out in first 5 years and for the remaining years the proposal for gap filling. The seedling of height not less than 2 meters to be selected and accordingly cost of plantation needs to be decided. In addition to this, plantation in the safety zone at project boundary the plantation should be planned in such a way that it should be completed within 2 years only.
2.5	PP shall carry out extensive plantation activities during the coming monsoon and details of the same shall be presented during appraisal of EC proposal along with geo tagged photos.
2.6	Action plan for development of Three tier plantation programme (33% of total project cover area) along the periphery of the project boundary shall be provided. Plan shall be dully approved by the local forest department.
2.7	A detailed plan need to be submitted for undertaking extensive green plantation within 10 km radius of the plant focusing on water reservoir, school, hospital and other institutional area and same need to be incorporated in EIA/EMP report.
2.8	Detailed action plan shall be prepared for maintenance of air pollution control equipment for proposed and existing units and shall be incorporated in EIA/EMP report.
2.9	Details of Ash management of 5-year plan for 100 % ash utilization for proposed project shall be submitted. MoU signed for ash utilization with companies shall be submitted.
2.10	PP shall get the detailed study done to accommodate the ash from the proposed expansion project to existing ash pond area to avoid setting up of a new ash pond.
2.11	Detailed plan for 100% utilization of total ash including legacy ash, if any shall be submitted. Details of Dry Ash handling system along with the supplementary coal handling system shall be submitted.
2.12	Proper protection measures like HDPE lining, appropriate height of bund and adequate distance between the proposed Ash pond and water body (minimum 60 meters) etc. shall be planned to reduce the possibility of mixing leachate with any freshwater body for under-construction ash pond. A high-density Slurry disposal plan shall be prepared.

S. No	Terms of Reference
2.13	Action plan for Ground water monitoring stations on all hotspots like schools/hospitals within 2 km radius of the plant boundary be submitted. Baseline Study for Heavy metals in Groundwater, Surface water and soil to be carried out and incorporated in EIA/EMP report.
2.14	Details pertaining to water source, treatment and discharge should be provided. Water allocation of 52 MCM/Year water to Water Resource Department (WRD), Jaipur, Rajasthan shall be submitted.
2.15	PP shall provide details of infrastructure facilities like water pipeline & intake to be used for already exists for operational TPP.
2.16	PP shall submit action plan for using treated Sewage/Domestic wastewater for its operations.
2.17	Project Proponent to conduct Environmental Cost Benefit Analysis for the project in EIA/EMP Report.
2.18	An action plan shall be prepared for Water shed development within 10 km radius of the plant boundary in consultation with reputed government institution and incorporated in EIA/EMP report.
2.19	PP shall provide the details of transportation of flyash from the plant, transportation route etc. Further, carry out a traffic study for at least one month and provide the impact of transportation along with the mitigation measures.
2.20	PP shall submit the action plan to adhere to the Plastic Waste Management Rules 2016 and to adhere Ministry's OM dated 18/07/2022.
2.21	Details on renewable energy (solar plant) proposed to be installed as energy conservation measures shall be submitted.
2.22	PP shall provide the details of wastewater treatment facilities to be installed within its capacity, timeline and budget.
2.23	PP should clearly bring out that what is the specific diesel consumption ~ (Liters/Tonne of total material handled) and steps to be taken for reduction of the same. The year-wise target for reduction in the specific diesel consumption needs to be submitted. PP shall also explore the possibility of using e-vehicles/LNG/CNG-based machinery and trucks for the operation and transportation of Coal and ash and submit a time bound action plan.
2.24	A Cumulative Environmental Impact Assessment study of all the existing and proposed projects in the 10-km radius of the proposed project shall be conducted and the same shall be included the in EIA/EMP report. Details of industrial units present in 10 Km radius of the power plant shall be submitted.
2.25	A Disaster Management Plan shall be prepared and incorporated in the EIA/EMP report

3. [D] Miscellaneous

S. No	Terms of Reference
3.1	Plot the wind rose diagram using the typical meteorological year (TMY) data for the period

S. No	Terms of Reference
	considered for the study. The monitoring units shall be deployed in the field based on the coverage area ratio and direction of the wind. A mathematical model shall be developed for the local site rather than using the standard model available in software for both air & water quality modelling.
3.2	PP shall align its activities to one/few of the Sustainable Development Goals (SDG) and start working on the mission of net zero by 2050. PPs shall update the same to the EAC.
3.3	PP shall submit the EIA/EMP report after the plagiarism check using authenticated plagiarism software.
3.4	Detailed description of all the court cases including all directions given by the apex and currents status of them shall submit.
3.5	PP should provide in the EIA Report details of all the statutory clearances, permissions, no objection certificates, consents etc. required for this project under various Acts, Rules and regulations and their status or estimated timeline after grant of EC.
3.6	The PP should submit the photograph of monitoring stations & sampling locations. The photograph should bear the date, time, latitude & longitude of the monitoring station/sampling location. In addition to this PP should submit the original test reports and certificates of the labs which will analyze the samples.
3.7	PP should clearly bring out the details of the manpower to be engaged for this project with their roles /responsibilities/designations. In addition to this PP should mention the number and designation of persons to be engaged for the implementation of environmental management plan (EMP). The capital and recurring expenditure to be incurred needs to be submitted.
3.8	PP should submit the year-wise, activity wise and time-bound budget earmarked for EMP, occupational health surveillance, and activities proposed to address the issues raised during Public Hearing. The capital and recurring expenditure to be incurred needs to be submitted.
3.9	Activities shall be prepared based on the issues arise during previous public hearing conducted and fresh Public Hearing with defined timeline and budgetary provisions.
3.10	PP shall submit detailed plan to reallocate of nearby school, hospital and/or other sensitive infrastructure.
3.11	PP shall submit land use change within 10 kms radius in time series using satellite imageries.
3.12	The PP should ensure that only NABET-accredited consultants shall be engaged for the preparation of EIA/EMP Reports. PP shall ensure that the accreditation of the consultant is valid during the collection of baseline data, preparation of EIA/EMP report and the appraisal process. The PP and consultant should submit an undertaking the information and data provided in the EIA Report and submitted to the Ministry are factually correct and the PP and consultant are fully accountable for the same.
3.13	PP should provide in the EIA Report details of the statutory clearances, permissions, no objection certificates, consents etc. required for this project under various Acts, Rules and regulations and their status or estimated timeline after the grant of EC.

S. No	Terms of Reference
3.14	The budget to be earmarked for the various activities shall be decided after perusal of the Standard EC Conditions published by the Ministry.
3.15	All the certificates viz. Involvement of Forest land, distance from the protected area, and list of flora & fauna should be duly authenticated by the Forest Department. The Certificate should bear the name, designation, official seal of the person signing the certificate and dispatch number.
3.16	Aerial view video of project site and transportation route proposed for this project shall be recorded through drone and be submitted.
3.17	PP shall comply with norms of OM J-13011/18/2014-IA. I (T) dated 15.03.2017.
3.18	A sub-committee of the EAC shall visit the site prior to appraisal.
3.19	PP shall submit 10 years of satellite image data shall be submitted w.r.t forest area, land use and land pattern of 10km radius from the plant boundary after analyzing the same.

Standard Terms of Reference for (Thermal Power Plants)

1. Statutory Compliance

S. No	Terms of Reference
1.1	The proposed project shall be given a unique name in consonance with the name submitted to other Government Departments etc. for its better identification and reference.
1.2	Vision document specifying prospective long term plan of the project shall be formulated and submitted.
1.3	Latest compliance report duly certified by the Regional Office of MoEF&CC for the conditions stipulated in the environmental and CRZ clearances of the previous phase(s) for the expansion projects shall be submitted.

2. Details Of The Project And Site

S. No	Terms of Reference
2.1	The project proponent needs to identify minimum three potential sites based on environmental, ecological and economic considerations, and choose one appropriate site having minimum impacts on ecology and environment. A detailed comparison of the sites in this regard shall be submitted.
2.2	Executive summary of the project indicating relevant details along with recent photographs of the proposed site (s) shall be provided. Response to the issues raised during Public Hearing and the written representations (if any), along with a time bound Action Plan and budgetary allocations to address the same, shall be provided in a tabular form, against each action proposed.
2.3	Harnessing solar power within the premises of the plant particularly at available roof tops and other available areas shall be formulated and for expansion projects, status of implementation shall also

S. No	Terms of Reference
	be submitted.
2.4	The geographical coordinates (WGS 84) of the proposed site (plant boundary), including location of ash pond along with topo sheet (1:50,000 scale) and IRS satellite map of the area, shall be submitted. Elevation of plant site and ash pond with respect to HFL of water body/nallah/River and high tide level from the sea shall be specified, if the site is located in proximity to them.
2.5	Layout plan indicating break-up of plant area, ash pond, green belt, infrastructure, roads etc. shall be provided.
2.6	Land requirement for the project shall be optimized and in any case not more than what has been specified by CEA from time to time. Item wise break up of land requirement shall be provided.
2.7	Present land use (including land class/kism) as per the revenue records and State Govt. records of the proposed site shall be furnished. Information on land to be acquired including coal transportation system, laying of pipeline, ROW, transmission lines etc. shall be specifically submitted. Status of land acquisition and litigation, if any, should be provided.
2.8	If the project involves forest land, details of application, including date of application, area applied for, and application registration number, for diversion under FCA and its status should be provided along with copies of relevant documents.
2.9	The land acquisition and R&R scheme with a time bound Action Plan should be formulated and addressed in the EIA report.
2.10	Satellite imagery and authenticated topo sheet indicating drainage, cropping pattern, water bodies (wetland, river system, stream, nallahs, ponds etc.), location of nearest habitations (villages), creeks, mangroves, rivers, reservoirs etc. in the study area shall be provided.
2.11	Topography of the study area supported by toposheet on 1:50,000 scale of Survey of India, along with a large scale map preferably of 1:25,000 scale and the specific information whether the site requires any filling shall be provided. In that case, details of filling, quantity of required fill material; its source, transportation etc. shall be submitted.

3. Ecology Biodiversity And Environment

S. No	Terms of Reference
3.1	A detailed study on land use pattern in the study area shall be carried out including identification of common property resources (such as grazing and community land, water resources etc.) available and Action Plan for its protection and management shall be formulated. If acquisition of grazing land is involved, it shall be ensured that an equal area of grazing land be acquired and developed and detailed plan submitted.
3.2	Location of any National Park, Sanctuary, Elephant/Tiger Reserve (existing as well as proposed), migratory routes / wildlife corridor, if any, within 10 km of the project site shall be specified and marked on the map duly authenticated by the Chief Wildlife Warden of the State or an officer authorized by him.

S. No	Terms of Reference
3.3	A mineralogical map of the proposed site (including soil type) and information (if available) that the site is not located on potentially mineable mineral deposit shall be submitted.
3.4	The water requirement shall be optimized (by adopting measures such as dry fly ash and dry bottom ash disposal system, air cooled condenser, concept of zero discharge) and in any case not more than that stipulated by CEA from time to time, to be submitted along with details of source of water and water balance diagram. Details of water balance calculated shall take into account reuse and re-circulation of effluents.
3.5	Water body/Nallah (if any) passing across the site should not be disturbed as far as possible. In case any Nallah / drain is proposed to be diverted, it shall be ensured that the diversion does not disturb the natural drainage pattern of the area. Details of proposed diversion shall be furnished duly approved by the concerned Department of the State.
3.6	It shall also be ensured that a minimum of 500 m distance of plant boundary is kept from the HFL of river system / streams etc. and the boundary of site should also be located 500 m away from railway track and National Highways.
3.7	Hydro-geological study of the area shall be carried out through an institute/ organization of repute to assess the impact on ground and surface water regimes. Specific mitigation measures shall be spelt out and time bound Action Plan for its implementation shall be submitted
3.8	Detailed Studies on the impacts of the ecology including fisheries of the River/Estuary/Sea due to the proposed withdrawal of water / discharge of treated wastewater into the River/Sea etc shall be carried out and submitted along with the EIA Report. In case of requirement of marine impact assessment study, the location of intake and outfall shall be clearly specified along with depth of water drawl and discharge into open sea.
3.9	Source of water and its sustainability even in lean season shall be provided along with details of ecological impacts arising out of withdrawal of water and taking into account inter-state shares (if any). Information on other competing sources downstream of the proposed project and commitment regarding availability of requisite quantity of water from the Competent Authority shall be provided along with letter / document stating firm allocation of water.
3.10	Detailed plan for rainwater harvesting and its proposed utilization in the plant shall be furnished.In addition, wherever ground water is drawn, PP shall submit detailed plan of Water charging activity to be undertaken.
3.11	Feasibility of near zero discharge concept shall be critically examined and its details submitted.
3.12	Optimization of Cycles of Concentration (COC) along with other water conservation measures in the project shall be specified.
3.13	Plan for recirculation of ash pond water and its implementation shall be submitted.
3.14	Detailed plan for conducting monitoring of water quality regularly with proper maintenance of records shall be formulated. Detail of methodology and identification of monitoring points (between the plant and drainage in the direction of flow of surface / ground water) shall be submitted. It shall be ensured that parameter to be monitored also include heavy metals. A provision for long-term monitoring of ground water table using Piezometer shall be incorporated in EIA, particularly from

S. No	Terms of Reference
	the study area.
3.15	Hazards Characterization: Past incidents of hazard events within 10km radius of project area with detailed analysis of causes and probability of reoccurrence

4. Environmental Baseline Study And Mitigation Measures

S. No	Terms of Reference
4.1	One complete season (critical season) site specific meteorological and AAQ data (except monsoon season) as per latest MoEF&CC Notification shall be collected along with past three year's meteorological data for that particular season for wins speed analysisand the dates of monitoring shall be recorded. The parameters to be covered for AAQ shall include PM10, PM2.5, SO2, NOx, CO and Hg. The location of the monitoring stations should be so decided so as to take into consideration the upwind direction, pre-dominant downwind direction, other dominant directions, habitation and sensitive receptors. There should be at least one monitoring station each in the upwind and in the pre - dominant downwind direction at a location where maximum ground level concentration is likely to occur.
4.2	In case of expansion project, air quality monitoring data of 104 observations a year for relevant parameters at air quality monitoring stations as identified/stipulated shall be submitted to assess for compliance of AAQ Standards (annual average as well as 24 hrs).
4.3	A list of industries existing and proposed in the study area shall be furnished.
4.4	Cumulative impacts of all sources of emissions including handling and transportation of existing and proposed projects on the environment of the area shall be assessed in detail. Details of the Model used and the input data used for modelling shall also be provided. The air quality contours should be plotted on a location map showing the location of project site, habitation nearby, sensitive receptors, if any. The windrose and isopleths should also be shown on the location map. The cumulative study should also include impacts on water, soil and socio-economics.
4.5	Radio activity and heavy metal contents of coal to be sourced shall be examined and submitted along with laboratory reports.
4.6	Fuel analysis shall be provided. Details of auxiliary fuel, if any, including its quantity, quality, storage etc should also be furnished.
4.7	Quantity of fuel required, its source and characteristics and documentary evidence to substantiate confirmed fuel linkage shall be furnished. The Ministry's Notification dated 02.01.2014 regarding ash content in coal shall be complied. For the expansion projects, the compliance of the existing units to the said Notification shall also be submitted
4.8	Details of transportation of fuel from the source (including port handling) to the proposed plant and its impact on ambient AAQ shall be suitably assessed and submitted. If transportation entails a long distance it shall be ensured that rail transportation to the site shall be first assessed. Wagon loading at source shall preferably be through silo/conveyor belt.
4.9	For proposals based on imported coal, inland transportation and port handling and rail movement

S. No	Terms of Reference
	shall be examined and details furnished. The approval of the Port and Rail Authorities shall be submitted.
4.10	Details regarding infrastructure facilities such as sanitation, fuel, restrooms, medical facilities, safety during construction phase etc. to be provided to the labour force during construction as well as to the casual workers including truck drivers during operation phase should be adequately catered for and details furnished.

5. Environmental Management Plan

S. No	Terms of Reference
5.1	EMP to mitigate the adverse impacts due to the project along with item - wise cost of its implementation in a time bound manner shall be specified.
5.2	A Disaster Management Plan (DMP) along with risk assessment study including fire and explosion issues due to storage and use of fuel should be prepared. It should take into account the maximum inventory of storage at site at any point of time. The risk contours should be plotted on the plant layout map clearly showing which of the proposed activities would be affected in case of an accident taking place. Based on the same, proposed safeguard measures should be provided. Measures to guard against fire hazards should also be invariably provided. Provision for mock drills shall be suitably incorporated to check the efficiency of the plans drawn.
5.3	The DMP so formulated shall include measures against likely Fires/Tsunami/Cyclones/Storm Surges/ Earthquakes etc, as applicable. It shall be ensured that DMP consists of both On-site and Off-site plans, complete with details of containing likely disaster and shall specifically mention personnel identified for the task. Smaller version of the plan for different possible disasters shall be prepared both in English and local languages and circulated widely.
5.4	Details of fly ash utilization plan as per the latest fly ash Utilization Notification of GOI along with firm agreements / MoU with contracting parties including other usages etc. shall be submitted. The plan shall also include disposal method / mechanism of bottom ash along with monitoring mechanism.

6. Green Belt Development

S. No	Terms of Reference
6.1	Detailed scheme for raising green belt of native species of appropriate width (50 to 100 m) and consisting of at least 3 tiers around plant boundary not less than 2000 tree per ha with survival rate of more than 85%shall be submitted. Photographic evidence must be created and submitted periodically including NRSA reports in case of expansion projects. A shrub layer beneath tree layer would serve as an effective sieve for dust and sink for CO2 and other gaseous pollutants and hence a stratified green belt should be developed.
6.2	Over and above the green belt, as carbon sink, plan for additional plantation shall be drawn by identifying blocks of degraded forests, in close consultation with the District Forests Department. In pursuance to this the project proponent shall formulate time bound Action Plans along with financial allocation and shall submit status of implementation to the Ministry every six months

7. Socio-economic Activities

S. No	Terms of Reference
7.1	Socio-economic study of the study area comprising of 10 km from the plant site shall be carried out through a reputed institute / agency which shall consist of detail assessment of the impact on livelihood of the local communities.
7.2	Action Plan for identification of local employable youth for training in skills, relevant to the project, for eventual employment in the project itself shall be formulated and numbers specified during construction & operation phases of the Project.
7.3	If the area has tribal population, it shall be ensured that the rights of tribals are well protected. The project proponent shall accordingly identify tribal issues under various provisions of the law of the land.
7.4	A detailed CER plan along with activities wise break up of financial commitment shall be prepared in terms of the provisions OM No. 22-65/2017-IA.III dated 30.09.2020.CER component shall be identified considering need based assessment study and Public Hearing issues. Sustainable income generating measures which can help in upliftment of affected section of society, which is consistent with the traditional skills of the people shall be identified.
7.5	While formulating CER schemes it shall be ensured that an in-built monitoring mechanism for the schemes identified are in place and mechanism for conducting annual social audit from the nearest government institute of repute in the region shall be prepared. The project proponent shall also provide Action Plan for the status of implementation of the scheme from time to time and dovetail the same with any Govt. scheme(s). CERdetails done in the past should be clearly spelt out in case of expansion projects.
7.6	R&R plan, as applicable, shall be formulated wherein mechanism for protecting the rights and livelihood of the people in the region who are likely to be impacted, is taken into consideration. R&R plan shall be formulated after a detailed census of population based on socio economic surveys who were dependant on land falling in the project, as well as, population who were dependant on land not owned by them.
7.7	Assessment of occupational health and endemic diseases of environmental origin in the study area shall be carried out and Action Plan to mitigate the same shall be prepared.
7.8	Occupational health and safety measures for the workers including identification of work related health hazards shall be formulated. The company shall engage full time qualified doctors who are trained in occupational health. Health monitoring of the workers shall be conducted at periodic intervals and health records maintained. Awareness programme for workers due to likely adverse impact on their health due to working in non-conducive environment shall be carried out and precautionary measures like use of personal equipments etc. shall be provided. Review of impact of various health measures undertaken at intervals of two to three years shall be conducted with an excellent follow up plan of action wherever required.

