Initial Environmental Examination (Draft)

June 2011

India: National Grid Improvement Project

Prepared by Power Grid Corporation of India Limited for Asian Development Bank

POWER GRID CORPORATION OF INDIA LTD.
(A Government of India Enterprise)

INITIAL ENVIRONMENTAL EXAMINATION REPORT

Champa- Kurukshetra-Jallandhar Transmission System Project

June 2011

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CURRENCY EQUIVALENTS

(as of 3 June 2011)

Currency Unit - India rupee/s (INR)
Rupee 1.00 = $0.02243
$1.00 = Rs44.59

ABBREVIATIONS

ADB	-	Asian Development Bank
APs	-	Affected Persons
CEA	-	Central Electrical Authority
DC	-	District Collector
DDP	-	Desert Development Program
DSM	-	Demand Side Management
EA	-	Executing Agency
EIA	-	Environmental Impact Assessment
ESMU	-	Environment and Social Management Unit
FGD	-	Focus Group Discussions
GOC	-	Government of Chhattisgarh
GOI	-	Government of India
GRC	-	Grievance Redress Committee
IA	-	Implementing Agency
IEE	-	Initial Environmental Examination
INRM	-	India Resident Mission
IPP	-	Independent Power Producer
km	-	Kilometres
LAA	-	Land Acquisition Act 1894, as amended in 1984
LAO	-	Land Acquisition Officer
LTOA	-	Long Term Open Access
M&E	-	Monitoring and Evaluation
MRM	-	Management Review Meeting
NGOs	-	Non-Government Organizations
NRRP	-	National Rehabilitation and Resettlement Policy, 2007
PMU	-	Project Management Unit
RF	-	Resettlement Framework
RP	-	Resettlement Plan
SCs	-	Scheduled Castes
STs	-	Scheduled Tribes
WR	-	Western Region
NR	-	Northern Region

1.0 INTRODUCTION

The Government of India (GOI) and Power Grid Corporation of India Limited (POWERGRID) have requested the Asian Development Bank (ADB) for a loan of USD 750 million (USD 500 million as Sovereign and USD 250 million as Non-Sovereign) to support continued investment, specifically for strengthening interregional transmission system. POWERGRID is the Executing Agency for the loan.

The loan will partly finance the expansion and augmentation of the interregional transmission networks. The proposed investments are necessary to: (i) optimize transnational power supply and promote country-wide power transfer in an efficient manner; (ii) facilitate increased power transfers to accommodate increased demand and economic growth; (iii) have a low carbon investment.

1.1 Background

The current installed generation capacity in India is 173,626 MW, of which the existing interregional transmission capacity is limited at 13% of this total (i.e., around 22,400 MW). With focus on increasing generation capacity over the next few years, commensurate expansion of transmission capacity is the most urgent need to ensure enhanced, reliable power supply. Traditionally, GOI has accelerated investment in power generation to alleviate the acute power shortage. On the other hand, the private sector has been increasing their power generation capacity in the last four years.[1] In the process, transmission and distribution development has fallen behind and attracted significantly less investment in comparison to generation.

POWERGRID, the Central Transmission Utility (CTU) of the country, operates more than 95% of inter-state power transmission. POWERGRID's immediate investment will be focused on the various transmission lines required to transport electricity to the main load centers from new power generation plants of 90 independent power producers (IPPs), which are collectively known as the High Capacity Power Transmission Corridors program. The program includes nine major transmission schemes approved by the Central Electricity Regulatory Commission (CERC).

The proposed project scope is the biggest transmission scheme to strengthen the interregional transmission connection between Chhattisgarh in the Western regional grid and Haryana in the Northern regional grid of India to support bulk power supply from private generation companies of 14 IPPs. The system will mainly comprise high voltage direct current (HVDC) transmission which is used as a smart grid technology to stabilize long distance power transfer with energy efficient and economical solutions through flexible operations of interconnected systems.

Looking at the transmission system requirement for the transfer of power to Northern/Western region from generation projects coming up in Chhattisgarh, a comprehensive transmission scheme on system strengthening in Western-Northern inter-regional HVDC transmission corridor is proposed. Considering its hybrid nature, the scheme is divided into:

Component 1: HVDC interregional transmission system between the Western Region (WR) in Chhattisgarh and the Northern Region (NR) in Haryana and;

[1] As of 31 January 2011, the generation capacity has been 1,931 MW (1997-2002 under the 10th Plan) to 11,040 MW (2007-2012 under the 11th Plan)

Component 2: Transmission system strengthening in Northern region for Haryana and Punjab

A Detailed Project Report (DPR) was prepared by POWERGRID (April 2011) for the transmission system strengthening and submitted to ADB for financing consideration.

1.2 Scope of Assessment

The Ministry of Environment and Forests (MoEF) of GOI has declared in September 2006 that transmission projects are exempted from environmental clearances due to the non-pollutive nature of its activities.[2] However, forest clearances under the Forest Conservation Act 1980 will be secured in the event that the transmission line will pass through forest areas.

To address the environmental and social issues related to its power transmission projects, POWERGRID has developed its corporate environmental and social policy and procedures (ESPP) in 1998 based on the principles of Avoidance, Minimization, and Mitigation. The ESPP had been updated and revised in 2009 with the assistance from the World Bank under its Use of Country System policy.[3] This is now referred to by POWERGRID as the ESPP 2009.

Under the ADB's Safeguard Policy Statement 2009 (SPS 2009), the proposed Project is classified as Category B since the potential adverse environmental impacts are site-specific, few if any of them irreversible, and can be readily mitigated. For Category B projects, an initial environmental examination (IEE) is required.

The Project consists of Component 1 and Component 2.[4] Only Component 1 will be considered for financing by ADB. However, since Component 2 is taken as an associated facility of Component 1, environmental assessment was conducted following ADB's SPS 2009. This IEE was prepared for the Project by the Consultants, on behalf of POWERGRID, following the requirements of SPS 2009 and ESPP 2009.

This IEE describes the proposed transmission system investments, environmental benefits and negative impacts, public consultations, proposed mitigation measures, and environmental management plan (EMP).[5]

2.0 POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

Power transmission activity is undertaken within the purview of GOI's laws keeping in mind appropriate international obligations and directives and guidelines with respect to environmental and social considerations of funding agencies. The following is a brief description of relevant laws and regulations:

[2] Notification in the Gazette of India, Extra-ordinary part II and section 3, subsection II, 14 September 2006).
[3] Power Grid Corporation of India Ltd., Environment and Social Management, *Environmental and Social Policy & Procedures (ESPP),* p5, CC/ESMD/ESPP-09.
[4] Details of project components discussed in Section 3.0 of the IEE.
[5] The EMP will be updated periodically during project implementation.

2.1 Environmental

a) Constitutional Provisions

Subsequent to the 1st United Nations Conference on Human Environment at Stockholm in June 1972, which emphasized the need to preserve and protect the natural environment, the Constitution of India was amended through the historical 42nd Amendment Act 1976 by inserting Article 48-A and 51-A (g) for protection and promotion of the environment under the Directive Principles of State Policy and the Fundamental Duties respectively. The amendment, inter alia provides:

> "The State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country". (New Article 48A)
>
> ”It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures”. (New Article 51 A(g))

Article 21 of the constitution provides that, “no person shall be deprived of his life or personal liberty except according to procedure established by law”. This article is the heart of the fundamental rights and has received expanded meaning from time to time after the decision of the Supreme Court in 1978. The Article 21 guarantees fundamental right to life – a life of dignity to be lived in a proper environment, free of danger of disease and infection.

Recently, the Supreme Court has broadly and liberally interpreted the Article 21, transgressed into the area of protection of environment, and held that the protection of environment and citizens’ right to live in eco-friendly atmosphere are to be interpreted as the basic right guaranteed under Article 21. Thus, the Indian Constitution has now two fold provisions. First, it gives directive to the State for the protection and improvement of environment and second, the citizens owe a constitutional duty to protect and to improve the natural environment.

b) Mandatory Requirements (National)

- **Ministry of Power (MOP) order/sanction under the Electricity Act of 2003**

Sanction of MoP, GOI is a mandatory requirement for taking up any new transmission project under the section 68(1) of The Electricity Act, 2003. The sanction authorizes POWERGRID to plan and coordinate activities to commission the new projects.

- **Forest Clearance under the Forest (Conservation) Act of 1980**

When transmission projects pass through forest land, clearance has to be obtained from relevant authorities under the Forest (Conservation) Act, 1980. This Act aims to prevent rapid deforestation and environmental degradation. State governments cannot de-reserve any forest land or authorize its use for any non-forest purposes without prior approval from the Central government. POWERGRID projects, when involving forest areas, undergo detailed review and approval procedures to obtain a Forest Clearance certificate from Ministry of Environment and Forests (MoEF) before starting any construction activity in the designated forest areas.

- **Environmental Clearances under the Environment (Protection) Act of 1986**

Since transmission line projects are environmentally clean and do not involve any disposal of solid waste, effluents and hazardous substances in land, air and water, they are kept out of the purview of Environment (Protection) Act, 1986. However, the recent amendment in the Environment (Protection) Act, 1986 made it necessary to obtain clearance from MoEF for power transmission projects in two districts in the Aravalis: Alwar in Rajasthan and Gurgaon in Haryana.

- **Batteries (Management and Handling) Rules of 2001**

MoEF, vide its notification on 16 May 2001 under the section of 6, 8 and 25 of the Environment (Protection) Act 1986, has put certain restrictions on disposal of used batteries and its handling. The notification provides that it is the responsibility of bulk consumer (POWERGRID) to ensure that used batteries are not disposed of, in any manner, other than by deposing with the dealer/manufacturer/registered recycler/importer/reconditioner or at the designated collection centres – and to file half yearly return in prescribed form to the concerned State Pollution Control Board.