8. Corporate Environment Policy

S. No	Terms of Reference
8.1	Does the company has a well laid down Environment Policy approved by its Board of Directors? If so, it may be detailed in the EIA report.
8.2	Does the Environment Policy prescribe for standard operating process / procedures to bring into focus any infringement / deviation / violation of the environmental or forest norms / conditions? If so, it may be detailed in the EIA.
8.3	What is the hierarchical system or Administrative order of the company to deal with the environmental issues and for ensuring compliance with the environmental clearance conditions. Details of this system may be given.
8.4	Does the company has compliance management system in place wherein compliance status along with compliances / violations of environmental norms are reported to the CMD and the Board of Directors of the company and / or shareholders or stakeholders at large? This reporting mechanism should be detailed in the EIA report.

9. Miscellaneous

S. No	Terms of Reference
9.1	All the above details should be adequately brought out in the EIA report and in the presentation to the Committee.
9.2	Details of litigation pending or otherwise with respect to project in any Court, Tribunal etc. shall invariably be furnished.
9.3	In case any dismantling of old plants are envisaged, the planned land use & land reclamation of dismantled area to be furnished.

10. Additional Tor For Coastal Based Thermal Power Plants Projects (Tpps)

S. No	Terms of Reference
10.1	Low lying areas fulfilling the definition wetland as per Ramsar Convention shall be identified and clearly demarcated w.r.t the proposed site.
10.2	If the site includes or is located close to marshy areas and backwaters, these areas must be excluded from the site and the project boundary should be away from the CRZ line. Authenticated CRZ map from any of the authorized agencies shall be submitted.
10.3	The soil levelling should be minimum with no or minimal disturbance to the natural drainage of the area. If the minor canals (if any) have to be diverted, the design for diversion should be such that the diverted canals not only drains the plant area but also collect the volume of flood water from the surrounding areas and discharge into marshy areas/major canals that enter into creek. Major canals should not be altered but their embankments should be strengthened and desilted.
10.4	Additional soil required for levelling of the sites should as far as possible be generated within the site itself in such a manner that the natural drainage system of the area is protected and improved.

S. No	Terms of Reference
10.5	Marshy areas which hold large quantities of flood water to be identified and shall not be disturbed.
10.6	No waste should be discharged into Creek, Canal systems, Backwaters, Marshy areas and seas without appropriate treatment. Wherever feasible, the outfall should be first treated in a Guard Pond and then only discharged into deep sea (10 to 15 m depth). Similarly, the Intake should be from deep sea to avoid aggregation of fish and in no case shall be from the estuarine zone. The brine that comes out from Desalinization Plants (if any) should not be discharged into sea without adequate dilution.
10.7	Mangrove conservation and regeneration plan shall be formulated and Action Plan with details of time bound implementation shall be specified, if mangroves are present in Study Area.
10.8	A common Green Endowment Fund should be created by the project proponents out of EMP budgets. The interest earned out of it should be used for the development and management of green cover of the area.
10.9	Impact on fisheries at various socio economic level shall be assessed.
10.10	An endowment Fishermen Welfare Fund should be created out of CER grants not only to enhance their quality of life by creation of facilities for Fish Landing Platforms / Fishing Harbour / cold storage, but also to provide relief in case of emergency situations such as missing of fishermen on duty due to rough seas, tropical cyclones and storms etc.
10.11	Tsunami Emergency Management Plan shall be prepared wherever applicable and Plan submitted prior to the commencement of construction work.
10.12	There should not be any contamination of soil, ground and surface waters (canals & village pond) with sea water in and around the project sites. In other words necessary preventive measures for spillage from pipelines, such as lining of Guard Pond used for the treatment of outfall before discharging into the sea and surface RCC channels along the pipelines of outfall and intake should be adopted. This is just because the areas around the projects boundaries could be fertile agricultural land used for paddy cultivation.

Compliance of Terms of Reference

Compliance of Terms of Reference (ToR) prescribed by MoEF&CC, New Delhi vide TOR Identification No: TO24A0601RJ5203867N dated 29/07/2024. Copy of ToR letter enclosed as **Annexure 1.**

S. No.	Terms of Reference	Compliance status
Specific Terms of Reference		
1. [C]	**Socio-economic Study**	
1.1	The Public Health Delivery Plan including the provisions for drinking water supply for the local population shall be in the EIA/EMP Report. The status of the existing medical facilities in the project area shall be discussed. Possibilities of strengthening of existing medical facilities, construction of new medical infrastructure etc. will be explored after assessing the needs of the labour force and local populace.	A budget of Rs. 66.00 crore (as per Ministry's OM dated 01.05.2018) is allocated for Social EMP (CER) activities. The final budgetary allocation will be submitted with Final EIA/EMP report with incorporating the suggestions/comments during Public Hearing along with time bound action plan ensuring responsible corporate practices. APL, Kawai will continue to carry out its CSR activities in consultation with Adani Foundation, in line to the applicability of Company's Act 2013, in the field of Education, Health, Sustainable Livelihood, Community Infrastructure, Training & Skill development thereby increasing the quality life in study area. The status of the nearest existing medical facilities in the study area is given in Chapter 1 of this EIA report.
1.2	Public consultation (Public Hearing and written submission) shall be conducted as per the provisions of EIA Notification, 2006 and as amended. As per the Ministry's O.M. dated 30.09.2020, to address the concern raised during the Public Hearing, the Project Proponent is required to submit the detailed activities proposed with year-wise budgetary provision (Capital and recurring) for 10 years. Activities proposed shall be part of EMP. Tentative no. of project affected families (if	The Draft EIA & EMP report has been submitted to Rajasthan State Pollution Control Boad (RSPCB) for conducting Public Hearing as per the provisions of EIA Notification, 2006 (as amended) and OMs issued in this regard by MoEF&CC in consultation with RSPCB. The suggestions/comments raised during Public Hearing and recommendation as per Need based assessment & Socio-economic study will be incorporated in the Final EIA & EMP Report along with time bound action plan and final budgetary allocation for Socio EMP (CER) and same shall be submitted

S. No.	Terms of Reference	Compliance status
	any) shall be identified and accordingly appropriate Rehabilitation & Resettlement plan shall be prepared. The recommendation Socio-economic study may also be considered while planning the activities & budget.	to the MOEF&CC for appraisal by respective EAC for the grant of Environmental Clearance. No R&R is involved as the proposed expansion is with in the APL, Kawai premises.
1.3	Demographic details in 10 km area shall be submitted.	Demographic details of 10 km study area based on primary field survey and secondary data are given in Chapter 3 of this EIA report.
1.4	PP shall prepare budget wise time bound action plan for relocation of Govt. School and Health Center of village falling in proximity of the proposed TPP to a suitable location at a safer distance and details of the same shall be included in EIA/EMP report.	During Site Visit of MoEFCC, EAC Members & IRO, Jaipur on January'2025 The members suggested relocation of School & hospital is not necessary.
1.5	To ascertain the need of the local people a need based assessment to be done and an action plan on its recommendations may also be submitted with budgetary provisions.	Need based Assessment & Socio-economic impact assessment study has been carried out for the project by IISWBM, University of Calcutta in the study area of 10 km radius. A budget of Rs. 66.00 crore (as per Ministry's OM dated 01.05.2018) is allocated for Social EMP (CER) activities. The final budgetary allocation will be submitted with Final EIA/EMP report with incorporating the suggestions/comments during Public Hearing and recommendations as per need based assessment & Socio-economic impact assessment study along with time bound action plan and same shall be submitted to MOEF&CC for appraisal by respective EAC for the grant of Environmental Clearance.
2. [A]	**Environmental Management And Biodiversity Conservation**	
2.1	PP is advised to implement the 'Ek Ped Maa Ke Naam' Campaign which was launched on 5th June 2024 on the occasion of the World Environment Day to increase the forest cover	Greenbelt & plantation plan in study area in line to 'Ek Ped Maa Ke Naam' Campaign & to also act as carbon sink will be submitted with Final EIA Report.

S. No.	Terms of Reference	Compliance status
	across the Country. This plantation drive is other than Green belt development. An action plan in this regard shall be submitted.	About 900 saplings equals to the total number of employees will be planted in identified locations in the study area.
2.2	Radioactivity studies along with coal analysis to be provided (sulphur, ash percentage and heavy metals including Pb, Cr, As and Hg). Details of auxiliary fuel, if any including its quantity, quality, storage, etc. should also be given.	Coal analysis is given in Chapter 2 & Radioactivity studies are under process & will be submitted with Final EIA report. Auxiliary Fuel, Light Diesel Oil (LDO) / High Speed Diesel (HSD) oil @ 30000 KL per annum will be required for boiler start up considering 85% PLF & flame stabilization (30% of BMCR), as necessary. Details of the same are given in Chapter II & Chapter VII of the EIA Report.
2.3	A comparative chart shall be prepared with changes observed from the previous baseline study and present baseline study.	The Comparative study will be provided along with Final EIA & EMP report.
2.4	PP should submit the detailed plan in tabular format (year-wise for the life of the project) for concurrent afforestation and green belt development in and around the project site. The PP should submit the number of saplings to be planted, names of native species, area to be covered under afforestation & green belt, location of plantation, target for survival rate and budget earmarked for the afforestation & green belt development. In addition to this, PP should show on a surface plan (5-year interval for life of project) of suitable scale the area to be covered under afforestation & green belt clearly mentioning the latitude and longitude of the area to be covered during each 5 years. The capital and recurring expenditure to be incurred needs to be submitted. Plantation plan should be prepared in such a way that 80% of the plantation to be carried out in first 5 years and for the	Greenbelt on plant periphery and plantation within plant premises is proposed in 169.44 Hectare in addition to the existing area pf 120.0 Ha. after exploring all the vacant spaces. It is proposed to plant 4,23,600 nos. of native trees. Details of greenbelt development are discussed in **Chapter 4** of this EIA report & action plan for year-wise and location wise greenbelt development & plantation.

S. No.	Terms of Reference	Compliance status
	remaining years the proposal for gap filling. The seedling of height not less than 2 meters to be selected and accordingly cost of plantation needs to be decided. In addition to this, plantation in the safety zone at project boundary the plantation should be planned in such a way that it should be completed within 2 years only.	
2.5	PP shall carry out extensive plantation activities during the coming monsoon and details of the same shall be presented during appraisal of EC proposal along with geo tagged photos.	APL, Kawai has greenbelt in existing 120 ha. and is continuously Plantation has been carried out in the monsoon seasons, in which 20,015 Nos. of plantation done in FY 2024-25. The details of plantation will be provided with Final EIA report.
2.6	Action plan for development of Three tier plantation programme (33% of total project cover area) along the periphery of the project boundary shall be provided. Plan shall be duly approved by the local forest department.	Action plan for development of 3-tier plantation along project periphery is detailed in Chapter 4 of this EIA report.
2.7	A detailed plan need to be submitted for undertaking extensive green plantation within 10 km radius of the plant focusing on water reservoir, school, hospital and other institutional area and same need to be incorporated in EIA/EMP report.	APL, Kawai will plant saplings in schools, PHCs, CHCs, around ponds and rivers under social EMP action plan. The detailed plan with timeline and budgetary allocation will be provided with Final EIA report.
2.8	Detailed action plan shall be prepared for maintenance of air pollution control equipment for proposed and existing units and shall be incorporated in EIA/EMP report.	The air pollution control equipment maintenance plan for the thermal power plant encompass a systematic approach to upkeep and ensure the longevity and efficiency of pollution control devices. This plan involves routine inspections, cleaning schedules, and periodic assessments of equipment conditions. Trained personnel will be assigned specific responsibilities to carry out these tasks diligently. Regular monitoring will be conducted to detect any deviations or malfunctions promptly.

S. No.	Terms of Reference	Compliance status
		Additionally, protocols for immediate response to issues will be followed, including timely repairs or replacements to uphold the effectiveness of the air pollution control systems. Regular reviews and updates will be carried out to incorporate any advancements in technology or changes in regulatory requirements.
2.9	Details of Ash management plan as per MoEF&CC notification dated 31/12/2021 & its subsequent amendment for the proposed project shall be submitted. MoU signed for ash utilization with companies shall be submitted.	Bottom ash will be collected in wet form; while fly ash will be collected in dry form to facilitate utilization. Fly ash and bottom ash shall be disposed via High Concentration Slurry disposal (HCSD) system to Ash dyke in case of exigencies; Ash extraction system is unitized basis and ash disposal systems will be common for all units. An ash dyke in 57.06-hectare area is proposed in addition to the existing ash dyke of area 60.0 hectare for storage of unutilized ash before final disposal as per fly ash notification. An MoU has been signed between APL and Ashtech (India) Private Limited, Mumbai, India for utilization of Fly ash for the proposed 3200 (4x800) MW. Details of ash generation, management & disposal is given in Chapter 2 of this EIA report.

S. No.	Description	Ash quantity in Million TPA	Management & disposal
1.	Fly ash	4.12	Collection in dry form, pneumatic transfer to closed silos & sent to cement manufacturing, Construction work (RMC plant, Roads, Highways), Brick Manufacturing, etc.
2.	Bottom ash	1.04	Collection in wet form & Road Mix Concrete (RMC) / brick producers / filling of low lying area / filling of mine voids
Unutilized Fly ash and bottom ash shall be disposed via High Concentration Slurry disposal (HCSD) system to Ash dyke in case of exigencies.			

S. No.	Terms of Reference	Compliance status
2.10	PP shall get the detailed study done to accommodate the ash from the proposed expansion project to existing ash pond area to avoid setting up of a new ash pond.	Efforts will be made for 100% utilization of ash generated from the proposed expansion of 3200 MW. Ash will be used for Cement manufacturing industries, abandoned mine voids, Stone quarry, manufacturing bricks, road construction, aggregate placement in concrete, etc. in compliance of Fly

S. No.	Terms of Reference	Compliance status
		Ash Notification, 31.12.2021 and amendments. The existing ash pond is being used for unutilized Ash from Phase-I (2x660 MW) in case of exigencies. For the proposed expansion as Phase-II, (4x800 MW) minimum Ash dyke area of 57.06 Ha is envisaged, which is much lesser and only about 18% of 320 Ha allowed as per Fly Ash Notification dated 31.12.2021 (i.e. 0.1 Ha/MW) for unutilized ash in case of emergency & during rainy season.
2.11	Detailed plan for 100% utilization of total ash including legacy ash, if any shall be submitted. Details of Dry Ash handling system along with the supplementary coal handling system shall be submitted.	Fly ash will be collected in dry form through vacuum & pressurized air conveying in silos and all efforts will be made for 100% utilization of ash. The Dry Ash Handling System involves the extraction of ash, primarily Fly Ash, from electrostatic precipitators in dry form. Collected ash in ESP hoppers is then conveyed to dry ash storage silos for industrial use, ensuring efficient and versatile disposal. From the fly ash silos, fly ash shall be transported in dry form through road for possible utilization. Dry ash will be transported to 4 nos. main storage silos of RCC construction having combined capacity of 16 hrs storage, common for four (04) units. Each main fly ash silo shall be equipped with two outlets for loading of ash in conditioned form into bulkers/truck and two outlets for dry unloading in to closed tankers/trucks/bulkers for utilization and two outlets for future use. Detailed Ash Management plan will be provided in the Final EIA & EMP Report.
2.12	Proper protection measures like high-density polyethylene (HDPE) lining, appropriate height of bund and adequate distance between the proposed Ash pond and water body (minimum 60 meters) etc. shall be planned to reduce the possibility of mixing leachate with any freshwater body for under-construction ash pond.A high-density Slurry disposal plan shall be prepared.	All the protection measures such as HDPE lining, appropriate height of bund, etc. as specified by CPCB/ CEA have been considered for design of ash pond. The nearest water body is Andheri nadi at 0.55 km and there will be minimum possibility of mixing of leachate. Details of the ash disposal system & high-density Slurry disposal plan are given in Chapter 2 of EIA report.

S. No.	Terms of Reference	Compliance status
2.13	Action plan for Ground water monitoring stations on all hotspots like schools/hospitals within 2 km radius of the plant boundary be submitted. Baseline Study for Heavy metals in Groundwater, Surface water and soil to be carried out and incorporated in EIA/EMP report.	Action plan for Ground water monitoring in study area is given in Chapter 6 as a part of environmental monitoring programme. Baseline monitoring locations have been selected considering available ground water and surface water sources in the study area. 02 no of ground water locations & 2 no of surface water locations are within 2.0 Km radius of project boundary (excluding core zone) & 6 no of ground water and 5 surface water monitoring locations are within 2.1 to 10 km radius of project site. Summary of baseline monitoring for ground water, surface water and soil quality are given in Chapter 3 of EIA.
2.14	Details pertaining to water source, treatment and discharge should be provided. Water allocation of 52 MCM/Year water to Water Resource Department (WRD), Jaipur, Rajasthan shall be submitted.	• The total water requirement for the proposed expansion project is 6400 m^3/hr (56 MCM/Year). The water will be sourced from Parwan River/Dam through water pipeline of about 18.4 km in length. • Water allocation of 34 MCM/year is already obtained from Water Resource Department (WRD), Jaipur, Rajasthan and water allocation for additional 52 MCM/Year water allocation has been submitted on 03.06.2024 to WRD, Jaipur (R.J) and will be obtained. • The Plant is based on Zero Liquid Discharge (ZLD). • ETP is proposed for effluent streams from plant and STP is proposed for domestic sewage. • The treated wastewater will be utilised for plant consumptive requirements in Ash handling and green belt development.
2.15	PP shall provide details of infrastructure facilities like water pipeline & intake to be used for already exists for operational TPP.	Water for proposed phase II will be pumped through existing water pipeline used for Phase I which is about 18.4 km in length.
2.16	PP shall submit action plan for using treated Sewage/Domestic wastewater for its operations.	Treated sewage will be utilized for green belt development & maintenance. The same is in Chapter 4 of the EIA report.