- **Hazardous Wastes (Management and Handling) Amendment Rules of 2003**

MoEF, vide its notification on 20 May 2003 under the section of 6, 8 and 25 of the Environment (Protection) Act 1986, has put used mineral oil under the category of hazardous waste which requires proper handling and disposal. The notification provides that all used oil should be auctioned and/or sold to registered recyclers only and to file annual return on prescribed form to the concerned State Pollution Control Board.

- **Ozone Depleting Substances (Regulation and Control) Rules of 2000**

MoEF, vide its notification on 17 July 2000 under the section of 6, 8 and 25 of the Environment (Protection) Act 1986, has notified rules for regulation/control of Ozone Depleting Substances under the Montreal Protocol adopted by GOI on 16 September 1987. The notification provides for certain controls and regulations to be imposed on manufacturing, import, export, and use of these compounds. POWERGRID is following the provisions of the notification and is phasing out all equipment which uses these substances and planning to achieve CFC-free organization in the near future.

- **The Biological Diversity Act, 2002**

Under the United Nations Convention on Biological Diversity, signed at Rio de Janeiro on 5 June 1992 of which India is a party, MoEF has enacted the Biological Diversity Act of 2002 to provide for conservation of biological diversity, sustainable use of its components, and fair and equitable sharing of the benefits arising out of the use of biological resources, knowledge and for matters connected therewith. According to the Act, certain areas which are rich in biodiversity and encompass unique and representative ecosystems are identified and designated as Biosphere Reserve to facilitate its conservation. All restrictions applicable to protected areas like national park and sanctuaries are also applicable to these reserves. POWERGRID will abide by the provisions of act, wherever applicable, and try to totally avoid these biosphere reserves in selecting the final route alignment.

2.2 Funding Agencies Requirements

The SPS 2009 describes ADB's policy and operational procedures on three key safeguard areas: environment, involuntary resettlement, and indigenous peoples, as well as a set of specific safeguard requirements that borrowers are expected to meet when borrowing for development projects. Its objective is to ensure social and environmental sustainability of projects through avoidance, minimization, mitigation and/or compensation of adverse impacts on environment and affected peoples.

2.3 Relevant Policies

- National Conservation Strategy and Policy Statement on Environment and Development of 1992
- National Environment Policy of 2006
- Rights-of-Way (ROW) and Compensation under the Electricity Act of 2003

2.4 Comparison of POWERGRID ESPP and the ADB Safeguard Policy Statement 2009

The table below presents a brief comparison of ESPP and ADB's SPS 2009.

Table 2.1 Comparison of ESPP and ADB's SPS 2009

Project Stage	ADB Safeguard Policy Statement 2009 for environmental assessment	POWERGRID's ESPP	Remarks
Project identification and categorization	Screening of each proposed project at initial stage using checklists and categorize the project as A,B,C,FI based on potential environmental impacts	POWERGRID does not categorize a project, and has no legislative provision[6] for screening and categorization to define the depth of environmental assessment. However, it conducts an environmental and social screening at Project conceptualization in line with international good practices.	• Under the national policy, it is not required for POWERGRID to categorize their projects to identify the environmental assessment needed

[6] The applicable legal provisions under the Electricity Act 2003 are as follows: Section 68(1) **-** sanction from the Ministry of Power (MOP) is a mandatory requirement for taking up any new transmission project. The sanction authorizes POWERGRID to plan and coordinate activities to commission new project. Section 164(B) **–** under this section of the Act, POWERGRID has all the powers that the telegraph authority possesses and can erect and construct towers without actually acquiring the land.

Project Stage	ADB Safeguard Policy Statement 2009 for environmental assessment	POWERGRID's ESPP	Remarks
Conduct Environmental Assessment (i.e., EIA or IEE)	Assessment of all potential impacts on physical, ecological, sociological, and cultural resources.	• Undertakes environmental assessment for all projects as a standard management procedure (an Initial Environment Assessment Report) • Prepares Environmental Assessment and Management Plan (EAMP) in consultation with MoEF and Revenue Authority if transmission line route will pass through forest areas • Operates within permissible standards of ambient air quality and noise levels as prescribed by national laws and international regulations • Conducts cost-benefit analysis as part of Forest Clearance applications • Use environmental and social risk management framework as part of environmental and social management strategies – creating funds to absorb risks and prepare for contingencies, maintains insurance schemes	• Prepares Initial Environment Assessment Report (IEAR) of transmission projects required for securing the Forest Clearance from MoEF. • Content of IEAR is generally aligned with the IEE.
Assessment of Alternative	Assessment of feasible alternatives (technical, sitting, routing, etc as appropriate)	• During project planning, conducts "Bee" line survey to select the most optimum route with the least environmental impacts • Uses GPS/GIS and government-published data and/or reports such as Survey of India toposheets, Forest Atlas, etc to select three "best" alternative routes for detailed study in consultation with relevant government agencies	• Prepares two or three route alternatives for detailed study and therefore, aligned with ADB's requirements
Prepare environmental management plan with budget estimates	Develop and implement Environmental Management Plans (EMP), Environmental Monitoring Plans and define institutional arrangement to achieve defined plans	Prepares Environmental Assessment and Management Plan in consultation with relevant authorities such as MoEF and Department of Revenue	Aligned with ADB's requirements
Public consultation	Public consultations (stakeholders including project affected groups, local NGOs, etc) throughout the project cycle	• Informal consultations are done during walkover survey for transmission line and tower spotting, during construction, and maintenance (e.g., landowners, people along the route, etc) • Formal public consultation is conducted as part of Section 4 of the Land Acquisition Act	Aligned with ADB's requirements
Information	Environmental documents publicly	• EMP is translated into local	Aligned with ADB's