S. No.	Terms of Reference	Compliance status
2.17	Project Proponent to conduct Environmental Cost Benefit Analysis for the project in EIA/EMP Report.	ECBA is under process and will be submitted with Final EIA/EMP report.
2.18	An action plan shall be prepared for Water shed development within a 10 km radius of the plant boundary in consultation with a reputed government institution and incorporated in the EIA/EMP report.	Action plan for the watershed development within 10 km radius of the project boundary is prepared and will be submitted along with final EIA & EMP report.
2.19	PP shall provide the details of transportation of fly ash from the plant, transportation route etc. Further, carry out a traffic study for at least one month and provide the impact of transportation along with the mitigation measures.	Fly ash from the plant will be transported in closed bulkers by Road /Rail. Summary of traffic study done during baseline period is given in Chapter 3 of this EIA/EMP report and impact is presented in Chapter 4 of this EIA Report. Baseline monitoring reports are enclosed as **Annexure 8.**
2.20	PP shall submit the action plan to adhere to the Plastic Waste Management Rules 2016 and to adhere Ministry's OM dated 18/07/2022.	APL, Kawai is certified as Single Use Plastic Free and also ISO 14001:2015 certified Thermal Power Plant. We have Establish and adhere to Plastic Waste Management aligned with PWM rules, 2016 and MoEF&CC O.M. 18.07.2022.
2.21	Details on renewable energy (solar plant) proposed to be installed as energy conservation measures shall be submitted.	A roof top solar PV plant of 1.0 MW is proposed within plant premises for harnessing solar power. Additionally, it is proposed to install solar streetlights in the plant premises.
2.22	PP shall provide the details of wastewater treatment facilities to be installed within its capacity, timeline and budget.	• The plant is based on ZLD. Ultra supercritical Boilers don't have boiler blowdown. • Regeneration waste from DM (Demineralised Water) Plant and CPU (Condensate Polishing Unit) will be collected in neutralizing pit. After Neutralizing; the water will be pumped to CMB (Central Monitoring Basin) • Various effluent streams (2125 KLD) will be collected in CMB. ETP (2400 KLD) is proposed comprising of pH correction followed by PSF, UF & RO etc. to make suitable for reuse (2018 KLD) in DM Plant makeup/ CW (Cooling Water) make-up.

S. No.	Terms of Reference	Compliance status
		• The domestic sewage (32 KLD) will be treated in a STP (40 KLD). • The treated effluent (20 KLD) will be utilized for greenbelt & plantation.
2.23	PP should clearly bring out that what is the specific diesel consumption ~ (Liters/Tonne of total material handled) and steps to be taken for reduction of the same. The year-wise target for reduction in the specific diesel consumption needs to be submitted. PP shall also explore the possibility of using e-vehicles/LNG/CNG-based machinery and trucks for the operation and transportation of Coal and ash and submit an implementation strategy.	Specific diesel consumption is 1 ml per unit (kWh). Diesel used in trucks and vehicles for transportation of ash will be reduced as e-vehicles will be used in future for transportation for short distances. Common Vehicles/Transport will used for manpower.
2.24	A Cumulative Environmental Impact Assessment study of all the existing and proposed projects in the 10-km radius of the proposed project shall be conducted and the same shall be included the in EIA/EMP report. Details of industrial units present in 10 Km radius of the power plant shall be submitted.	There are no existing and proposed industries/ projects within 10 km radius of the project site, therefore Cumulative Environmental Impact Assessment study has not been carried out. No industrial units within 10 km radius of Kawai TPP.
2.25	A Disaster Management Plan shall be prepared and incorporated in the EIA/EMP report.	A comprehensive Disaster Management Plan (DMP) has been developed, incorporating a thorough risk assessment study that specifically addresses potential fire and explosion risks associated with fuel storage and utilization. The plan meticulously accounts for the maximum inventory of storage on-site at any given time, with risk contours illustrated on the plant layout map, outlining potential impacts on proposed activities in the event of an accident. Furthermore, the plan outlines proposed safeguard measures, including preventive measures against fire hazards. The integration of mock drills will be conducted to assess and enhance the effectiveness of the formulated emergency response plans. Details are given

S. No.	Terms of Reference	Compliance status
		in Chapter 7 of the EIA report.
3. [D]	**Miscellaneous**	
3.1	Plot the wind rose diagram using the typical meteorological year (TMY) data for the period considered for the study. The monitoring units shall be deployed in the field based on the coverage area ratio and direction of the wind. A mathematical model shall be developed for the local site rather than using the standard model available in software for both air & water quality modelling.	Wind rose plotted for TMY is given in Chapter 3 of this EIA report. The monitoring stations were selected covering upwind and downwind directions. For the purpose of present study, air quality modeling has been done using AERMOD dispersion model for different stability state Gaussian plume dispersion, designed for multiple point sources for short term and developed by United States Environmental Protection Agency [USEPA] has been used for simulations. The input data and isopleths depicting the GLC levels are provided in Chapter 4 of the EIA report. The project does not involve any ground water abstraction and/or waste water discharge, hence water quality modeling has not been carried out.
3.2	PP shall align its activities to one/few of the Sustainable Development Goals (SDG) and start working on the mission of net zero by 2050. PPs shall update the same to the EAC.	APL recognizes the importance of aligning its operations with global sustainability initiatives, particularly the SDGs outlined by the United Nations, and is committed to supporting India's pledge toward achieving net-zero emissions by 2050. The following measures highlight the alignment of the proposed Ultra Super Critical (USC) Thermal Power Plant project with relevant SDGs and the roadmap for progressing toward the net-zero mission: *1. Alignment with Sustainable Development Goals (SDGs)* The USC thermal power plant project aligns with the following SDGs: • **SDG 7: Affordable and Clean Energy** o The adoption of USC technology significantly improves thermal efficiency, thereby reducing fuel consumption and greenhouse gas emissions compared to conventional power plants. • **SDG 9: Industry, Innovation, and Infrastructure** o Deployment of advanced emission control systems such as, **Selective Catalytic Reduction (SCR)**, and

S. No.	Terms of Reference	Compliance status
		Electrostatic Precipitators (ESP) to minimize environmental impact. o Implementation of real-time emission monitoring systems (**CEMS**) & **CAAQMS** to ensure regulatory compliance and maintain transparency. • **SDG 13: Climate Action** o Reduction in CO_2 emissions per unit of energy generated by adopting ultra-supercritical technology. o Active participation in afforestation projects and carbon offset programs to contribute to climate mitigation. • **SDG 6: Clean Water and Sanitation** o Incorporating **zero liquid discharge (ZLD)** systems to ensure efficient water usage and recycling within the plant operations. • **SDG 12: Responsible Consumption and Production** o fly ash utilization in cement and construction industries to ensure waste-to-resource conversion. o Maximizing efficiency in coal usage through advanced coal handling and combustion techniques. *2. Net Zero by 2050: Roadmap and Actions* To align with the mission of achieving net-zero emissions by 2050, Adani Power's USC thermal power plant will adopt the following measures: • **Energy Efficiency and Emission Reductions** o Maintain plant efficiency leveraging USC technology to minimize CO_2 emissions per unit of energy produced. o Ensure compliance with stringent emission norms through state-of-the-art pollution control systems (e.g., for SO_2, SCR for NOx). • **Carbon Offsetting and Sequestration** o Partner with local governments and NGOs for large-scale afforestation projects to offset residual emissions. o Implement agroforestry and promote biodiversity conservation in areas surrounding the plant site.

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		• **Stakeholder Engagement and Reporting** o Develop and regularly update a detailed roadmap for net-zero emissions, including interim milestones. o Engage with the regulatory authority and stakeholders by submitting periodic updates on progress toward SDG alignment and net-zero commitments. o Leverage digital tools and AI for transparent monitoring, reporting, and verification of emission data and sustainability metrics. *3. Key Actions Already Undertaken* • Installation of USC boilers, which improve efficiency and reduce CO_2 emissions by 20% compared to subcritical plants. • Deployment of cutting-edge pollution control equipment (e.g., SCR, ESP) to achieve emissions well within prescribed norms. • Implementation of Z**ero liquid discharge (ZLD)** to ensure water conservation and waste management. • Utilization of fly ash for cement and brick manufacturing to achieve 100% utilization targets. *4. Commitments and Future Reporting* APL is committed to: • Periodically updating the regulatory authority & stakeholders with progress reports on SDG alignment and the net-zero roadmap. • Undertaking third-party audits to validate emission reductions and sustainability efforts. • Engaging with international climate action programs to align with global best practices in decarbonization. • This comprehensive strategy reflects APL's commitment to sustainable growth while supporting India's and the world's journey toward a low-carbon future.
3.3	PP shall submit the EIA/EMP report after the plagiarism check using authenticated plagiarism software.	Final EIA/EMP report will be submitted after the plagiarism check using authenticated plagiarism software and the plagiarism certificate will be enclosed with Final EIA/EMP

S. No.	Terms of Reference	Compliance status
		report.
3.4	Detailed description of all the court cases including all directions given by the apex and currents status of them shall submit.	No litigation pertaining to the Environment & Forest. Details of court cases with current status will be enclosed with the Final EIA & EMP Report**.**
3.5	PP should provide in the EIA Report details of all the statutory clearances, permissions, no objection certificates, consents etc. required for this project under various Acts, Rules and regulations and their status or estimated timeline after grant of EC.	Details of statutory clearances, permissions, no objection certificates, consents etc. applicable for the project are given in table no. 1.5 of Chapter 1 of this EIA report.
3.6	The PP should submit the photograph of monitoring stations & sampling locations. The photograph should bear the date, time, latitude & longitude of the monitoring station/sampling location. In addition to this PP should submit the original test reports and certificates of the labs which will analyze the samples.	The baseline monitoring photographs depicting monitoring stations & sampling locations bearing the date, time, latitude & longitude along with the original test reports and certificates (NABL accreditation & MoEF&CC certificate) of the environmental monitoring laboratory are enclosed as **Annexure 8.**
3.7	PP should clearly bring out the details of the manpower to be engaged for this project with their roles / responsibilities / designations. In addition to this PP should mention the number and designation of persons to be engaged for the implementation of environmental management plan (EMP). The capital and recurring expenditure to be incurred needs to be submitted.	**Construction Phase:** Permanent: 350, Contractual: 8000 **Operation Phase:** Permanent: 550, Contractual:350 The comprehensive handling of environmental considerations during the construction and operation phases of the thermal power station will be entrusted to a dedicated and fully equipped Environmental Management Division (EMD) comprising of suitable equipped manpower. The estimated budget for implementation of Environmental Management Plan (EMP) Rs. 5,992.94 Crore.
3.8	PP should submit the year-wise, activity-wise and time-bound budget earmarked for EMP, occupational health surveillance, and activities proposed to address the issues raised during the Public Hearing. The capital and recurring expenditures to be incurred	A budget of Rs. 66.00 crore (as per Ministry's OM dated 01.05.2018) is allocated for Social EMP (CER) activities, and concerns raised /suggestions made by stakeholders during public consultation will be addressed in the final EIA report by means of a time bound action plan ensuring responsible corporate practices.

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	need to be submitted.	The budgetary allocation based on socio-economic survey of the study area is given in Chapter 8 of this EIA & is subject to revisions based on recommendations/suggestions received from stakeholders during public consultation and recommendations/directions of the Hon'ble EAC during appraisal of environmental clearance. The final budgetary allocation will be submitted with Final EIA/EMP report.
3.9	Activities shall be prepared based on the issues arise during public hearing conducted and fresh written submission with defined timeline and budgetary provisions.	Action plan with timeline & budgetary allocation based on need based survey while also addressing suggestions received during public hearing will be submitted along with Final EIA/EMP report.
3.10	PP shall submit detailed plan to reallocate of nearby school, hospital and/or other sensitive infrastructure.	During Site Visit of MoEFCC, EAC Members & IRO, Jaipur on January'2025 The members suggested relocation of School & hospital is not necessary.
3.11	PP shall submit land use change within 10 kms radius in time series using satellite imageries.	Details of change in land use of study area in last 10 years is given in Chapter 3 of this EIA report.
3.12	The PP should ensure that only NABET-accredited consultants shall be engaged for the preparation of EIA/EMP Reports. PP shall ensure that the accreditation of the consultant is valid during the collection of baseline data, preparation of EIA/EMP report and the appraisal process. The PP and consultant should submit an undertaking the information and data provided in the EIA Report and submitted to the Ministry are factually correct and the PP and consultant are fully accountable for the same.	Noted. • NABET accredited EIA consultant organization: Gaurang Environmental Solutions Pvt. Ltd. • NABET Certificate: NABET / EIA / 23-26/RA 0338 valid upto 07.12.2026 • The copy of NABET accreditation certificate is given at **S. No. A** of this EIA report. • NABL certified environmental monitoring laboratory: Newcon Consultants and Laboratories, Ghaziabad • NABL Certificate Number & Validity: Certificate No.: TC-12621; Validity period: 17.11.2023 to 16.11.2025 • The copy of NABL Certificate is enclosed with baseline monitoring reports enclosed as **Annexure 8** with this EIA report. • Copy of undertaking in compliance to ToR point 4.11 by EIA Coordinator & PP will be submitted with Final EIA Report**.**

S. No.	Terms of Reference	Compliance status
3.13	PP should provide in the EIA Report details of the statutory clearances, permissions, no objection certificates, consents etc. required for this project under various Acts, Rules and regulations and their status or estimated timeline after the grant of EC.	Details of statutory clearances, permissions, no objection certificates, consents etc. applicable for the project are given in table no. 1.5 of Chapter 1 of this EIA report.
3.14	The budget to be earmarked for the various activities shall be decided after perusal of the Standard EC Conditions published by the Ministry	The estimated capital cost for the proposed project is Rs. 36,600 Crore. The estimated budget for implementation of Environmental Management Plan (EMP) Rs. 5,992.94 Crore. A budget of Rs. 66 Crore (as per Ministry's OM dated 01.05.2018) is allocated for Social EMP (CER) activities, and concerns raised /suggestions made by stakeholders during public consultation will be addressed in the final EIA report by means of a time bound action plan ensuring responsible corporate practices. The budgetary allocation based on socio-economic survey of the study area is given in Chapter 8 of this EIA & is subject to revisions based on recommendations/suggestions received from stakeholders during public consultation and recommendations/directions of the Hon'ble EAC during appraisal of environmental clearance as per MoEF&CC O.M dated 30.09.2020. The final budgetary allocation will be submitted with Final EIA/EMP report.
3.15	All the certificates viz. Involvement of Forest land, distance from the protected area, and list of flora & fauna should be duly authenticated by the Forest Department. The Certificate should bear the name, designation, official seal of the person signing the certificate and dispatch number.	The total project area is 822.45 Ha which includes 1.758 Ha. forest land outside Plant boundary after forest dept inspection for proposed Coal Conveyor between proposed coal yard and BTG. The remaining 820.69 Ha is in possession of APL, Kawai. Application of FC (Proposal No. FP/RJ/OTHERS/467838/2024) for Land diversion of 1.758 Ha. (Forest Area) for Coal Conveyor after Forest dept inspection has already submitted and is under process.
3.16	Aerial view video of project site and transportation route proposed for this project shall be recorded through drone and be	Aerial view video will be submitted during appraisal for Environmental Clearance.

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	submitted.	
3.17	PP shall comply with norms of OM J-13011/18/2014-IA. I (T) dated 15.03.2017.	APL, Kawai will comply.
3.18	A sub-committee of the EAC shall visit the site prior to appraisal.	The Site Visit of sub-committee of EAC has completed on 07.01.2025.
3.19	PP shall submit 10 years of satellite image data shall be submitted w.r.t forest area, land use and land pattern of 10km radius from the plant boundary after analyzing the same.	Details of change in land use w.r.t. forest area, agricultural land, water bodies etc. of study area is given in Chapter 3 of this EIA report.
Standard Terms of Reference for (Thermal Power Plants)		
1	**Statutory Compliance**	
1.1	The proposed project shall be given a unique name in consonance with the name submitted to other Government Departments etc. for its better identification and reference.	Contents of para 1.1 are duly noted. The project name is as under: *"Proposed Expansion of Kawai Thermal Power Plant under Phase–II by adding 3200 (4x800) MW Ultra Super Critical Thermal Power Plant to Existing 1320 (2x660) MW at Village Kawai, Tehsil Atru, District Baran, Rajasthan."* The same shall be in consonance with the name submitted to concerned Government Departments.
1.2	Vision document specifying prospective long-term plan of the project shall be formulated and submitted.	Vision document specifying prospective long-term plan is enclosed as **Annexure 3.**
1.3	Latest compliance report duly certified by the Regional Office of MoEF&CC for the conditions stipulated in the environmental and CRZ clearances of the previous phase(s) for the expansion projects shall be submitted.	Integrated Regional Office of MoEFCC, Jaipur has Certified vide File No. IV/ENV/R/TH-44/821/2011 dated: 26.05.2013 & 09.10.2015. MoEFCC, Lucknow Office had visited the Kawai TPP dated 23rd and 24th November in 2020. APL, Kawai has submitted a request letter to IRO, Jaipur for Certified EC Compliance Report (CCR) vide letter no. APL/Kawai/TPP/EC/IRO/MoEFCC/201/2025 dated 02.01.2025 and Site Visit has been completed on 07.01.2025.
2.	**Details of the Project and Site**	
2.1	The project proponent needs to identify minimum three potential sites based on environmental, ecological and economic	The proposed expansion 3200 MW of existing 1320 MW operational Kawai Thermal Power Plant in Village Kawai, Tehsil Atru, District Baran, Rajasthan, no alternative sites

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	considerations, and choose one appropriate site having minimum impacts on ecology and environment. A detailed comparison of the sites in this regard shall be submitted.	have been examined for the Thermal Power Plant. However, alternative route analysis has been carried out for proposed Coal Conveyor Belt route to transfer coal from coal handling plant to BTG area. Details are as below: • No wildlife sanctuary / Biosphere/ Protected Areas / Archaeological sites. • Least/minimum forest involvement • Higher density tree patches avoided • No involvement of temples/ Cultural Habitats/ Schools & colleges. • Minimum route length The proposed forest area is the minimum area & unavoidable area. The detailed alternate site analysis for conveyor belt is given in Chapter 5 of EIA report.
2.2	Executive summary of the project indicating relevant details along with recent photographs of the proposed site (s) shall be provided. Response to the issues raised during Public Hearing and the written representations (if any), along with a time bound Action Plan and budgetary allocations to address the same, shall be provided in a tabular form, against each action proposed.	The executive summary of the project, including pertinent information is given in Chapter 11 of this EIA report and also enclosed separately for the purpose of Public Hearing in English as well as vernacular language (Hindi). Recent project site photographs are provided in Chapter 1 of this EIA report. Time bound Action Plan to address issues raised during the Public Hearing and written representations with budgetary allocation will be submitted with Final EIA Report.
2.3	Harnessing solar power within the premises of the plant particularly at available roof tops and other available areas shall be formulated and for expansion projects, status of implementation shall also be submitted.	A roof top solar PV plant of 1.0 MW is proposed within plant premises for harnessing solar power. Additionally, it is proposed to install solar streetlights in the plant premises.
2.4	The geographical coordinates (WGS 84) of the proposed site (plant boundary), including location of ash pond along with topo sheet (1:50,000 scale) and IRS satellite map of the area, shall be submitted. Elevation of plant site and ash pond with respect to HFL of water body/nallah/River and high tide level	The Google Earth Imagery depicting the proposed project site (plant boundary) with geographical coordinates is given in Chapter 2. The SOI Topomap showing plant boundary & environmental settings is given in Chapter 1 & the IRS satellite map of the area is given in Chapter 3 of this EIA Report. Average site elevation - 315 AMSL. The nearest water body

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	from the sea shall be specified, if the site is located in proximity to them.	is Lhasi Nadi at 0.35 km towards SSE of project site.
2.5	Layout plan indicating break-up of plant area, ash pond, green belt, infrastructure, roads etc. shall be provided.	Plant layout specifying the land use break up as indicted in Chapter 2 of EIA & EMP Report.
2.6	Land requirement for the project shall be optimized and in any case not more than what has been specified by CEA from time to time. Item wise break up of land requirement shall be provided.	
2.7	Present land use (including land class/kism) as per the revenue records and State Govt. records of the proposed site shall be furnished. Information on land to be acquired including coal transportation system, laying of pipeline, ROW, transmission lines etc. shall be specifically submitted. Status of land acquisition and litigation, if any, should be provided.	The proposed expansion project is within the APL, Kawai premises and the total project is 822.45 Ha. Application of FC (Proposal No. FP/RJ/OTHERS/467838/2024) for Land diversion of 1.8414 Ha. Coal Conveyor has already submitted and is under process.
2.8	If the project involves forest land, details of application, including date of application, area applied for, and application registration number, for diversion under FCA and its status should be provided along with copies of relevant documents.	The proposed expansion project is within the APL, Kawai premises and the total project is 822.45 Ha. (*includes 1.758 Ha. Forest Area outside power plant premises for Coal Conveyor after Forest dept. inspection*) Application of FC (Proposal No. FP/RJ/OTHERS/467838/2024) for Land diversion of 1.8414 Ha. Coal Conveyor has already been submitted and is under process.
2.9	The land acquisition and R&R scheme with a time bound Action Plan should be formulated and addressed in the EIA report.	No R&R is involved as the proposed expansion is with in the APL, Kawai premises.
2.10	Satellite imagery and authenticated topo sheet indicating drainage, cropping pattern, water bodies (wetland, river system, stream, nallahs, ponds etc.), location of nearest	Satellite imagery of the project site and study area is given in chapter 3 of this EIA report and SOI toposheet of 10 km radius showing project site & environmental settings is given in Chapter 1.

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	habitations (villages), creeks, mangroves, rivers, reservoirs etc. in the study area shall be provided.	
2.11	Topography of the study area supported by toposheet on 1:50,000 scale of Survey of India, along with a large scale map preferably of 1:25,000 scale and the specific information whether the site requires any filling shall be provided. In that case, details of filling, quantity of required fill material; its source, transportation etc. shall be submitted.	As per Survey of India project site falls under G43W9. SOI toposheet of 10 km radius showing project site & environmental settings is given in Chapter 1. The levelling & grading works will result in excavated earth which will be utilized for filling & grading within plant premises other than top soil, which will be stored & used for greenbelt & plantation.
3.	**Ecology Biodiversity And Environment**	
3.1	A detailed study on land use pattern in the study area shall be carried out including identification of common property resources (such as grazing and community land, water resources etc.) available and Action Plan for its protection and management shall be formulated. If acquisition of grazing land is involved, it shall be ensured that an equal area of grazing land be acquired and developed and detailed plan submitted.	The project does not involve acquisition of any grazing land. Detailed description of land use pattern with land use classification of the study area & project site is given Chapter 3 of this EIA report.
3.2	Location of any National Park, Sanctuary, Elephant/Tiger Reserve (existing as well as proposed), migratory routes / wildlife corridor, if any, within 10 km of the project site shall be specified and marked on the map duly authenticated by the Chief Wildlife Warden of the State or an officer authorized by him.	There is no notified National Park, Wildlife Sanctuary, Elephant/Tiger Reserve, or migratory routes/WL corridor exists within 10 km of the study area. SOI toposheet of 10 km radius showing project site & environmental settings are enclosed in Chapter 1**.**
3.3	A mineralogical map of the proposed site (including soil type) and information (if available) that the site is not located on	The project site is not located on potentially mineable mineral deposit. Loamy soil with fine texture was found in study area. Geomorphological map of study area is given in Chapter 3 of

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	potentially mineable mineral deposit shall be submitted.	this EIA and summary of soil quality in study area is provided in Chapter 3 of this EIA report.
3.4	The water requirement shall be optimized (by adopting measures such as dry fly ash and dry bottom ash disposal system, air cooled condenser, concept of zero discharge) and in any case not more than that stipulated by CEA from time to time, to be submitted along with details of source of water and water balance diagram. Details of water balance calculated shall take into account reuse and re- circulation of effluents.	The total water requirement for the proposed project is 6400 m^3/hr (56 MCM/Year) i.e. 2 m^3/MWh, which is well within the stipulated norms and standards. The water will be sourced from Parwan River/Dam through existing water pipeline of about 18.4 km in length. With a focus on continuous operation, the project employs advanced thermal power station technologies, including Ultra-Supercritical Steam Parameters for enhanced efficiency and reduced environmental impact. Boilers designed for uniform heat distribution result in a 3-5% efficiency gain. The strategy also addresses environmental concerns, lowering PM, SO_2, and NOx emissions. The proposed expansion plant is designed for Zero Liquid Discharge (ZLD) concept with Cycle of Concentration (COC) 5. Details of water requirement and utilization with water balance are given in Chapter 2 of the EIA report. Water allocation of 34 MCM/year is already obtained from Water Resource Department (WRD), Jaipur, Rajasthan and water allocation for additional 52 MCM/Year water allocation has been submitted on 03.06.2024 to WRD, Jaipur.
3.5	Water body/Nallah (if any) passing across the site should not be disturbed as far as possible. In case any Nallah / drain is proposed to be diverted, it shall be ensured that the diversion does not disturb the natural drainage pattern of the area. Details of proposed diversion shall be furnished duly approved by the concerned Department of the State.	Not applicable as the no water body/ nallah is passing through the site.
3.6	It shall also ensure that a minimum of 500 m distance of plant boundary is kept from the HFL of river system/streams etc. and the	The proposed expansion is within the existing APL, Kawai Premises. Details of water bodies & highways are given in Chapter 1 of EIA & EMP report.

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	boundary of site should also be located 500 m away from railway track and National Highways.	
3.7	Hydro-geological study of the area shall be carried out through an institute / organization of repute to assess the impact on ground and surface water regimes. Specific mitigation measures shall be spelt out and time bound Action Plan for its implementation shall be submitted	The study on Hydrogeology of the project site as well study area through a reputed institute/Government organization has been conducted. Specific mitigation measures shall be spelt out and time bound Action Plan for its implementation will be submitted with Final EIA/EMP report.
3.8	Detailed Studies on the impacts of the ecology including fisheries of the River/Estuary/Sea due to the proposed withdrawal of water / discharge of treated wastewater into the River/Sea etc shall be carried out and submitted along with the EIA Report. In case of requirement of marine impact assessment study, the location of intake and outfall shall be clearly specified along with depth of water drawl and discharge into open sea.	The study on Hydrogeology of the project site as well study area through a reputed institute/Government organization has been conducted. The plant is based on Zero Liquid Discharge (ZLD). Wastewater generated will be treated in ETP & STP to conform to the effluent standards and will be recycled for Ash Handling /plant use and greenbelt development.
3.9	Source of water and its sustainability even in lean season shall be provided along with details of ecological impacts arising out of withdrawal of water and taking into account inter-state shares (if any). Information on other competing sources downstream of the proposed project and commitment regarding availability of requisite quantity of water from the Competent Authority shall be providedalong with letter / document stating firm allocation of water	• The proposed expansion project requires 56 MCM/ year which will be sourced from Parwan River/Dam to plant site through existing water pipeline of about 30 km in length. • No groundwater source will be tapped for the proposed thermal power plant. The study on Hydrogeology of the project site as well study area through a reputed institute/Government organization has been conducted.
3.10	Detailed plan for rainwater harvesting and its proposed utilization in the plant shall be	No groundwater source will be tapped for the proposed thermal power plant. Detailed plan for rainwater harvesting

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	furnished. In addition, wherever ground water is drawn, PP shall submit detailed plan of Water charging activity to be undertaken.	is given in Chapter 4 of this EIA report.
3.11	Feasibility of near zero discharge concept shall be critically examined and its details submitted.	The proposed expansion project is based on ZLD principle. Details are given in Chapter 2 & 4 of the EIA report.
3.12	Optimization of Cycles of Concentration (COC) along with other water conservation measures inthe project shall be specified.	The estimated total raw water requirement stands at 56 MCM/annum., factoring in 1.0% for heat cycle makeup, approximately 1.7% for cooling towers with a COC of 5, and other consumptive needs such as potable water, process water, and service water. To minimize raw water consumption, blowdown water from the cooling tower will be repurposed in the Ash Handling System. Details are given in Chapter 2 of the EIA report.
3.13	Plan for recirculation of ash pond water and its implementation shall be submitted.	Ash Water Recovery System (AWRS) will be provided for recirculation of ash pond water. Settling and Surge Tank shall be provided for recirculation of water (i.e. BA hopper overflow water, decanted water from Hydrobins) for use in the Ash Handling system. Details are given in Chapter 2 of this EIA report.
3.14	Detailed plan for conducting monitoring of water quality regularly with proper maintenance of records shall be formulated. Detail of methodology and identification of monitoring points (between the plant and drainage in the direction of flow of surface / ground water) shall be submitted. It shall be ensured that parameter to be monitored also include heavy metals. A provision for long-term monitoring of ground water table using Piezometer shall be incorporated in EIA, particularly from the study area.	The plan for post EC water quality monitoring has been formulated and given in Chapter 6 of this EIA report.
3.15	Hazards Characterization: Past incidents of hazard events within 10 km radius of project	Contents of para 3.15 are duly noted. No major hazard has been reported in study area in the past year.

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	area with detailed analysis of causes and probability of reoccurrence.	
4.	**Environmental Baseline Study And Mitigation Measures**	
4.1	One complete season (critical season) site specific meteorological and AAQ data (except monsoon season) as per latest MoEF&CC Notification shall be collected along with past three year's meteorological data for that particular season for wind speed analysis and the dates of monitoring shall be recorded. The parameters to be covered for AAQ shall include PM_{10}, $PM_{2.5}$, SO_2, NOx, CO and Hg. The location of the monitoring stations should be so decided so as to take into consideration the upwind direction, pre-dominant downwind direction, other dominant directions, habitation and sensitive receptors. There should be at least one monitoring station each in the upwind and in the pre - dominant downwind direction at a location where maximum ground level concentration is likely to occur.	The Baseline data collection has been done during post-monsoon season (Oct-Dec' 2024). Environmental monitoring for primary data was carried out by NABL and MoEF&CC approved laboratory M/s Newcon Consultants and Laboratories. The AAQ monitoring had been carried out at 11 stations including the project site. The parameters monitored include PM_{10}, $PM_{2.5}$, SO_2, NOx, CO. The monitoring stations were finalized taking into consideration the upwind direction, pre-dominant downwind direction, other dominant directions, habitation and sensitive receptors. The results of the monitored data are given in Chapter 3 of the EIA report.
4.2	In case of expansion project, air quality monitoring data of 104 observations a year for relevant parameters at air quality monitoring stations as identified/stipulated shall be submitted to assess for compliance of AAQ Standards (annual average as well as 24 hrs).	Contents of para 4.2 is noted. Air quality monitoring is being done in 6 locations (4 in core zone and 2 in nearby villages Mukhandpur & Kawai). The CAAQMS at existing TPP is already connected to SPCB/CPCB servers, The results are being submitted to MoEFCC, SPCB/CPCB periodically along with Six monthly Compliance reports.
4.3	A list of industries existing and proposed in the study area shall be furnished.	There are no industries present within 10 km radius of study area.
4.4	Cumulative impacts of all sources of emissions including handling and	For the purpose of present study, air quality modeling has been done using AERMOD dispersion model for different

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	transportation of existing and proposed projects on the environment of the area shall be assessed in detail. Details of the Model used and the input data used for modelling shall also be provided. The air quality contours should be plotted on a location map showing the location of project site, habitation nearby, sensitivereceptors, if any. The windrose and isopleths should also be shown on the location map. The cumulative study should also include impacts on water, soil and socio-economics.	stability state Gaussian plume dispersion, designed for multiple point sources for short term and developed by United States Environmental Protection Agency [USEPA] has been used for simulations. The input data and isopleths depicting the GLC levels are provided in Chapter 4 of the EIA report. The project does not involve any ground water abstraction and/or waste water discharge, hence water quality modeling has not been carried out.
4.5	Radio activity and heavy metal contents of coal to be sourced shall be examined and submitted along with laboratory reports.	Details regarding proximate and ultimate analysis of coal are given in Chapter 2 of the EIA report. Radioactivity and heavy metal contents of coal will be submitted with Final EIA/EMP report.
4.6	Fuel analysis shall be provided. Details of auxiliary fuel, if any, including its quantity, quality,storage etc should also be furnished.	• For the proposed project expansion project of 4x800MW, the annual fuel (coal) requirement is estimated at 12.90 million MTPA at 85% PLF with Design Coal GCV of 3700 k Cal/kg. The Coal will be sourced from Commercial Coal Mines through rail till plant. • LDO will be used as secondary fuel @ 30000 KL per annum. • The auxiliary fuel for the envisioned Power Project, specifically LDO/HSD, is scheduled to be conveyed to the power plant using road in tankers and stored in vertical cylindrical steel tanks. The transfer of HSD/LDO to the boilers is intended to be facilitated directly from the existing storage tanks through unloading pumps. Each tank will be equipped with a radar-type level transmitter to provide indications in the Central Control Room. • Details are given in Chapter 2 of the EIA report.
4.7	Quantity of fuel required, its source and characteristics and documentary evidence to substantiate confirmed fuel linkage shall be furnished. The Ministry's Notification dated 02.01.2014 regarding ash content in coal shall be complied. For the expansion projects, the compliance of the existing units to the said Notification shall also be submitted	
4.8	Details of transportation of fuel from the source (including port handling) to the proposed plant and its impact on ambient AAQ shall be suitably assessed and submitted. If transportation entails a long distance it shall be ensured that rail transportation to the site shall be first	

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	assessed. Wagon loading at source shall preferably be through silo/conveyor belt.	
4.9	For proposals based on imported coal, inland transportation and port handling and rail movement shall be examined and details furnished. The approval of the Port and Rail Authorities shall be submitted.	Domestic Coal will be sourced from Commercial Coal Mines through Rail up to plant.
4.10	Details regarding infrastructure facilities such as sanitation, fuel, restrooms, medical facilities, safety during construction phase etc. to be provided to the labour force during construction as well as to the casual workers including truck drivers during operation phase should be adequately catered for and details furnished.	Facilities such as infrastructure, sanitation, fuel, restrooms, medical facilities, and safety measures, will be provided for the construction workforce and casual workers, including truck drivers, during both the construction and operation phases.
5.	**Environmental Management Plan**	
5.1	EMP to mitigate the adverse impacts due to the project along with item - wise cost of its implementation in a time bound manner shall be specified.	The estimated budget for implementation of Environmental Management Plan (EMP) Rs. 5,992.94 Crore The item wise breakup of the same is given in Chapter 10 of the EIA report.
5.2	A Disaster Management Plan (DMP) along with risk assessment study including fire and explosion issues due to storage and use of fuel should be prepared. It should take into account the maximum inventory of storage at site at any point of time. The risk contours should be plotted on the plant layout map accident taking place. Based on the same, proposed safeguard measures should be provided. Measures to guard against fire hazards should also be invariably provided. Provision for mock drills shall be suitably incorporated to check the efficiency of the plans drawn.	A comprehensive Disaster Management Plan (DMP) has been developed, incorporating a thorough risk assessment study that specifically addresses potential fire and explosion risks associated with fuel storage and utilization. The plan meticulously accounts for the maximum inventory of storage on-site at any given time, with risk contours clearly illustrated on the plant layout map, outlining potential impacts on proposed activities in the event of an accident. Furthermore, the plan outlines proposed safeguard measures, including preventive measures against fire hazards. The integration of mock drills will be conducted to assess and enhance the effectiveness of the formulated emergency response plans. Details given in Chapter 7 of the EIA report.

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5.3	The DMP so formulated shall include measures against likely Fires/Tsunami/Cyclones/Storm Surges/ Earthquakes etc, as applicable. It shall be ensured that DMP consists of both On-site and Off-site plans, complete with details of containing likely disaster and shall specifically mention personnel identified for the task. Smaller version of the plan for different possible disasters shall be prepared both in English and local languages and circulated widely.	The Disaster Management Plan (DMP) comprehensively covers measures addressing potential incidents such as Fires, Tsunamis, Cyclones, Storm Surges, Earthquakes, among others, as applicable to the project site. The DMP encompasses both On-site and Off-site plans, providing detailed strategies for managing likely disasters.
5.4	Details of fly ash utilization plan as per the latest fly ash Utilization Notification of GOI along with firm agreements / MoU with contracting parties including other usages etc. shall be submitted. The plan shall also include disposal method / mechanism of bottom ash along with monitoring mechanism.	The Ash Handling System for each unit entails the collection and disposal of bottom and fly ash with a focus on maximum utilization. Bottom ash is gathered wet, with efforts for full utilization; unutilized ash is directed to the ash pond. Fly ash is efficiently removed using vacuum and pressurized conveying systems, transported to storage silos, and disposed via High Concentration Slurry Disposal (HCSD) in emergencies. The Ash Water System, common for all units, includes tanks and pumps, promoting water recirculation. Ash will be utilized for Cement Industries, Road Construction, filling of mine voids/stone quarry area, manufacturing of Bricks, aggregate replacement in concrete, etc. as per Fly Ash Notification, 31.12.2021 and amendments. MoA with cement industries (for utilization of fly ash) has been executed for Proposed expansion project.
6.	**Green Belt Development**	
6.1	Detailed scheme for raising green belt of native species of appropriate width (50 to 100 m) and consisting of at least 3 tiers around plant boundary not less than 2000 tree per ha with survival rate of more than 85%shall be submitted. Photographic evidence must be created and submitted periodically including	Greenbelt on plant periphery and plantation within plant premises is proposed in 169.44 Hectare in addition to the existing area 120 Ha. after exploring all the vacant spaces. It is proposed to plant 4,23,600 nos. of native trees in addition to the existing. Brief of greenbelt development are as below: Total area under greenbelt & plantation within plant premises will be 35% i.e. 289.44 Hectare.

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	NRSA reports in case of expansion projects. A shrub layer beneath tree layer would serve as an effective sieve for dust and sink for CO_2 and other gaseous pollutants and hence a stratified green belt should be developed.	The details of greenbelt development are discussed in **Chapter 4** of this EIA report & action plan for year-wise and location wise greenbelt development & plantation along with Plant layout showing greenbelt & plantation.
6.2	Over and above the green belt, as carbon sink, plan for additional plantation shall be drawn by identifying blocks of degraded forests, in close consultation with the District Forests Department. In pursuance to this the project proponent shall formulate time bound Action Plans along with financial allocation and shall submit status of implementation to the Ministry every six months	Greenbelt & plantation plan in study area to act as carbon sink to be developed under Social EMP plan will be submitted with Final EIA Report. A separate budget Rs. 66 crore towards CER activities (as per Ministry's OM dated 01.05.2018) is allocated for Social EMP (CER) activities, and efforts will be made to address concerns raised after the public consultation during the final EIA ensuring responsible corporate practices.
7.	**Socio-economic Activities**	
7.1	Socio-economic study of the study area comprising of 10 km from the plant site shall be carried out through a reputed institute / agency which shall consist of detail assessment of the impact on livelihood of the local communities.	Socio-economic study of the study area comprising of 10 km from the plant site has been conducted. Details are given in Chapter 3 of the EIA report. The same shall be vetted through an institute of repute & submitted with Final EIA report. APL will prioritise locals for employment based on qualification & eligibility and the details for identification of employable youth and employment oriented technical/vocational/training program will be included in the detailed action plan under Social EMP to be included in Final EIA based on recommendations/suggestions during Public consultation.
7.2	Action Plan for identification of local employable youth for training in skills, relevant to the project, for eventual employment in the project itself shall be formulated and numbers specified during construction & operation phases of the Project.	
7.3	If the area has tribal population, it shall be ensured that the rights of tribals are well protected. The project proponent shall accordingly identify tribal issues under various provisions of the law of the land.	