Project Stage	ADB Safeguard Policy Statement 2009 for environmental assessment	POWERGRID's ESPP	Remarks
disclosure	disclosed at ADB website: • 120-day prior to ADB Board consideration of the project for Category A (an EIA is required) • New/updated environmental assessment and corrective plan prepared during implementation • Environmental monitoring reports	language and made available at the village/community level • Copies of EMP available at local level for stakeholders' inputs (as needed)	requirements

Based on the brief description given in **Table 2.1**, except for categorization of projects, the ESPP 2009 is generally aligned with the requirements of ADB's SPS 2009.

3.0 DESCRIPTION OF THE PROJECT

3.1 Objective

The objective of the project is to provide sufficient transmission arrangements and to strengthen transmission capacity from the Western region in Chhattisgarh to the Northern region in Haryana and Punjab.

3.2 Justification

Based on Long-term Open Access applications, it is estimated that IPP generation projects with long-term power transfer requirement of about 15000-16000 MW, is coming up in Raigarh (Kotra), Champa, Raigarh (Tamnar) and Raipur generation complex in Chhattisgarh progressively in the next 3-4 years. Out of the 15000-16000 MW of power transfer requirement, about 5,000 MW power is indicated for transfer to Northern region as the target region and balance power is to be transferred to the Western region.

Presently, the North-West inter-regional transmission corridors are being developed with alternating current technology. However, the long distance and the amount of power transfer requirements to NR from IPP generation projects in Chhattisgarh (i.e., 5,000 MW), it is proposed that power generated by these IPPs be transferred over an HVDC system. The HVDC system facilitates the establishment of transmission corridors with hybrid technology. This shall also facilitate in meeting the controlled power flow requirement, flexibility of operation as well as maintaining system parameters within limits through its control mechanism.

For this 800 kV transmission system, 3000 MW HVDC bipole between Champa Pooling Station and Kurukshetra, a major load center in NR, is proposed. For power transfer from Kurukshetra onwards, a 400 kV transmission corridor towards Nakodar/Jallandhar in Punjab is proposed. It is also proposed that provision should be kept to upgrade above HVDC Bipole to 6000 MW at a later date with increased power transfer requirement to NR.

3.3 Project Benefits

The proposed scheme shall facilitate strengthening of North-West transmission corridor for dispersal of power with reliability and security. In addition, the project is expected to generate direct and indirect employment opportunities, promote industrial growth and stimulate overall

development of the region. POWERGRID, as a responsible corporate entity, always undertakes community development works around the location of its substations. Hence, the basic infrastructure around the proposed substation will also improve substantially.

3.4 Independent Power Producers in Chhattisgarh

This Project will provide the transmission scheme associated with 14 IPPs and one public power trading company in Chhattisgarh through a Pooling substation in Champa. The 14 IPPs are scheduled for commissioning from July 2010 to March 2014 and are mainly coming from Raigarh (near Kotra), Champa-Janjgir and Raigarh (near Tamnar) complex. **Table 3.1** presents the list of the IPPs with Long-term Open Access (LTOA) applications for transfer of power to Western and Northern regions.

The IPPs will use pulverized coal as fuel to generate power. Environmental assessments have been prepared for these power generation projects and the IPPs are in varying stages of securing the environmental clearance from MoEF. For example, the Athena Chhattisgarh Power Pvt. Ltd, which is scheduled to commission in June 2013, has been issued the environmental clearance on 4 June 2010 by the MoEF as provided for by the Environmental Impact Assessment (EIA) Notification vide S. O. 1533 (E), 14 September 2006.

Based on the environmental assessment reports of the power generation projects, the IPPs will be equipped with pollution control device such as high-efficiency electrostatic precipitator (99.99%) to capture fly ash produced, high smokestack ranging from 220 m to 275 m to adequately disperse the flue gas generated during the combustion of pulverized coal, low-NO_x burner, and water spray system to suppress dust at the coal yard and ash disposal area. Some of the mitigation measures that the IPPs will implement include establishment of greenbelt in the power plant perimeter (i.e., 20-30 m wide), wastewater and solid waste management, and rain harvesting. To implement the environmental management plan and to conduct the environmental monitoring during construction and operation, an Environmental Management Cell will be set up by these IPPs.