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7.4	A detailed CER plan along with activities wise break up of financial commitment shall be prepared in terms of the provisions OM No. 22-65/2017-IA.III dated 30.09.2020. CER component shall be identified considering need based assessment study and Public Hearing issues. Sustainable income generating measures which can help in upliftment of affected section of society, which is consistent with the traditional skills of the people shall be identified.	A budget of Rs. 66 Crore (as per Ministry's OM dated 01.05.2018) is allocated for Socio EMP (CER) activities, and efforts will be made to address concerns raised after the public consultation during the final EIA preparation ensuring responsible corporate practices. The budgetary allocation based on socio-economic survey of the study area given is given in Chapter 8 of this EIA & is subject to revisions based on recommendations/suggestions received during public consultation and recommendations/directions of the Hon'ble EAC during appraisal of environmental clearance. The final budgetary allocation will be submitted with Final EIA/EMP report. The key Highlight of some initiatives & activities is going to undertake in nearby villages are as follow: • Sustainable Livelihood options & Woman Empowerment • Educational Initiatives • Community Health Initiatives • Community Rural Infrastructure development • Sports & Culture Development • General Management & Administration
7.5	While formulating CER schemes it shall be ensured that an in-built monitoring mechanism for the schemes identified are in place and mechanism for conducting annual social audit from the nearest government institute of repute in the region shall be prepared. The project proponent shall also provide Action Plan for the status of implementation of the scheme from time to time and dovetail the same with any Govt. scheme(s). CER details done in the past should be clearly spelt out in case of expansion projects.	
7.6	R&R plan, as applicable, shall be formulated wherein mechanism for protecting the rights and livelihood of the people in the region who are likely to be impacted, is taken into consideration. R&R plan shall be formulated after a detailed census of population based on socio economic surveys who were dependent on land falling in the project, as well as, population who were dependent on land not owned by them.	No R&R is involved as the proposed expansion is with in the APL, Kawai premises.

S. No.	Terms of Reference	Compliance status
7.7	Assessment of occupational health and endemic diseases of environmental origin in the study area shall be carried out and Action Plan to mitigate the same shall be prepared.	APL is committed to ensuring the health and safety of its workforce and the surrounding communities while minimizing the environmental impact of its proposed ultra-supercritical thermal power plant project. The following outlines the assessment of occupational health and endemic diseases and the corresponding action plan to mitigate them: **1. Assessment of Occupational Health Risks** IME & PME will be conducted periodically as per Factory's act. ***1.1 Potential Occupational Health Hazards*** **Respiratory Issues**: Due to exposure to dust, particulate matter (PM), and gaseous emissions (SO_2, NOx). **Thermal Stress**: From high-temperature working environments, especially in boiler operations. **Noise-Induced Hearing Loss**: Due to prolonged exposure to high noise levels from turbines, generators, and other equipment. **Ergonomic Risks**: Associated with manual handling, awkward postures, and repetitive tasks during equipment maintenance and operations. **Electrical Hazards**: Potential risks of electrical shocks and burns due to high-voltage equipment. **2. Action Plan to Mitigate Occupational and Environmental Health Risks** A comprehensive action plan has been prepared to address the identified risks and mitigate their impacts. ***3.1 Occupational Health Management Plan*** **Preventive Measures**: • Provision of Personal Protective Equipment (PPE), such as respirators, earplugs, heat-resistant clothing, and gloves. • Conduction of regular workplace air quality monitoring to control exposure to dust and gaseous emissions. • Installation of noise barriers and provide hearing protection in high-noise areas.

S. No.	Terms of Reference	Compliance status
		• Implementation proper ergonomic design and automation to reduce manual handling risks. **Health Surveillance**: • Conduction of regular health check-ups, including pulmonary function tests, audiometry, and medical screenings for all employees. • Maintenance of an occupational health database to track health trends and provide early intervention for at-risk employees. **Training and Awareness**: • Provide periodic training on workplace safety, handling of hazardous materials, and emergency response. • Conduct awareness programs on the importance of PPE usage and healthy practices. **Onsite Medical Facilities**: • Establish a fully equipped onsite medical center with trained personnel. • Provide first aid stations and ensure quick response to workplace injuries and emergencies. ***3.2 Mitigation of Endemic Diseases*** **Air Quality Management**: • Installation of advanced pollution control equipment, including Selective Catalytic Reduction (SCR), adequate Stack Height and Electrostatic Precipitators (ESP), to ensure emissions are within prescribed limits. • Conduction of regular air quality monitoring in the surrounding areas and share findings with local authorities and communities. **Water and Sanitation Improvements**: • Implementation of Zero **Liquid Discharge (ZLD)**. • Support to local government initiatives for clean drinking water and improved sanitation in surrounding communities. **Waste Management**:

S. No.	Terms of Reference	Compliance status
		• Ensuring proper disposal and utilization of fly ash and other by-products to minimize environmental contamination. • Collaborating with local authorities to improve waste collection and disposal systems in nearby villages. **Community Health Initiatives**: Organization of health camps in the surrounding villages to screen and treat respiratory, waterborne, and vector-borne diseases. Provision of training and awareness programs on hygiene, sanitation, and disease prevention. ***3.3 Emergency Response and Contingency Planning*** Developing and implementation of an **Occupational Health and Safety Management System (OHSMS)** aligned with ISO 45001. Preparing a detailed Emergency Response Plan (ERP) to address potential incidents like chemical spills, fires, or medical emergencies. Regular conduction of mock drills for employees and contractors to enhance preparedness for emergencies. **4. Monitoring and Reporting** Establishing an Environmental Management Division (EMD) to oversee the implementation of the action plan. Monitoring key health and safety performance indicators (e.g., accident frequency rate, occupational disease cases). Periodically updating the regulatory authority & stakeholders on health assessments and mitigation progress. **5. Long-Term Goals** • Continuous improvement of occupational health and safety measures to achieve **zero harm** targets. • Collaboration with local authorities and stakeholders to improve healthcare infrastructure in the region.
7.8	Occupational health and safety measures for the workers including identification of work related health hazards shall be formulated.	The details of Occupational health and safety measures for the workers are given in the Chapter 7 of this EIA report.

S. No.	Terms of Reference	Compliance status
	The company shall engage full time qualified doctors who are trained in occupational health. Health monitoring of the workers shall be conducted at periodic intervals and health records maintained. Awareness programme for workers due to likely adverse impact on their health due to working in non-conducive environment shall be carried out and precautionary measures like use of personal equipment etc. shall be provided. Review of impact of various health measures undertaken at intervals of two to three years shall be conducted with an excellent follow up plan of action wherever required.	
8.	**Corporate Environment Policy**	
8.1	Does the company has a well laid down Environment Policy approved by its Board of Directors? If so, it may be detailed in the EIA report.	The Environmental Policy of APL prescribing SOP / procedures to bring into focus any infringement / deviation / violation of the environmental norms / conditions will be submitted with Final EIA report. Corporate Environmental Policy of APL is enclosed as Annexure -5.
8.2	Does the Environment Policy prescribe for standard operating process / procedures to bring into focus any infringement / deviation / violation of the environmental or forest norms / conditions? If so, it may be detailed in the EIA.	
8.3	What is the hierarchical system or Administrative order of the company to deal with the environmental issues and for ensuring compliance with the environmental clearance conditions. Details of this system may be given.	APL, Kawai has a well-defined hierarchical system in place. Details of Environmental Management Division/Cell (EMD) is given in Chapter 10 of the EIA report. A dedicated and fully equipped Environmental Management Division (EMD) is proposed to deal with the environmental issues and for ensuring compliance with the environmental clearance conditions & for compliance management system. The EMD will be staffed with a proficient team encompassing environmental engineers, chemists,
8.4	Does the company has compliance management system in place wherein compliance status along with compliances /	

S. No.	Terms of Reference	Compliance status
	violations of environmental norms are reported to the CMD and the Board of Directors of the company and / or shareholders or stakeholders at large? This reporting mechanism should be detailed in the EIA report.	horticulturists, safety specialists, and well-trained personnel responsible for the operation and maintenance of pollution control equipment.
9.	**Miscellaneous**	
9.1	All the above details should be adequately brought out in the EIA report and in the presentationto the Committee.	Noted.
9.2	Details of litigation pending or otherwise with respect to project in any Court, Tribunal etc. shallinvariably be furnished.	No litigation pertaining to the Environment & Forest. Details of court cases with current status will be enclosed with the Final EIA & EMP Report**.**
9.3	In case any dismantling of old plants are envisaged, the planned land use & land reclamation of dismantled area to be furnished.	The proposed expansion is within the APL, Kawai premises. At present the land for proposed expansion is used as Air Strip by Adani Group on a temporary basis which will be cleared.
10.	**Additional Tor For Coastal Based Thermal Power Plants Projects (Tpps)**	Not Applicable. The proposal is for Expansion of Kawai TPP in Baran district of Rajasthan & there is no CRZ in study area of project site as the state is land locked.
10.1	Low lying areas fulfilling the definition wetland as per Ramsar Convention shall be identified and clearly demarcated w.r.t the proposed site.	
10.2	If the site includes or is located close to marshy areas and backwaters, these areas must be excluded from the site and the project boundary should be away from the CRZ line. Authenticated CRZ map from any of the authorized agencies shall be submitted.	
10.3	The soil levelling should be minimum with no or minimal disturbance to the natural drainage of the area. If the minor canals (if any) have to be diverted, the design for diversion should be such that the diverted	

S. No.	Terms of Reference	Compliance status
	canals not only drains the plant area but also collect the volume of flood water from the surrounding areas and discharge into marshy areas/major canals that enter into creek. Major canals should not be altered but their embankments should be strengthened and desilted.	
10.4	Additional soil required for levelling of the sites should as far as possible be generated within the site itself in such a manner that the natural drainage system of the area is protected and improved.	
10.5	Marshy areas which hold large quantities of flood water to be identified and shall not be disturbed.	
10.6	No waste should be discharged into Creek, Canal systems, Backwaters, Marshy areas and seas without appropriate treatment. Wherever feasible, the outfall should be first treated in a Guard Pond and then only discharged into deep sea (10 to 15 m depth). Similarly, the Intake should be from deep sea to avoid aggregation of fish and in no case shall be from the estuarine zone. The brine that comes out from Desalinization Plants (if any) should not be discharged into sea without adequate dilution.	
10.7	Mangrove conservation and regeneration plan shall be formulated and Action Plan with details of time bound implementation shall be specified, if mangroves are present in Study Area.	
10.8	A common Green Endowment Fund should be created by the project	

S. No.	Terms of Reference	Compliance status
	proponents out of EMP budgets. The interest earned out of it should be used for the development and management of green cover of the area.	
10.9	Impact on fisheries at various socio economic level shall be assessed.	
10.10	An endowment Fishermen Welfare Fund should be created out of CER grants not only to enhance their quality of life by creation of facilities for Fish Landing Platforms / Fishing Harbour / cold storage, but also to provide relief in case of emergency situations such as missing of fishermen on duty due to rough seas, tropical cyclones and storms etc.	
10.11	Tsunami Emergency Management Plan shall be prepared wherever applicable and Plan submitted prior to the commencement of construction work.	
10.12	There should not be any contamination of soil, ground and surface waters (canals & village pond) with sea water in and around the project sites. In other words necessary preventive measures for spillage from pipelines, such as lining of Guard Pond used for the treatment of outfall before discharging into the sea and surface RCC channels along the pipelines of outfall and intake should be adopted. This is just because the areas around the projects boundaries could be fertile agricultural land used for paddy cultivation.	

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F. No. J-13012/154/2008-IA.II (T)
Government of India
Ministry of Environment, Forest and Climate Change
(Impact Assessment Division)

2nd Floor, Vayu Block
Indira Paryavaran Bhawan
Aliganj, Jor Bagh Road,
New Delhi – 110 003

Dated: 24th April, 2023

To,

M/s Adani Power Ltd.
Adani House, Nr Mithakhali Circle
Navrangpura, Ahmedabad- 380009 (Gujarat)

Sub: 2X660 MW Super Critical Imported Coal Based Thermal Power Plant at Village Kawai in Atru Taluk, in Baran District, Rajasthan Transfer of Environmental Clearance from M/s Adani Power Rajasthan Limited to M/s Adani Power Ltd - reg.

Sir,

This has reference to your online proposal no. IA/RJ/THE/297950/2023 dated 25th February, 2023 regarding transfer of the environmental clearance for the above said project from M/s Adani Power Rajasthan Limited to M/s Adani Power Ltd.

2. The Ministry had earlier issued environmental clearance for the project 2X660 MW Super Critical Imported Coal Based Thermal Power Plant at Village Kawai in Atru Taluk, in Baran District, Rajasthan in favour of M/s Adani Power Rajasthan Limited vide letter dated 4th May, 2011, followed by amendment in EC dated 13th March, 2014 for change of source of coal from Imported to Domestic.

3. M/s Adani Power Ltd has submitted application for transfer of environmental clearance and informed that the Hon'ble NCLT vide its order dated 08th February, 2023, sanctioning the scheme of amalgamation of M/s Adani Power Rajasthan Limited with M/s Adani Power Ltd, and thus necessitating transfer of all requisite approvals in the name of M/s Adani Power Ltd. Also, it has informed that M/s Adani Power Rajasthan Limited is wholly owned subsidiary company of Adani Power Ltd.

4. M/s Adani Power Ltd, has submitted an affidavit to abide by the terms and conditions stipulated in the environment clearance dated 4th May, 2011, followed by amendment in EC dated 13th March, 2014 issued in the name of M/s Adani Power Rajasthan Limited.

5. As per the relevant provisions of the EIA Notification, 2006, the environmental clearance granted to the project vide letter dated 4th May, 2011 for 2X660 MW Super Critical Imported Coal Based Thermal Power followed by amendment in EC dated 13th March, 2014 at Village Kawai in Atru Taluk, in Baran District, Rajasthan are hereby transferred from M/s Adani Power Rajasthan

Limited to M/s Adani Power Ltd on the same terms and conditions under which prior environmental clearance was initially granted.

6. This issues with approval of the competent authority.

24.4.2023

(Yogendra Pal Singh)
Scientist 'E'
Tele: 011-20819364
Email Id: yogendra78@nic.in

Copy to: -

1. The Secretary, Ministry of Power, Shram Shakti Bhawan, Rafi Marg, New Delhi – 110 001.
2. The Chairman, Central Electricity Authority, Sewa Bhawan, R.K. Puram, New Delhi – 110 066.
3. The Member Secretary, Central Pollution Control Board, Parivesh Bhawan, CBD cum-Office Complex, East Arjun Nagar, Delhi – 110 032.
4. The Deputy Director General of Forests (C), Integrated Regional Office, Jaipur, A-209 & 218, 'Aranya Bhawan', Mahatma Gandhi Road, Jhalana Institutional Area, Jaipur (Raj.) – 304 002.
5. The Principal Secretary (Environment), Government of Rajasthan, Room No. 4224, Main Building, Government Secretariat Jaipur, (Rajasthan).
6. The Member Secretary, Rajasthan Pollution Control Board, 4, Jhalana Institutional Area, Jhalana Doongri, Jaipur (Rajasthan) – 302 004.
7. Guard file/Monitoring file.
8. Website of MoEF&CC.

24.4.2023

(Yogendra Pal Singh)
Scientist 'E'

J-13012/154/2008 -IA.II (T)
Government of India
Ministry of Environment & Forests

Paryavaran Bhawan
CGO Complex, Lodi Road
New Delhi-110 003
Dated: 13.03.2014.

To

M/s Adani Power Rajasthan Ltd.
Sambhaav House,
Judges Bangalow Road, Bodakdev
Ahmedabad- 380 015

Ph: 079-2555 6900; Fax: 079-2555 7155

Sub: **2x660 MW Super Critical Coal based TPP at Village Kawai, in Atru Taluk, in Baran Distt., in Rajasthan by M/s Adani Power Rajasthan Ltd. – reg. amendment in EC for change of source of coal from Imported to Domestic.**

Sir,

This has reference to your letters dated 22.07.2013, 16.08.2013, 12.09.2013, 24.09.2013 and 09.12.2013 requesting for the amendment of environmental clearance (EC) accorded for the above project vide letter of even no. dated 04.05.2011 regarding change of source of coal from Imported to Domestic.

2. The matter was placed before the Expert Appraisal Committee (Thermal Power) in its 3rd & 8th Meetings held during October 10, 2013 & January 9-10, 2014 respectively. In acceptance of the recommendation of the Expert Appraisal Committee (Thermal Power) and in view of the information/clarification furnished by you, with respect to the above mentioned power project, the Ministry accords amendment in the said EC for change of source of coal from Imported to Domestic.

3. Further, under Para no.4 of this Ministry's letter of even no. dated 04.05.2011, after the specific condition no. (xxxiv), the following conditions shall be added:

(xxxv) The coal transportation by road shall be through tarpaulin covered trucks for a maximum period of two years and hence forth shall be only through mechanically covered trucks.

(xxxvi) Avenue plantation of 2/3 rows all along the road shall be carried out by the project proponent at its own expenses.

(xxxvii) Periodic maintenance of the road shall be done by the project proponent at its own expenses and shall also facilitate the traffic control on the road.

(xxxviii) Sulphur and ash contents in the domestic coal to be used in the project shall not exceed 0.4 % and 33 % at any given time. In case of variation of coal quality at any point of time, fresh reference shall be made to the Ministry for suitable amendments to environmental clearance condition wherever necessary.

(xxxix) A long term study of radio activity and heavy metals contents on coal to be used shall be carried out through a reputed institute. Thereafter, mechanism for an in-built continuous monitoring for radio activity and heavy metals in coal and fly ash (including bottom ash) shall be put in place.

(xl) Harnessing solar power within the premises of the plant particularly at available roof tops shall be undertaken and status of implementation shall be submitted periodically to the Regional Office of the Ministry.

(xli) Fugitive emissions shall be controlled to prevent impact on agricultural or non-agricultural land.

(xlii) Fly ash shall not be used for agricultural purpose. No mine void filling will be undertaken as an option for ash utilization without adequate lining of mine with suitable media such that no leachate shall take place at any point of time. In case, the option of mine void filling is to be adopted, prior detailed study of soil characteristics of the mine area shall be undertaken from an institute of repute and adequate clay lining shall be ascertained by the State Pollution Control Board and implementation done in close co-ordination with the State Pollution Control Board.

(xliii) Three tier green belt shall be developed all around Ash Pond over and above the Green Belt around the plant boundary and grassing shall be done on the ash mound.

(xliv) An Environmental Cell shall be created at the project site itself and shall be headed by an officer of the company of appropriate seniority and qualification. It shall be ensured that the head of the Cell shall directly report to the Head of the Organization.The Environmental Cell shall be responsible and accountble for implementation of all the conditions given in the EC including in the amendment letter.

(xlv) The project proponent shall formulate a well laid Corporate Environment Policy and identify and designate responsible officers at all levels of its hierarchy for ensuring adherence to the policy and compliance with the conditions stipulated in this clearance letter and other applicable environmental laws and regulations.