Table 3.1 List of IPPs with Long-Term Open Access Application for Transfer of Power

Developer	Capacity, MW	LTOA, MW	Commissioning Schedule
RAIGARH COMPLEX			
RKM Powergen Ltd (4x360MW)	1440	819	June 2011, September 2011, December 2011, March 2012
Athena Chhattisgarh Power Ltd. (2x600)	1200	683	June 2013, November 2013
Jindal Power Ltd. (4x600MW)	2400	1400	March 2012, July 2012, November 2012, March 2013
Jindal Power Ltd [225 MW from Dongamahua CPP (4x135MW) + 175MW from existing Tamnar TPS (4x250MW)]	400	400	July 2010, Existing
SKS Power Gen (Ch) Ltd. (4x300MW)	1200	683	December 2012, September 2013, November 2013, December 2013
Korba West Power Co. Ltd. (1x600MW)	600	240	November 2012
DB Power Ltd. (2x600MW)	1200	705	October 2013, February 2014
Visa Power (2x600MW)	1200	678	January 2013, April 2013

JANJGIR-CHAMPA COMPLEX			
KSK Mahanadi Power Co. Ltd. (6x600MW)	3600	2340	February 2012, June 2012, October 2012, February 2013, June 2013, October 2013
BALCO (4x300MW)	1200	200	October 2010, January 2011, May 2011, August 2011
Vandana Vidyut Ltd. (2x135MW + 1x270MW)	540	265	January 2012, March 2012, March 2014
Lanco Amarkantak Power Pvt. Ltd. (2x660MW)	1320	858	January 2012, March 2012
Chhattisgarh Steel and Power Ltd. (1x35MW + 1x250MW)	285	167	June 2013
RAIPUR COMPLEX			
GMR Chhattisgarh Energy (2x685MW)70	1370	816	August 2013, January 2014

3.5 Description of the Power Transmission System

The Project consists of the following:

Component 1: HVDC interregional transmission system between the Western and Northern regions (Chattisgarh and Haryana)

(i) A 800kV HVDC transmission line (1,365 km) between Champa in Chhattisgarh and Kurukshetra in Haryana;
(ii) Expansion of a substation at Champa; and,
(iii) Establishment of 800kV HVDC terminals at Champa and Kurukshetra.

Component 2: Transmission system strengthening in the Northern region (Haryana and Punjab)

(i) A 400kV double circuit transmission line (268 km) between the substations at Kurukshetra in Haryana and at Jalandhar via Nakodar in Punjab;
(ii) A 400kV double circuit transmission line (50 km) from Kurukshetra to Abdullapur and Sonepa; and,
(iii) Establishment of a substation at Kurukshetra.

ADB has been requested to finance only Component 1. However, since Component 2 is considered as an associated facility within the context of project's area of influence, environmental due diligence was also conducted following ADB's SPS 2009.

4.0 ROUTE SELECTION

4.1 Preliminary Identification

Preliminary route selection is done by POWERGRID based on the toposheets from the Survey of India and Forest Atlas. During the preliminary identification of route alignment, all possible efforts are made to avoid the forest area completely or to keep it to the minimum, whenever it becomes unavoidable due to terrain or the prohibitive cost involved in avoiding it.

a) Project Conceptualization

The preliminary/tentative route maps are forwarded to concerned field division of POWERGRID for arranging actual walk over survey (preliminary survey) along the tentative routes and return a copy of tentative route map proposing the most suitable route together with their detailed report covering information on following parameters:

- physical, topographical, geo-technical information
- forest (if any) that may be affected and estimates of the area and length of T/L
- details of environmental features
- historical/cultural monuments, if any, along the route or adjacent to it
- settlements and its distance, if any, near the line such as cities, villages, houses/ hutments, structures, agricultural crops, if any, temples/playgrounds, irrigational tanks, reservoirs, bunds and wells etc.
- crossing such as road, river, canal, railway, power line, telephone lines etc.

b) Project Planning

Field officers record all critical information such as rivers, hills, railway crossings, telephone, and power transmission lines and any environmental and social details. Detailed Survey is carried out for forest areas and preliminary survey for the rest of the areas. POWERGRID employs modern survey tools such as Global Positioning System (GPS), aerial photography and satellite images to collect all relevant information.

The collected information is transferred to Geographic Information System (GIS) and the optimum route is selected ensuring that the alignment avoids forests and areas of significant natural resources. If this is unavoidable, POWERGRID ensures that the route does not involve human habitation and areas of cultural importance and the use of forest is kept to a minimum.

After the finalization of route, POWERGRID carries out the environmental assessment with the help of authorized agencies (e.g., MoEF and the Department of Revenue) and formulates an Environmental Assessment and Management Plan (EAMP), which includes the forest proposal. Local forest authorities certify that the final route selected involves the minimum forested areas. The EAMP is submitted to MoEF to secure the forest clearance with an undertaking to bear the cost of compensatory afforestation (CA) on degraded forest land which is double the area affected by the T/L.