4. All other conditions mentioned in this Ministry's letter of even no. dated 04.05.2011shall remain the same.

5. This issues with the approval of the Competent Authority.

(Dr. Saroj)
Director

Copy to:

1. The Secretary, Ministry of Power, Shram Shakti Bhawan, Rafi Marg, New Delhi 110001.
2. The Secretary, Department of Forests & Environment, Government of Rajasthan, Secretariat, Jaipur.
3. The Chairman, Central Electricity Authority, Sewa Bhawan, R.K. Puram, New Delhi-110066.

4. The Chairman, Rajasthan Pollution Control Board, 4, Institutional Area, Jhalana Doongri, Jaipur
5. The Chairman, Central Pollution Control Board, Parivesh Bhawan, CBD-cum-Office Complex, East Arjun Nagar, Delhi- 110032.
6. The Chief Conservator of Forests, Regional Office (WZ), E-5, Kendriya Bhandar, 5th Floor, Sector-H, Aliganj, Lucknow – 226 020.
7. The District Collector, Baran District, Rajasthan.
8. Guard file.
9. Monitoring File.

(Dr. Saroj)
Director

BY SPEED POST

J-13012/154/2008-IA.II (T)
Government of India
Ministry of Environment & Forests

सत्यमेव जयते

Ph: 011-2436 3963
Paryavaran Bhawan
CGO Complex, Lodi Road
New Delhi-110 003
Dated: May 04, 2011.

To

M/s Adani Power Rajasthan Ltd.
7th Floor, Sambhav Building
Judges Bangalow Road, Bodakdev
Ahmedabad – 380 015.

Sub: 2x660 MW Super Critical Imported Coal Based Thermal Power Plant at village Kawai, in Atru Taluk, in Baran Distt., in Rajasthan - reg. Environmental Clearance.

Sir,

The undersigned is directed to refer to your letters dated 05.01.2011 on the subject mentioned above. The Ministry of Environment & Forests has examined the application.

2. It has been noted that the proposal is for setting up of 2x660 MW Super Critical Imported Coal Based Thermal Power Plant at village Kawai, in Atru Taluk, in Baran Distt., in Rajasthan. Land requirement will be 865 acres, which is a waste land. The co-ordinates of the site are at Latitude Latitude 24°46'12.40" N to 24°48'14.00"N and Longitude 76°44'18.60" E to 76°43'32.70" E. Imported coal from South Africa will be used for an interim period until domestic coal is made available. Imported Coal requirement will be 5.26 MTPA. Sulphur and Ash contents in imported coal will be around 0.4 % and 29% respectively. Area requirement for ash pond/dyke will be 150 acres. About 1.22 MTPA of fly ash and 0.31 MTPA of bottom ash respectively will be generated. Stack height will be 275 m. Water requirement will be 34 MCM and will be sourced from the Parvan major irrigation project through a pipeline at a distance of 15.0 km from project site. Water allocation from the Water Resources Dept., Govt. of Rajasthan has been obtained. There are no national parks, wildlife sanctuaries, heritage sites, tiger/biosphere reserves etc. within 10 km of the site. Public hearing was held on 20.11.2009. Cost of the project will be Rs 7000.0 Crores.

3. The project has been considered in accordance with the provisions of the EIA notification issued by the Ministry of Environment & Forests vide S.O. 1533 (E), dated September 14, 2006.

4. Based on the information submitted by you, as at Para 2 above and others and presentation made before the Expert Appraisal Committee (Thermal Power) in its 19th Meeting held during February 7-8, 2011, by you and your consultant M/s GIS Enabled Environment & Neo graphic Centre,

Ghaziabad the Ministry of Environment and Forests hereby accords environmental clearance to the above project under the provisions of EIA notification dated September 14, 2006, subject to the compliance of the following Specific and General conditions:

A. Specific Conditions:

(i) Vision document specifying prospective plan for the site shall be formulated and submitted to the Ministry within **six months**.

(ii) In case source of fuel supply is to be changed at a later stage (now proposed on imported coal from South Africa) the project proponent shall intimate the Ministry well in advance along with necessary requisite documents for its concurrence for allowing the change. In such a case the necessity for re-conducting public hearing may be decided by the Ministry in consultation with the Expert Appraisal Committee.

(iii) Wildlife conservation plan shall be prepared in consultation with the Office of the Chief Wildlife Warden concerned for implementation. Status of implementation shall be submitted to the Regional Office of the Ministry periodically.

(iv) Possibility for harnessing solar power within the premises of the plant particularly at available roof tops shall be examined and status of implementation shall be submitted.

(v) An equal area of grazing land proposed to be acquired for the project shall be identified and developed in consultation with the village Panchayat and the district administration before final acquisition of the said land.

(vi) Coal transportation to plant site shall be by rail. The project proponent shall take up the matter with the Railways and shall submit action taken and implementation status to the Ministry from time to time.

(vii) Existing de-generated water bodies (if any) in the study area shall be regenerated at the project proponent's expenses in consultation with the state govt.

(viii) Hydrogeology of the area shall be reviewed annually from an institute/ organization of repute to assess impact of surface water and ground regime (especially around ash dyke). In case and deterioration is observed specific mitigation measures shall be undertaken and reports/ data of water quality monitored regularly and maintained shall be submitted to the Regional Office of the Ministry.

(ix) Source of water for meeting the requirement during lean season shall be specified and submitted to the Regional Office of the Ministry **within three** months.

(x) No ground water shall be extracted for use in operation of the power plant even in lean season.

(xi) No water bodies (including natural drainage system) in the area shall be disturbed due to activities associated with the setting up / operation of the power plant.

(xii) Minimum required environmental flow suggested by the Competent Authority of the State Govt. shall be maintained in the Channel/ Rivers (as applicable) even in lean season.

(xiii) Water requirement shall be restricted as per CEA norms and COC of 5.0 shall be adopted.

(xiv) Regular monitoring of ground water level shall be carried out by establishing a network of existing wells and constructing new piezometers. Monitoring around the ash pond area shall be carried out particularly for heavy metals (Hg,Cr,As,Pb) and records maintained and submitted to the Regional Office of this Ministry. The data so obtained should be compared with the baseline data so as to ensure that the ground water quality is not adversely affected due to the project.

(xv) Monitoring surface water quality in the area shall also be regularly conducted and records maintained. The monitored data shall be submitted to the Ministry regularly. Further, monitoring points shall be located between the plant and drainage in the direction of flow of ground water and records maintained. Monitoring for heavy metals in ground water shall be undertaken.

(xvi) A well designed rainwater harvesting shall be put in place before commissioning of the plant. Central Groundwater Authority/ Board shall be consulted for finalization of appropriate rainwater harvesting technology/design within **a period of three months** from the date of this clearance and details shall be furnished. The design of rain water harvesting shall comprise of rain water collection from the built up and open area in the plant premises. Action plan and road map for implementation shall be submitted to the Ministry **within six months**.

(xvii) Additional soil for leveling of the proposed site shall be generated within the sites (to the extent possible) so that natural drainage system of the area is protected and improved.

(xviii) Provision for installation of FGD shall be provided for future use.

(xix) The project proponent shall undertake measures and ensure that no fugitive fly ash emissions take place at any point of time.

(xx) Stack of 275 m height shall be installed and provided with continuous online monitoring equipments for SO_x, NO_x and $PM_{2.5}$ & PM_{10}. Exit velocity of flue gases shall not be less than 22 m/sec. Mercury emissions from stack may also monitored on periodic basis.

(xxi) High Efficiency Electrostatic Precipitators (ESPs) shall be installed to ensure that particulate emission does not exceed 50 mg/Nm^3.

(xxii) Adequate dust extraction system such as cyclones/ bag filters and water spray system in dusty areas such as in coal handling and ash handling points, transfer areas and other vulnerable dusty areas shall be provided.

(xxiii) Utilisation of 100% Fly Ash generated shall be made from **4th** year of operation. Status of implementation shall be reported to the Regional Office of the Ministry from time to time.

(xxiv) Fly ash shall be collected in dry form and storage facility (silos) shall be provided. Unutilized fly ash shall be disposed off in the ash pond in the form of slurry form. Mercury and other heavy metals (As,Hg, Cr, Pb etc.) will be monitored in the bottom ash as also in the effluents emanating from the existing ash pond. No ash shall be disposed off in low lying area.

(xxv) Ash pond shall be lined with HDP/LDPE lining or any other suitable impermeable media such that no leachate takes place at any point of time. Adequate safety measures shall also be implemented to protect the ash dyke from getting breached.

(xxvi) Sulphur and ash contents in the imported coal to be used in the project shall not exceed 0.6 % and 34% respectively at any given time. In case of variation of coal quality at any point of time fresh reference shall be made to the Ministry for suitable amendments to environmental clearance condition wherever necessary.

(xxvii) Green Belt consisting of 3 tiers of plantations of native species around plant and at least 75 m width shall be raised. Tree density shall not less than 2500 per ha with survival rate not less than 80 %.

(xxviii) Over and above the green belt, as carbon sink, social forestry shall be carried out in close consultation with the Forests Department. The project proponent shall accordingly identify blocks of land / degraded forests and shall undertake regeneration of degraded forests at a large scale. In pursuance to this the project proponent shall formulate time bound action plan along with financial allocation and shall submit status of implementation to the Ministry **within six months**.

(xxix) Atleast three nearest village shall be adopted and basic amenities like development of roads, drinking water supply, primary health centre, primary school etc shall be developed in co-ordination with the district administration.

(xxx) The project proponent shall also adequately contribute in the development of the neighbouring villages. Special package with implementation schedule for providing potable drinking water supply in the nearby villages and schools shall be undertaken in a time bound manner.

(xxxi) CSR scheme shall be identified based on need based assessment in and around the villages within 5.0 km of the site and in constant consultation with the village Panchayat and the District Administration. As part of CSR prior identification of local employable youth and eventual employment in the project after imparting relevant training shall be also undertaken.

(xxxii) It shall be ensured that an in-built monitoring mechanism for the CSR schemes identified is in place and annual social audit shall be got done from the nearest government institute of repute in the region. The project proponent shall also submit the status of implementation of the scheme from time to time. The achievements should be put on company's website.

(xxxiii) An amount of Rs 28.0 Crores shall be earmarked as one time capital cost for CSR programme as committed by the project proponent. Subsequently a recurring expenditure of Rs 5.6 Crores per annum shall be earmarked as recurring expenditure for CSR activities. Details of the activities to be undertaken shall be **submitted within six month** along with road map for implementation.

(xxxiv) It shall be ensured that in-built monitoring mechanism for the schemes identified is in place and annual social audit shall be got done from the nearest government institute of repute in the region. The project proponent shall also submit the status of implementation of the scheme from time to time

B. General Conditions:

(i) The treated effluents conforming to the prescribed standards only shall be re-circulated and reused within the plant. Arrangements shall be made that effluents and storm water do not do not get mixed.

(ii) A sewage treatment plant shall be provided (as applicable) and the treated sewage shall be used for raising greenbelt/plantation.

(iii) Adequate safety measures shall be provided in the plant area to check/minimize spontaneous fires in coal yard, especially during summer season. Copy of these measures with full details along with location plant layout shall be submitted to the Ministry as well as to the Regional Office of the Ministry.

(iv) Storage facilities for auxiliary liquid fuel such as LDO and/ HFO/LSHS shall be made in the plant area in consultation with Department of Explosives, Nagpur. Sulphur content in the liquid fuel will not exceed 0.5%. Disaster Management Plan shall be prepared to meet any eventuality in case of an accident taking place due to storage of oil.

(v) First Aid and sanitation arrangements shall be made for the drivers and other contract workers during construction phase.

(vi) Noise levels emanating from turbines shall be so controlled such that the noise in the work zone shall be limited to 85 dBA from source. For people working in the high noise area, requisite personal protective equipment like earplugs/ear muffs etc. shall be provided. Workers engaged in noisy areas such as turbine area, air compressors etc shall be periodically examined to maintain audiometric record and for treatment for any hearing loss including shifting to non noisy/less noisy areas.

(vii) Regular monitoring of ambient air ground level concentration of SO_2, NOx, $PM_{2.5}$ & PM_{10} and Hg shall be carried out in the impact zone and records maintained. If at any stage these levels are found to exceed the prescribed limits, necessary control measures shall be provided immediately. The location of the monitoring stations and frequency of monitoring shall be decided in consultation with SPCB. Periodic reports shall be submitted to the Regional Office of this Ministry. The data shall also be put on the website of the company.

(viii) Provision shall be made for the housing of construction labour (as applicable) within the site with all necessary infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP, safe drinking water, medical health care, crèche etc. The housing may be in the form of temporary structures to be removed after the completion of the project.

(ix) The project proponent shall advertise in at least two local newspapers widely circulated in the region around the project, one of which shall be in the vernacular language of the locality concerned within seven days from the date of this clearance letter, informing that the project has been accorded environmental clearance and copies of clearance letter are available with the State Pollution Control Board/Committee and may also be seen at Website of the Ministry of Environment and Forests at http://envfor.nic.in.

(x) A copy of the clearance letter shall be sent by the proponent to concerned Panchayat, Zila Parisad / Municipal Corporation, urban local Body and the Local NGO, if any, from whom suggestions/representations, if any, received while processing the proposal. The clearance letter shall also be put on the website of the Company by the proponent.

(xi) An Environmental Cell comprising of atleast one expert in environmental science / engineering, occupational health and social scientist, shall be created at the project site itself and shall be headed by an officer of appropriate superiority and qualification. It shall be ensured that the Head of the Cell shall directly report to the head of the organization and he shall be held responsible for implementation of environmental regulations and social impact improvement/mitigation measures.

(xii) The proponent shall upload the status of compliance of the stipulated environmental clearance conditions, including results of monitored data on their website and shall update the same periodically. It shall simultaneously be sent to the Regional Office of MOEF, the respective Zonal Office of CPCB and the SPCB. The criteria pollutant levels namely; SPM, RSPM ($PM_{2.5}$ & PM_{10}), SO_2, NO_x (ambient levels as well as stack emissions) shall be displayed at a convenient location near the main gate of the company in the public domain.

(xiii) The environment statement for each financial year ending 31st March in Form-V as is mandated to be submitted by the project proponent to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently, shall also be put on the website of the company along with the status of compliance of environmental clearance conditions and shall also be sent to the respective Regional Offices of the Ministry by e-mail.

(xiv) **The project proponent shall submit six monthly reports on the status of the implementation of the stipulated environmental safeguards to the Ministry of Environment and Forests, its Regional Office, Central Pollution Control Board and State Pollution Control Board. The project proponent shall upload the status of compliance of the environment of the environmental clearance conditions on their website and update the same periodically and simultaneously send the same by e-mail to the Regional Office, Ministry of Environment and Forests.**

(xv) Regional Office of the Ministry of Environment & Forests will monitor the implementation of the stipulated conditions. A complete set of documents including Environmental Impact Assessment Report and Environment Management Plan along with the additional information submitted from time to time shall be forwarded to the Regional Office for their use during monitoring. Project proponent will up-load the compliance status in their website and up-date the same from time to time at least six monthly basis. **Criteria pollutants levels including**

NO_x (from stack & ambient air) shall be displayed at the main gate of the power plant.

(xvi) Separate funds shall be allocated for implementation of environmental protection measures along with item-wise break-up. These cost shall be included as part of the project cost. The funds earmarked for the environment protection measures shall not be diverted for other purposes and year-wise expenditure should be reported to the Ministry.

(xvii) The project authorities shall inform the Regional Office as well as the Ministry regarding the date of financial closure and final approval of the project by the concerned authorities and the dates of start of land development work and commissioning of plant.

(xviii) Full cooperation shall be extended to the Scientists/Officers from the Ministry / Regional Office of the Ministry at Bangalore / CPCB/ SPCB who would be monitoring the compliance of environmental status.

4. The Ministry of Environment and Forests reserves the right to revoke the clearance if conditions stipulated are not implemented to the satisfaction of the Ministry. The Ministry may also impose additional environmental conditions or modify the existing ones, if necessary.

5. The environmental clearance accorded **shall be valid for a period of 5 years** to start operations by the power plant.

6. Concealing factual data or submission of false/fabricated data and failure to comply with any of the conditions mentioned above may result in withdrawal of this clearance and attract action under the provisions of Environment (Protection) Act, 1986.

7. In case of any deviation or alteration in the project proposed including coal transportation system from those submitted to this Ministry for clearance, a fresh reference should be made to the Ministry to assess the adequacy of the condition(s) imposed and to add additional environmental protection measures required, if any.

8. The above stipulations would be enforced among others under the Water (Prevention and Control of Pollution) Act, 1974, the Air (Prevention and Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986 and rules there under, Hazardous Wastes (Management and Handling) Rules, 1989 and its amendments, the Public Liability Insurance Act, 1991 and its amendments.

Yours faithfully,

P. Ahujarai

(Dr. P.L. Ahujarai)
Scientist 'F'

Copy to:

1. The Secretary, Ministry of Power, Shram Shakti Bhawan, Rafi Marg, New Delhi 110001.
2. The Secretary, Department of Forests & Environment, Government of Rajasthan, Secretariat, Jaipur.
3. The Chairman, Central Electricity Authority, Sewa Bhawan, R.K. Puram, New Delhi-110066.
4. The Chairman, Rajasthan Pollution Control Board, 4, Institutional Area, Jhalana Doongri, Jaipur
5. The Chairman, Central Pollution Control Board, Parivesh Bhawan, CBD-cum-Office Complex, East Arjun Nagar, Delhi- 110032.
6. The Chief Conservator of Forests, Regional Office (WZ), E-5, Kendriya Bhandar, 5th Floor, Sector-H, Aliganj, Lucknow – 226 020.
7. The District Collector, Baran District, Rajasthan.
8. Guard file.
9. Monitoring File.

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(Dr. P.L. Ahujarai)
Scientist 'F'

Adani Power Limited, Kawai

AN OVERVIEW AND VISION

Introduction

ADANI GROUP

Adani Group is a diversified organization in India with market cap of over $97.6 billion comprising 10 publicly traded companies. It has created a world class transport and utility infrastructure portfolio that has a pan-India presence. Adani Group headquartered in Ahmedabad, in the state of Gujarat, India. Over the years, Adani Group has positioned itself to be the market leader in its transport logistics and energy utility portfolio businesses focusing on large scale infrastructure development in India with O & M practices benchmarked to global standards. With four IG rated businesses, it is the only Infrastructure Investment Grade issuer in India.

Adani owes its success and leadership position to its core philosophy of 'Nation Building' driven by 'Growth with Goodness' - a guiding principle for sustainable growth. Adani is committed to increase its ESG footprint by realigning its businesses with emphasis on climate protection and increasing community outreach through its CSR program based on the principles of sustainability, diversity and shared values.

Business Portfolio

Transport & Logistics Portfolio

- Adani Ports and Special Economic Zone Ltd.
- North Queensland Terminal
- Sarguja Rail Corridor Pvt. Ltd.

Energy & Utility Portfolio

- Adani Power Ltd.
- Adani Transmission Ltd.
- Adani Green Energy Ltd.
- Adani Total Gas Ltd

Materials Portfolio

- Ambuja Cements Ltd.
- ACC Ltd.
- Orient Cement

AEL: Incubator

- Adani Airport Holdings Ltd.
- Adani Road Transport Ltd.
- Adani Water Ltd.
- Data Centre
- Defence and Aerospace

ADANI POWER LIMITED

Adani Power Limited (APL), a part of the diversified Adani Group, is the largest private thermal power producer in India. We have a power generation capacity of 17,510 MW comprising thermal power plants in Gujarat, Maharashtra, Karnataka, Tamil Nadu, Rajasthan, Chhattisgarh, Madhya Pradesh, Jharkhand.