4.2 Study of Alternatives

POWERGRID takes into consideration the following environmental criteria in route selection:

- The route of the proposed transmission lines does not involve any human rehabilitation.
- Any monument of cultural or historical importance is not affected by the route of the transmission line.
- The proposed route of transmission line does not create any threat to the survival of any community with special reference to Tribal Community.
- The proposed route of transmission line does not affect any public utility services like playgrounds, schools, other establishments etc.
- The line route does not pass through any sanctuaries, National Park etc.

- The line route does not infringe with area of natural resources.

Although under the national law POWERGRID has the right of eminent domain for power transmission, alternative alignments are considered keeping in mind the environmental criteria to avoid environmentally-sensitive areas and settlements at execution stage. Alignments are generally sited 10-15 km away from major towns, whenever possible, to account for future urban expansion. Similarly, forests are avoided to the extent possible, and when not possible, a route is selected in consultation with the local Divisional Forest Officer, that causes minimum damage to existing forest resources. Alignments are selected to avoid wetlands and unstable areas, national parks and sanctuaries, both for financial and environmental reasons.

4.3 Evaluation of Route Alignment Alternatives for 800 kV HVDC Bipole between Champa Pooling Station and Kurukshetra

Three different alignments were studied with the help of government-published data and maps such as Forest Atlas, Survey of India topographic sheets, etc. and walkover survey to arrive at the optimum route which can then be taken up for detailed survey and assessment. The comparative details of these three alternatives are given below.

Table 4.1 Comparison of Alternatives from Champa to Kurukshetra

S. N	Description	Alternative I	Alternative II	Alternative III
1.0 Route Particulars				
(i)	Route Length, km	1286.7	1295.3	1296
(ii)	Terrain (%)			
a.	Plain	89	86	85
b.	Hilly	11	14	15
2.0 Environmental Details				
(i)	Name of District/District details (Through which line pass)	*Chhattisgarh* Janjgir Champa,Korba, Bilaspur *Madhya Pradesh* Dindori,Jabalpur, Damoh and Chhatarpur *Uttar Pradesh* Banda, Hamirpur, Muzaffarna gar, Jalaun, Etawa, Auriya, Aligarh, Etah , Mainpuri, Ghaziabad , Bulandshahar,Meerut, *Haryana* Karnal, Kurukshetra	*Chhattisgarh* Janjgir-Champa,Korba, Bilaspur *Madhya Pradesh* Dindori,Jabalpur, Damoh and Chhatarpur *Uttar Pradesh* Banda, Hamirpur,Jalaun, Etawa Auriya, Mainpuri, Etah, Aligarh, Bulandshahar, Ghaziabad, Meerut, Muzaffarnagar *Haryana* Karnal, Kurukshetra	*Chhattisgarh* Janjgir-Champa,Korba, Bilaspur *Madhya Pradesh* Dindori,Jabalpur, Damoh and Chhatarpur *Uttar Pradesh* Banda, Hamirpur,Etah, Jalaun, Auriya, Aligarh, Etawa, Mainpuri, Ghaziabad Bulandshahar, Meerut, Muzaffarnagar *Haryana* Karnal, Kurukshetra