We are the world's first company to set up a coal-based Supercritical thermal power project registered under the Clean Development Mechanism (CDM) of the Kyoto protocol. Being a new entrant to power generation in 2006, we leveraged the project management skills of the Adani Group to set up our first power plant at Mundra successfully and efficiently.

The power sector in India has undergone a challenging period in the past few years, which put to test the resilience of our business model. By navigating the challenges through prudence, persistence, and discipline, we have implemented the best available technologies and practices that can serve as benchmarks for the power industry.

As we augment our generation capacity, both organically and inorganically, we also strive to make our footprints sustainable. Receiving a score of 59 for Adani Power in Corporate Sustainability Assessment by DJSI-S&P Global as compared to the world electric utilities' average of 33/100 also 3.5/5.0 in FTSE ESG rating, as compared to the world utilities average score of 2.7/5.0 and 87% in CSR Hub ESG rating, which is better than the global industry average. To promote reduced emission and promote sustainable energy, Adani Power partnered with IHI Corporation and Kowa company to explore ammonia co-firing at the Adani Power Mundra plant. The studies aim at initially de-carbonizing Adani's coal fired plants but with a larger objective to implement the technology in other coal-fired plants across India.

Kawai Thermal Power Plant

Project Background

Adani Power Limited, Kawai owns and operates 1320 (2x660) MW Coal based thermal power plant situated at village Kawai, Atru Taluk, Baran District in Rajasthan.
APL has Proposed Expansion of Kawai Thermal Power Plant under Phase–II by adding 3200 (4x800) MW Ultra Super Critical Thermal Power Plant to Existing 1320 (2x660) MW at Village Kawai, Tehsil Atru, District Baran, Rajasthan

Adani Power Limited, Kawai

Environmental Clearance (EC) was granted by MoEFCC, New Delhi vide File no. J-13012/154/2008-IA.II(T) dated 04.05.2011**.** Subsequently, EC amendment was granted on 13.03.2014 and EC was transferred to Adani Power Limited (APL, Kawai) on 24.04.2023.
Consent to Operate (CTO) for operation 1320 (2x660) MW issued with validity up to 28.02.2029 from RSPCB, Jaipur, Rajasthan**.** Both the units are operational since 2013.

The total land requirement for proposed plant is 472.54 Ha (*includes 1.758 Ha. Revised Forest Area after Forest dept. Survey outside power plant premises for Coal Conveyor. FC proposal is under progress & will be obtained)*

Justification of the Project

Electricity is the prime mover of growth and is vital to the sustenance of a modern economy. The projected growth of the Indian Economy depends primarily on the performance and growth of the power sector. The contribution of power sector in country's growth has grown significantly since independence. Total installed generation capacity of the country, which was 1362 MW at the time of independence, has increased to about 4,16,059 MW as on 31/03/2023. It is the endeavour of the government to ensure uninterrupted supply of electricity at affordable rates to the following categories of consumption to sustain steady economic growth: -

a) Domestic
b) Commercial
c) Public Lighting
d) Public Water Works
e) Irrigation
f) Industrial (LT, HT less than 1 MW, HT 1 MW and above)
g) Railway Traction
h) Bulk Non-Industrial HT supply

The following graph shows the plan-wise growth of installed capacity in the country and sector wise pie-chart.

Adani Power

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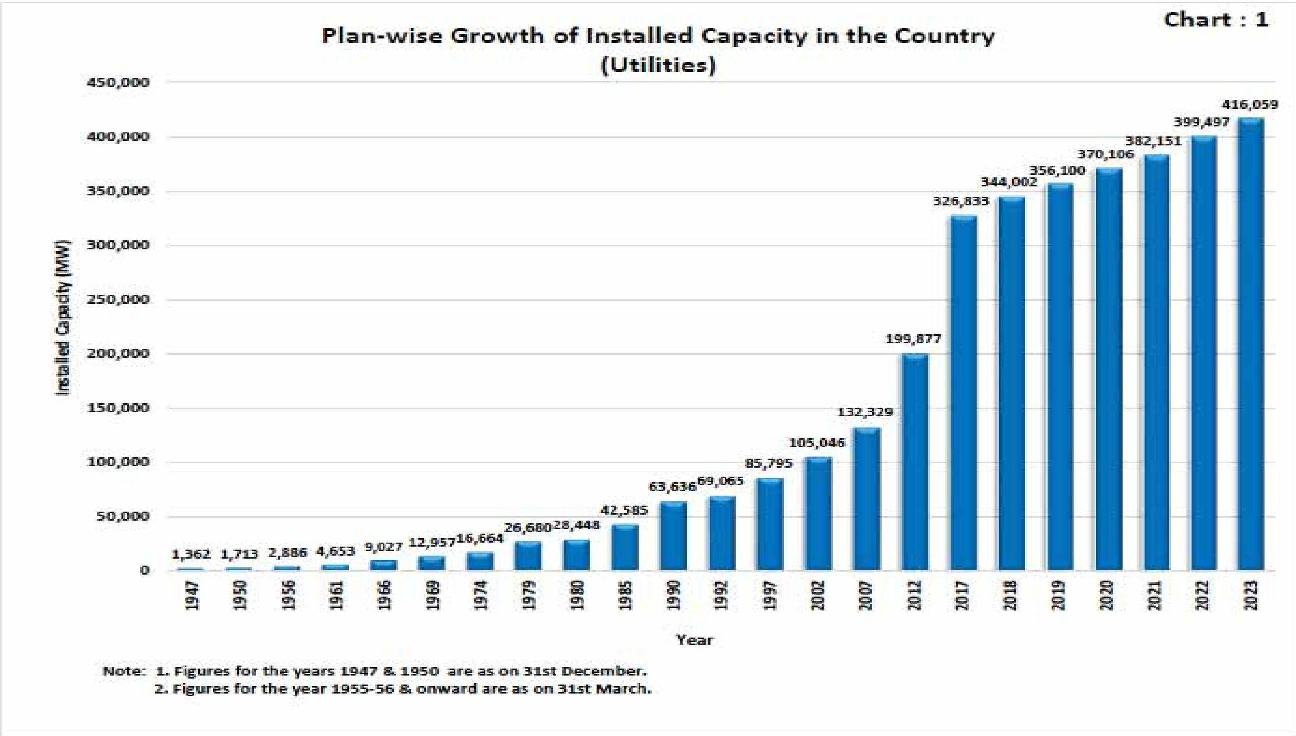
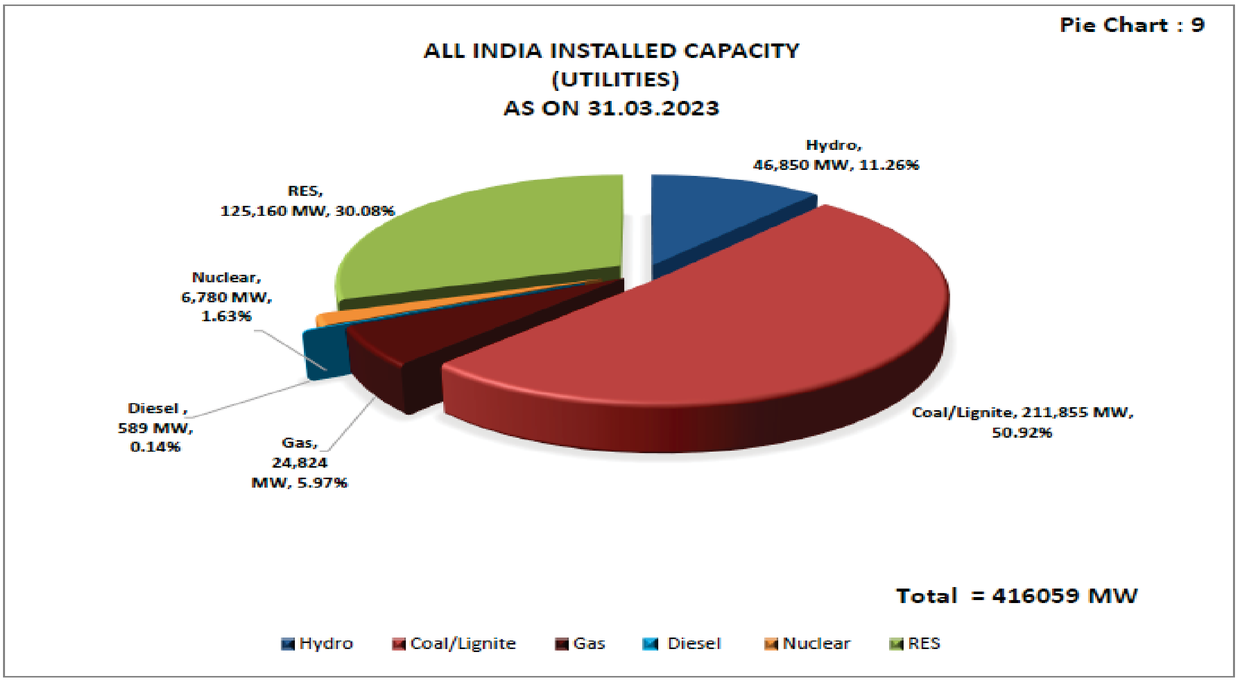
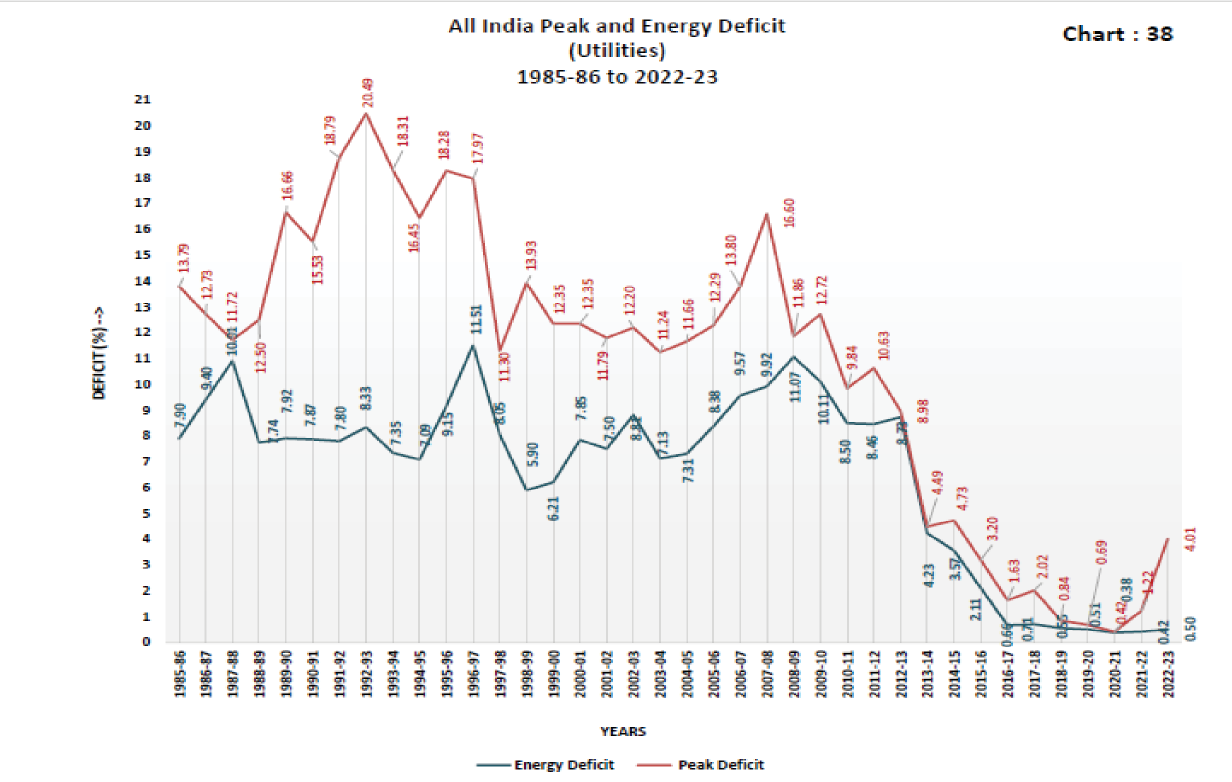




Adani Power Limited, Kawai

(Source: CEA Report- Growth of Electricity Sector in India from 1947-2021)

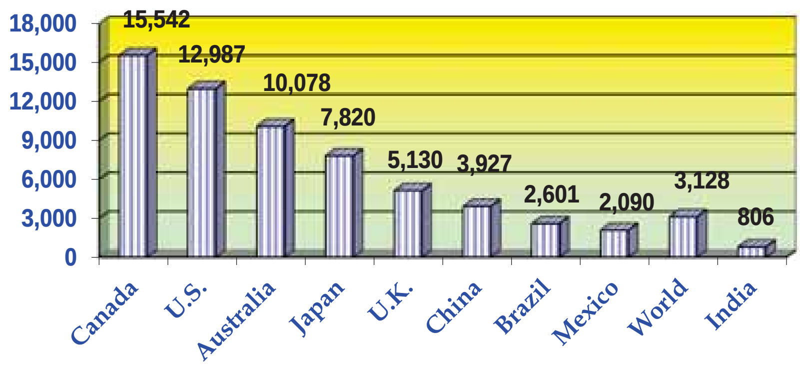
However, the power industry in India is historically being characterized by energy shortages i.e., demand for electricity far exceeding the supply. The following graph shows all India Peak demand and Deficit of energy from fiscal year 1985-86 to 2022-23.



Due to inadequate generation, supply and distribution infrastructure, the per capita consumption of energy in India is extremely low in comparison to most of the developing and developed nations. The following chart shows per capita electricity consumption of energy as per the World Bank record for the year 2014 in various developed and developing countries.

Adani Power Limited, Kawai

Electricity Consumption Per Capita (kWh)



As per CEA- Executive Summary on Power Sector- Dec 21 however, the per capita consumption of electricity in India during 2019-2020 stands as 1208 kWh.

Electricity is an essential requirement for all facets of our life. It is the critical infrastructure on which the socio-economic development of the country depends. Availability of reliable and quality power at competitive rates to industry would make it globally competitive and enable it to exploit the tremendous potential of employment generation.

Electricity being one of the key drivers for rapid economic growth and poverty alleviation, power sector attracts special attention of the Govt. of India (GOI) In this regard, the Govt. of India has taken many policy initiatives which have an impact on the electricity demand. Some of the major policy initiatives are provided below:

a) **Power for All:** Government of India had taken a joint initiative with the respective state governments/UT's to provide 24x7 power to all households/homes, industrial and commercial consumers, and adequate supply of power to agricultural consumers as per their policy. This initiative aims at ensuring uninterrupted supply of quality power to existing consumers and providing access to electricity to all un-connected consumers by the year 2019 in a phased manner. This initiative would result in higher growth of electrical energy requirement.

b) **Dedicated Freight Corridor:** Electricity demand on this account will be a great factor as the electricity demand will rise based on their programme of railway track electrification and expansion plan as per information provided by the Ministry of Railways/railway board.

c) **Make in India**: Make in India is an initiative launched by the Government of India to encourage multinational, as well as national companies to manufacture their products in India. This initiative would lead to growth in electricity demand.

Adani Power Limited, Kawai

In accordance with the provisions of National Electricity Policy (NEP), eminent experts of Electric Power Survey Committee (EPSC) formulated 19th Electric Power Survey report to work out All-India electricity demand forecast for the 13th plan (i.e. for the year 2016-17 to 2021-22) and project perspective year wise electricity demand for the 14th plan (i.e. 2021-22 to 2026-27) and the terminal year of 15th & 16th five-year plan i.e. year 2031-32 & 2036-37.

Present Power Scenario of Rajasthan

The State of Rajasthan falls within Northern region as per Central Electricity Authority (CEA) The total Installed capacities of Power Utilities as on 31.03.2023 with break-up in Western region are as follows in Table no. 1.1

Table 1.1: Fuel based Power break up in Rajasthan

Sector	Installed Generation Capacity (MW)	% Share in total
Thermal		
Coal	11747.56	30.12
Lignite	1580.0	4.05
Gas	774.63	1.99
Diesel	0.00	0.00
Nuclear	556.74	1.43
Renewable		
Hydro	1941.93	4.98
RES*(MNRE)	22398.05	57.43
Grand Total	**38998.91**	**100 %**

Source: CEA Annual Report

As per ‘Annual Report published by CEA, the following Demand, Supply and Deficit scenario has been captured in the state of Rajasthan during April, 2022 - March, 2023 revised, which is the latest published data:

- Peak Demand: 17,399 MW
- Peak Met: 17,206 MW
- Demand not met: 193 MW (1.1%)
- Energy Requirement: 101,801 MU
- Energy Supplied: 100,057 MU
- Energy not supplied: 1,745 MU (1.7 %)

From the above, it is obvious that in present scenario demand supply situation in M Rajasthan is closely matched and there is little room for accommodating large industrial load. To meet projected energy requirement and peak demand in the coming five years, significant new capacity addition is essential. Moreover, with the National grid being set up in the country, it makes sense to generate power economically at one location and transmit the same elsewhere where there is shortage of power.

Adani Power Limited, Kawai

Considering all above, the proposed project of 4x800 MW coal-based power station by M/s. Adani Power Limited (APL) at Kawai in Baran District, Rajasthan fits well in the overall power scenario of the state as well as country. Consequently, plant operation at high plant load factor can be expected by addition of new units.

Configuration of Proposed Plant

For selecting the unit size of the proposed extension units, the criteria given importance are

- Cost of energy generated from the station at reduced price.
- Steady load requirement and variations in maximum demand
- Thermodynamic cycle efficiency and reduced emission
- Operating flexibility for better load cycle
- Station availability
- PLF attainable
- Specific investment requirement
- Project timeframe and manpower requirement
- Economic performance and reduced environmental aspect.

The proposed 4x800 MW units at Baran district in Rajasthan, deploying ultra-supercritical steam parameters emerges as favourite as this set size is endowed with the following merits:

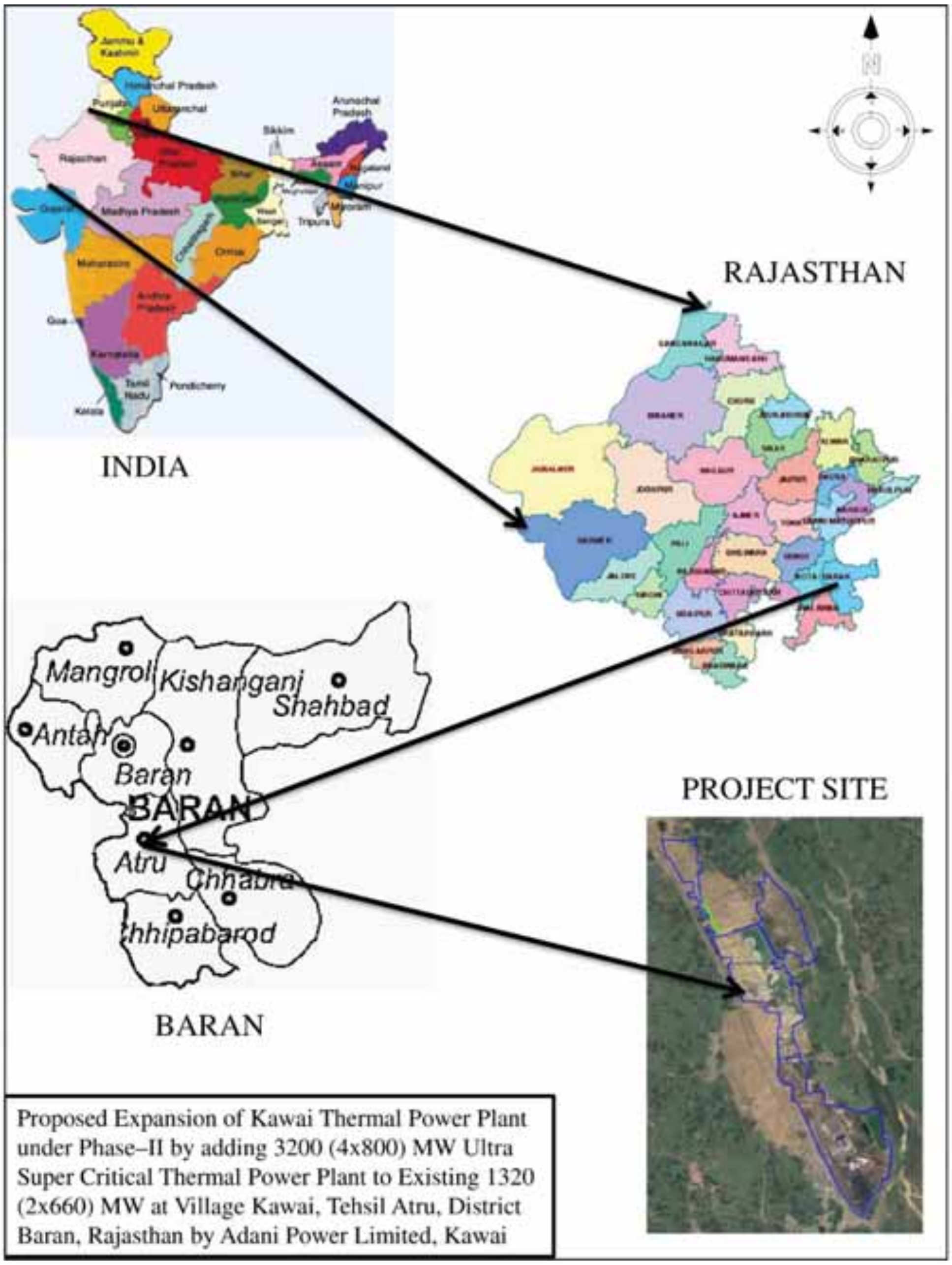
- Present-day technology
- High thermodynamic efficiency
- Favourable operating experience
- Load variation capability, if required.
- Availability of skilled and unskilled personnel
- Environment-friendly in terms of emission
- Easier availability of vendor's engineers.

Project Location Details

Project Authority	:	Adani Power Limited, Kawai.
Project	:	Coal based Ultra Super Critical Thermal Power Project (USCTPP) of 3200 (4X800) MW at Village Kawai, Tehsil Atru, District Baran, Rajasthan
Location	:	Village Kawai, Tehsil Atru, District Baran, Rajasthan.
Nearest Major Town	:	Atru at a distance of 4.10 km
Seismic Zone	:	Zone-II as per IS 1893.

Adani Power Limited, Kawai

Access by Road	:	From SH 37A located about 0.2 km away from the site (West).
Access by Rail	:	Salpura Railway Station on Katni-Bina line is at a distance of 6.5 kms southwest from the site.
Access by Sea	:	Nearest Seaport is at Hazira Port about 580 km.
Access by Air	:	Jaipur airport at a distance of 370 km.



Proposed Expansion of Kawai Thermal Power Plant under Phase–II by adding 3200 (4x800) MW Ultra Super Critical Thermal Power Plant to Existing 1320 (2x660) MW at Village Kawai, Tehsil Atru, District Baran, Rajasthan by Adani Power Limited, Kawai

Adani | Power

Adani Power Limited, Kawai

General Details of the Proposed Project

Land	:	The total land required for proposed expansion project is 472.54 Ha (*includes 1.758 Ha. Revised Forest Area after Forest dept. Survey outside power plant premises for Coal Conveyor*)
Layout Features	:	4x800 MW Ultra Super-Critical Units.
Power Generating Unit	:	3200 (4X800) MW turbine generator sets fed by steam from coal fired P.F. boiler will operate at Ultra Super-Critical Technology.
Water	:	56 MCM / year
Cooling System	:	Closed recirculating condenser cooling system with induced draft cooling tower.
Main Fuel	:	Coal from Coal Mines of Jitpur, Rampia, Ujheni & e-auction.
Fuel Transportation	:	Through Rail.
Coal Handling System	:	Coal handling facility, which comprises receipt of coal from Mines through LBC system, with in-plant coal handling system and finally feeding the bunker level conveyors.
Ash Utilization	:	Fly ash will be collected in dry form in silos for all efforts will be made for 100% utilization of ash. Ash will be used for Cement manufacturing industries, abandoned mine, filling of low-lying area, manufacturing bricks, road construction, aggregate placement in concrete, etc as per Fly Ash Notification, 31st December'2021 and amendments.
Environmental Aspects	:	Elaborate arrangements for Selective Catalytic Reduction (SCR) systems / Separated Overfire Air (SOFA) / Low NO_x burners complying with emission norms as per latest MoEF&CC & CPCB/MPPCB norms and an adequately designed electrostatic precipitator with more than 99.99% efficiency are envisaged. Wastewater quality to be maintained as per MoEF&CC notification. Zero Liquid Discharge facility shall be present since the cooling water, blow down water, wastewater and ash water would be recycled back to the system after suitable treatment.

Adani Power Limited, Kawai

R & R Requirement	:	The land required for proposed project is already under Possession with APL Kawai.

Land for the Project

Details of land utilization in various areas of the plant are as below:

Sr.	Details	2x660MW (Phase-I)	4x800MW (Phase-II)	Total (Ph I & Ph-II)
1	Plant Area	70	138	208
2	Reservoir	65	-	65
3	Coal Stock Yard	40	65.2	105.2
4	Ash Dyke	60	57.06	117.06
5	Ash based Industries	6	-	6
6	Township	30	-	30
7	Green Belt	79	210.44	289.44
8	Total	350	470.7	820.7

The total land required for proposed expansion project is 472.54 Ha (*includes 1.758 Ha. Revised Forest Area after Forest dept. Survey outside power plant premises for Coal Conveyor*)
Other technical aspects like wind direction, soil characteristics also have been taken into consideration while developing the proposed Plant Layout.

Technical Features of Main Plant & Equipment

Item	Main Design Parameters
Technology	
Steam Generator	Ultra-Super Critical Pressure 270 Bar Temperature 600°C
Turbo Generator	Turbine -270 Bar, 600°C, 3000 rpm Generator - 800 MW (Each unit) Generator Transformer -3 x 330 MVA
Major Auxiliary System	Boiler & Turbine Auxiliaries Pretreatment Plant Compressed Air System Coal and Ash Handling System CW System and Raw Water System Firefighting System

Adani Power Limited, Kawai

	Air conditioning System Ventilation System
Stack Details	
No. of Stack	2 (Bi flue)
Stack Height (meter)	275
No. of flue	Two
Additional equipment (attachment)	Electrostatic Precipitator (ESP)
Requirements	
Coal	Domestic Coal – 19.35 MMTPA (85% PLF with Design Coal GCV (Range 3200-4300 Kcal/Kg) Source: Coal from Coal Mines of Jitpur / Rampia / Ujheni / e-auction. Transportation: Through Rail.
Cooling Technology	Closed recirculating condenser cooling system with induced draft cooling tower.
Total Water Requirement	10274m^3/hr (90 MCM/year)
Total Discharge	Plant is based on ZLD.
Land	The total land requirement for the proposed unit is 472.54 Ha.
Project Cost	INR 36,600 crores (approx.)

Statutory clearances

1	Environmental Clearance	:	Environmental Clearance **for 1320 (2x660) MW** vide **J-13012/154/2008-IA.II(T) dated 04.05.2011.**
2	Land clearance	:	• The Land required for proposed project is already under possession with APL Kawai. • Township will be developed and for this activity applicable permission to be obtained from concern Authority.
3	Water drawl permission	:	34 MCM/year.
4	Coal linkage	:	Domestic coal from Coal Mines of Jitpur / Rampia / Ujheni / e-auction.
5	Consent for Establishment	:	25.07.2011
6	Fly Ash utilization	:	• Cement Manufacturing Industries • Abandoned Mine Back filling/Low Lying Area

			• Fly ash bricks • Road making / paving

Pollution control measures in thermal power plant

S. No.	Section	Type of pollution	Control Equipment
1.	Coal Handling Area	Fugitive Dust	Bag Filters. Covered conveyor belt. Dust Suppression Systems.
	Coal Mill Area	Noise	Acoustic Enclosures
	Coal Stockpile	Fugitive Dust	Sprinkling water
2.	Boiler Area	PM SO2 & NOx	ESP SCR / SOFA/ Low NOx burners 275m Stack
		Thermal	Insulation material
		Noise	Acoustic Enclosures
3.	Ash Handling Area	Fly ash & Bottom ash	Pneumatic handling Ash pond
4.	Boiler blow down & Cooling blow down. Water Treatment Colony/township	Wastewater Domestic wastewater	ETP STP
5.	Transportation	Fugitive Dust	Road Sweeping machine Water Sprinklers

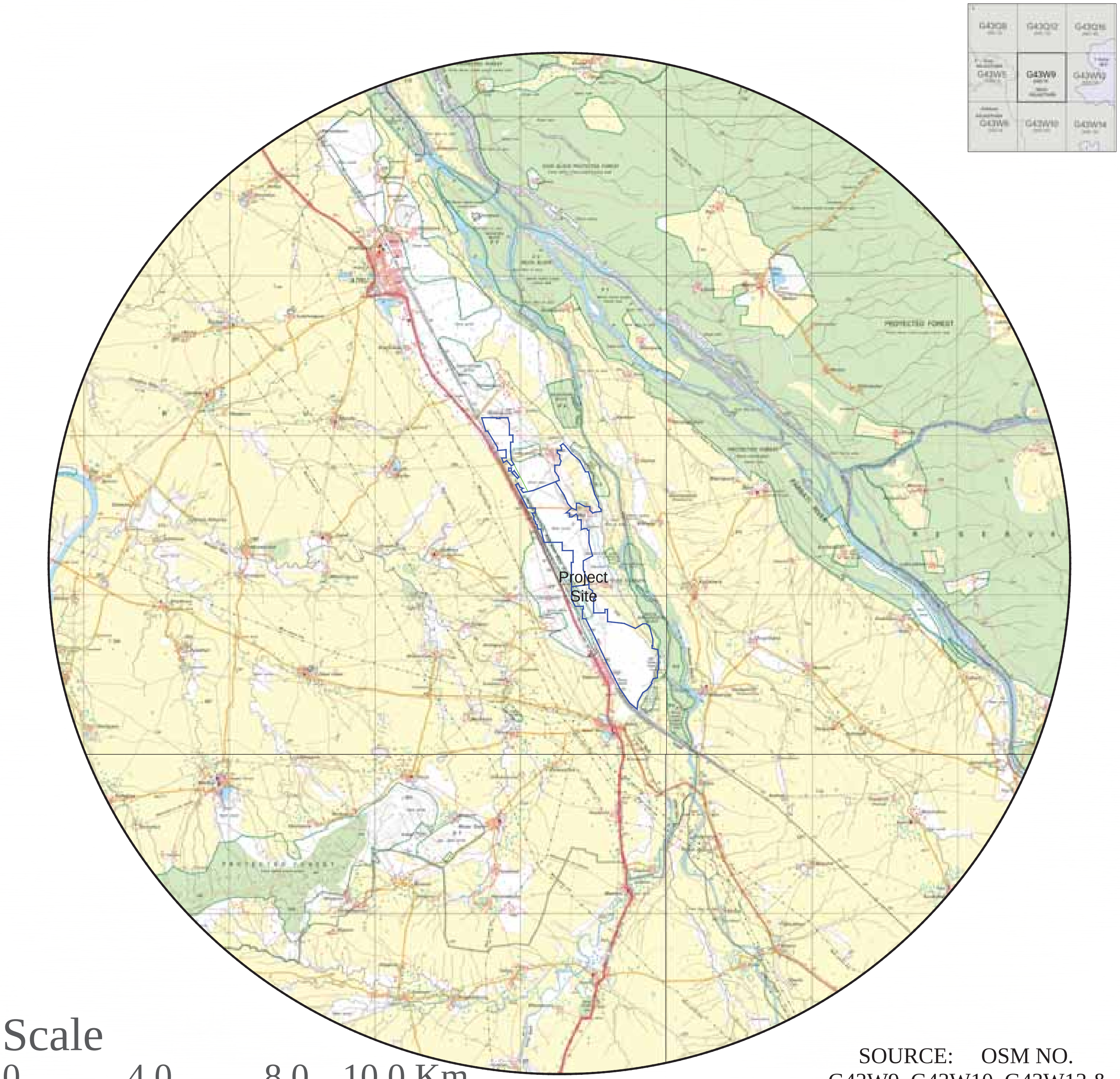
Rainwater Harvesting Program

The rainwater will be collected in the rainwater harvesting pits from the storm water drain running all around the project. Rainwater harvesting pits are connected at regular interval to the storm water drain. The rainwater will recharge the ground water.

Excess rainwater will flow to common collection pit from where water can be pumped for reuse in the plant.

Township facilities

Township for proposed expansion of Kawai TPP will be developed as per necessity & separate Environmental Clearance (EC) & other applicable permission will be obtained from the concerned authority, MoEFCC, SPCB/CPCB etc.



Scale

0 4.0 8.0 10.0 Km

SOURCE: OSM NO. G43W9, G43W10, G43W13 & G43W14

Legend	
Project boundary	

TOPOGRAPHICAL MAP OF A 10 KM RADIUS AROUND THE PROJECT SITE

Project Name - Proposed Expansion of Kawai Thermal Power Plant under Phase–II by adding 3200 (4x800) MW Ultra Super Critical Thermal Power Plant to Existing 1320 (2x660) MW at Village Kawai, Tehsil Atru, District Baran, Rajasthan by Adani Power Limited, Kawai adani

ENVIRONMENT, HEALTH & SAFETY POLICY

We at Adani, strive to make our businesses sustainable, that benefits our customers, our employees, our shareholders and society in general. We believe that in addition to integrated infrastructure business, there is a bottom line in performing our operations according to prescribed standards, specifications and regulations on governance, which are safe in working and environmental friendly for the well-being of the working community.

As a responsible corporate, we at ADANI have a firm conviction that the industrial injuries, occupational hazards as well as safety and environmental incidents are preventable. We recognize and trust people as our most important asset and have commitment to provide safe and healthy work environment impacting not only those, who are working in our industry but also community, which is living in the vicinity.

To achieve this objective, we shall

a. Develop, implement, maintain and sustain EHS Management System across the Group to set up new benchmarks for the respective sector of operations, which superimpose the regulatory and statutory requirements.

b. Verify, audit and periodically review EHS performance and set new targets to revise these benchmarks.

c. Formulate EHS objectives and targets for continual improvement and to have a periodic review for ensuring that these are in conjunction with the individual business and corporate levels.

d. Conduct all our operational activities in such a manner as to avoid harm to employees, contractors, stakeholders and community at large.

e. Inculcate safety & health as a personal value through behavioral intervention and recognize it across levels with continuous correction of unsafe behavior.

f. Provide adequate training and resources so as to bring awareness and ability to carry out work safely.

g. Emphasize responsibility and accountability to all employees and contractor workforce for safe performance on the job and encourage safe behavior off the job.

h. Evolve ways to reduce or eliminate the use or release of toxic and hazardous material and prevent pollution by conserving natural resources, recovering and recycling the raw materials for safe, healthy and clean environment.

GAUTAM S ADANI

Date: 01.01.2016

Adani Power Limited, Kawai

APL, Kawai recognizes the importance of aligning its operations with global sustainability initiatives, particularly the **SDGs** outlined by the United Nations, and is committed to supporting India's pledge toward achieving net-zero emissions by 2050. The following measures highlight the alignment of the proposed Ultra Super Critical (USC) Thermal Power Plant project with relevant SDGs and the roadmap for progressing toward the net-zero mission:

1. Alignment with Sustainable Development Goals (SDGs)

The USC thermal power plant project aligns with the following SDGs:

- **SDG 7: Affordable and Clean Energy**
  - The adoption of USC technology significantly improves thermal efficiency, thereby reducing fuel consumption and greenhouse gas emissions compared to conventional power plants.
- **SDG 9: Industry, Innovation, and Infrastructure**
  - Deployment of advanced emission control systems such as **Flue Gas Desulfurization (FGD)**, **Selective Catalytic Reduction (SCR)**, and **Electrostatic Precipitators (ESP)** to minimize environmental impact.
  - Implementation of real-time emission monitoring systems (**CEMS**) & **CAAQMS** to ensure regulatory compliance and maintain transparency.
- **SDG 13: Climate Action**
  - Reduction in CO_2 emissions per unit of energy generated by adopting ultra-supercritical technology.
  - Active participation in afforestation projects and carbon offset programs to contribute to climate mitigation.
- **SDG 6: Clean Water and Sanitation**
  - Incorporating **zero liquid discharge (ZLD)** systems to ensure efficient water usage and recycling within the plant operations.
- **SDG 12: Responsible Consumption and Production**
  - fly ash utilization in cement and construction industries to ensure waste-to-resource conversion.
  - Maximizing efficiency in coal usage through advanced coal handling and combustion techniques.

2. Net Zero by 2050: Roadmap and Actions

To align with the mission of achieving net-zero emissions by 2050, Adani Power's USC thermal power plant will adopt the following measures:

- **Energy Efficiency and Emission Reductions**
  - Maintain plant high efficiency leveraging USC technology to minimize CO_2 emissions per unit of energy produced.
  - Ensure compliance with stringent emission norms through state-of-the-art pollution control systems (e.g., FGD for SO_2, SCR for NOx).
- **Carbon Offsetting and Sequestration**

Adani Power Limited, Kawai

- Partner with local governments and NGOs for large-scale afforestation projects to offset residual emissions.
- Implement agroforestry and promote biodiversity conservation in areas surrounding the plant site.

- **Stakeholder Engagement and Reporting**
  - Develop and regularly update a detailed roadmap for net-zero emissions, including interim milestones.
  - Engage with the regulatory authority and stakeholders by submitting periodic updates on progress toward SDG alignment and net-zero commitments.

3. Key Actions Already Undertaken

- Installation of USC boilers, which improve efficiency and reduce CO_2 emissions by 20% compared to subcritical plants.
- Deployment of cutting-edge pollution control equipment (e.g., FGD, SCR, ESP) to achieve emissions well within prescribed norms.
- Implementation of **zero liquid discharge (ZLD)** to ensure water conservation and waste management.
- Utilization of fly ash for cement and brick manufacturing to achieve 100% utilization targets.

4. Commitments and Future Reporting

APL, Kawai is committed to:

- Periodically updating the regulatory authority & stakeholders with progress reports on SDG alignment and the net-zero roadmap.
- Undertaking third-party audits to validate emission reductions and sustainability efforts.