S. N	Description	Alternative I	Alternative II	Alternative III
(ii)	Town in Alignment nearby	*Chhattisgarh* Sipat Akaltara, , Ratanpur, Belgahan, Kenda, Pendra, Venkatnagar *Madhya Pradesh* Anuppur, Shahpur, Dindori, Sihora, Hatta, Damoh and Chhatarpur *Uttar Pradesh* Naraini,Banda,Rijor Nougaw,Mahoba,Beri	*Chhattisgarh* Akaltara, Sipat, Ratanpur, Belgahan, Kenda, Pendra, Venkatnagar *Madhya Pradesh* Anuppur, Dindori, Shahpur, Sihora, Hatta, Damoh & Chhatarpur *Uttar Pradesh* Naraini,Banda, Nougaw, Mahoba, Kalpi, Moudah	*Chhattisgarh* Akaltara, Sipat, Ratanpur, Belgahan, Kenda, Pendra, Venkatnagar *Madhya Pradesh* Anuppur, Dindori, Shahpur, Sihora, Hatta, Damoh and Chhatarpur *Uttar Pradesh* Naraini,Banda,Rijor Nougaw,Mahoba,Beri
		Moudah,Kalpi,Jalaun Kuthoindh,Etah Auriya, Ajitmal, Bagi, Bakevar, Bharthana, Ghiroir, Pilawa, Kauda, Kalan,Manpur,Chausana *Haryana* Jhinjhaja, Tana, Bhadeo, Shamli, Banat, Sisauli, Ghiar Barwala, Satheri, Kheri Lawar NP, Machhra, Debai, Alamgeepur, Udaipur, Atruali, Khanpur, Jahagirabad, Marehara, Bhadshon, Bansalu, Makhan majra, Butan Kheri	Beri, Kuthoindh, Jalaun, Auriya,Ajitmal, Bakevar, Bharthana,Karahal Ghiroir,Bagi Rijoir, Etah, Pilawa,Khudan, , Kalan, Chausana *Haryana* Jhinjhaja, Tana, Bhadeo, Shamli, Banat, Sisauli, Barwala, Satheri, Lawar NP, Machhra, Debai, Atruali Alamgeepur, Udaipur, , Khanpur, Jahagirabad, Marehara, Ghiar, Kheri, Bhadshon, Bibipur, Jatan, Butan Kheri, Bhadshon	Kalpi, Etah, Kuthoindh, Jalaun, Auriya, Ajitmal, Bakevar, Lachhmipura Bharthana, Karahal Ghiroir,Rijoir, Chausana Pilawa *Haryana* Jhinjhaja, Tana, Bhadeo, Shamli, Banat, Sisauli, Barwala, Satheri,LawarNP, Debai Machhra, Alamgeepur, Udaipur, Atruali, Ghiar, Khanpur, Jahagirabad, Marehara, Kheri,Majra, Bhadshon, Khirajpur, Moghal, Baragaon, Gari Gujran
(iii)	House within ROW	Nil	Nil	Nil
(Iv)	Forest in km/ha	75.565 km (521.398 ha)	120.02 km (828.138 ha)	117.39 km (809.991 ha)
(v)	Type of forest Reserve/Protected/ Mangrove/Wildlife/ Biosphere Reserve/any other environmentally-sensitive area	Reserve Forest/ Protected Forest/ Revenue Forest/ Social Forest	Reserve Forest/ Protected Forest/ Revenue Forest/ Social Forest	Reserve Forest/ Protected Forest/ Revenue Forest/ Social Forest
(vi)	Density of Forest	0.1-0.6	0.1-0.6	0.1-0.6
(vii)	Type of fauna	Dog, Bear, Monkey, Reptiles, Buffalo,	Dog, Bear, Monkey, Reptiles, Buffalo,	Dog, Bear, Monkey, Reptiles, Buffalo,
(viii)	Flora	Sal, Tendu, Saja, Teak, Babul, Neem, Eucalyptus, Sunflower	Sal, Tendu, Saja, Teak, Babul, Neem, Eucalyptus, Sunflower,	Sal, Tendu, Saja, Teak, Babul, Neem, Eucalyptus, Sunflower,
(ix)	Endangered species, if any	None	None	None

S. N	Description	Alternative I	Alternative II	Alternative III
(x)	Historical/Cultural monument	None	None	None
(xi)	Any other relevant information	None	None	None
3.0 Compensation Cost				
(i)	Crop (In Lakhs)	1212 Lakhs (Approx.)	1174 Lakhs (Approx.)	1178 Lakhs (Approx.)
(ii)	Forest and NPV (in Lakhs)	5960 Lakhs (Approx.)	9464 Lakhs (Approx.)	9258 Lakhs (Approx.)
4.0 No. of Crossing				
(i)	Railway	17	18	19
(ii)	Power Line	174	182	180
(iii)	Rivers, etc.	15	17	17
5.0 Construction Problem		Less problem as this line route is easily approachable through available roads, and also passing mostly through plain area with less involvement of forest area and river & power line crossing	Less problem as this line is approachable through state highway, village roads but line is passing through more hilly terrain, forest area and river crossing	Comparatively more problems as approach road is far away and also relatively more hilly terrain, forest area and nos. of river & power line crossing are more in the route alignment
6.0 O & M Problem		Very less as most part of the line is approachable and almost parallel to approach road	Less as most part of the line is approachable and near to state highway, road	Difficult as approach road are far away and hilly terrain involved
7.0 Overall Remarks		Construction and O & M will be comparatively easier.	Construction and O & M will be comparatively difficult	Construction and O & M will be comparatively more difficult

Source: POWERGRID

As shown above, Alternative I is considered as the best route, at this stage, since it involves the minimum area of forest and has shorter length compared to the other alternatives. Thus, Alternative I have been recommended for further detailed study and survey. The exact forest area shall be known only after the detailed survey has been completed and the entire length and route of the T/L is known and finalized.

5.0 DESCRIPTION OF THE EXISTING ENVIRONMENT

The project involves power transmission from Champa pooling station in Chhattisgarh to Kurushetra substation in Haryana, and on to Punjab. The project passes through Chhattisgarh, Madhya Pradesh, Uttar Pradesh, Haryana, and Punjab. The basic details of areas within the project are discussed below.

5.1 CHHATTISGARH

Chhattisgarh is located in the central part of India. The geographical location of Chhattisgarh is $17^{o}46'$ N to $24^{o}5'$ N latitude and from $80^{o}15'$ East to $84^{o}20'$ East longitude. Madhya Pradesh borders Chhattisgarh in the northwestern part, Maharashtra in the west, and Andhra Pradesh in

the south. Chhattisgarh is also bounded by Orissa in east and Jharkhand in the northeastern part. The general land use pattern is given below:

Table-5.1 Land Use Pattern in Chhattisgarh

Land use	Area in '000 ha	Percentage
Total Geographic Area	13,519	
Reporting area for land utilization	13,790	100.00
Forests	6,355	46.08
Not available for land cultivation	996	7.22
Permanent pastures and other grazing lands	857	6.21
Land under misc. tree crops & groves	1	0.01
Culturable Wastelands	350	2.54
Fallow land other than current fallows	238	1.73
Current fallows	271	1.97
Net area sown	4,772	34.24

Source: Land Use Statistics, Ministry of Agriculture, GOI, 2006

5.1.1 Physiography

Chhattisgarh is divided into three distinct areas namely; Northern Hill, Chhattisgarh Plains, and Bastar Plateau. In the north, are the Satpura Ranges, Maikal Range, and Vindhyachal Mountain Range; in the center, the plains of Mahanadi River and its tributaries; and in the South is the plateau of Bastar. The gradient of the Chhattisgarh Plain is generally flat. The elevation of the plain land varies from 250 meter to 330 meter.

5.1.2 Climate

The general climate in Chhattisgarh is dry sub-humid type. It is bordered by land on all sides. The geographical factors like distance from the sea and altitude of the state have influenced the Chhattisgarh climate.

During the summer season, from April to middle of June, the temperature varies from 40^{o}C to 42.5^{o}C. The average annual rainfall of the region is around 1400 mm and about 90 to 95% of this amount is received during southwest monsoon season (June-October). Rainfall in October occurs due to cyclonic activity in the Bay of Bengal. Winter conditions set in from mid-November when the average minimum temperature, varies from 10^{o}C to 15^{o}C. The atmospheric humidity is very high (>90%) during monsoon months and starts decreasing from October onwards and reaches as low as 15-20% during peak summer months.

5.1.3 Water Resources

Chhattisgarh has numerous water bodies consists of several rivers and lakes that provide the necessary water contributing much towards the fertile plains of the state.

The major rivers of Chhattisgarh are the Mahanadi, the Indravati and the Godavari, which drains most of the state along with their tributaries. The rivers meander through the uneven topography of the state giving rise to gorgeous waterfalls that are famous as places of tourist attraction. The other rivers in Chhattisgarh are Rihand, Sukha, Hasdo, Arpa, Shivnath, Mand, Eb, Jonk, Pary, Kelo, Udanti and Sone.

5.1.4 Mineral Resources

Chhattisgarh is one of the richest states in terms of mineral resources. A variety of mineral resources found are diamond, gold, iron-ore, coal, corundum, bauxite, dolomite, lime, tin and granite, to name a few. There are deposits of cumberlite pipe in Pailikhand and Deobhog area and gold deposits in Sonakhan area of Raipur district. High quality iron-ore deposits are found in the Bailadila Hill ranges as well as in Dalhi-Rajhara. Abundant deposits of limestone are found in the districts of Raipur, Bilaspur, Durg and Bastar. The State accounts for more than 13% of India's total mineral production. Twenty-three percent iron ore deposits, 14% of dolomite deposits, and 6.6% of limestone deposits of the country are found in Chhattisgarh. About 18% of coal reserves of the country, and the state is ranked third after Jharkhand and Orissa.

5.1.5 Soil

The soils of Chhattisgarh vary considerably in the three physiographic zones. Though the nomenclature is different, the types of soils especially the physical properties are the same. The different soil types are given in **Table 5.2**.

Table 5.2 Soil Type in Chhattisgarh

Chhattisgarh Plains	Bastar Plateau	Northern hills
Bhata (Lateritic)	Marhan (coarse sandy)	Hilly soils
Matasi (Sandy loam)	Tikra (sandy)	Tikra
Dorsa (clay loam)	Mal (sandy loam)	Goda chawar
Kanhar (clay)	Gabhar (clay & clay loam)	Bahara

The first two categories of the soils in the three areas are very light type of soils with very low water retentive capacity.

5.1.6 Ecological Resources

The forest cover, based on the satellite data in November-December 2006, is 55,870 km^2 which constitutes 41.33% of the geographic area or 12% of India's forests. Out of these, 4.162 km^2 is very dense forest, 35,038 km^2 constitutes moderately dense forest, and 16,670 km^2 represents open or degraded forest.

As per recorded data, the forest area of the State is 59,772 km^2. Reserve forests (RF) constitute 43.13%, protected forests 40.21%, and unclassified forests (UF) 16.65%. Chhattisgarh is identified as one of the richest biodiversity habitats, has the densest forests in India, and is rich in wildlife. Over 200 non-timber forest products, with tremendous potential for value addition are produced in the state. The forests are the main source of supply of fodder and fuel and subsistence for the poorest sections of the people and tribal population in the interior under-developed areas. The forests are broadly classified as tropical moist deciduous and tropical dry deciduous types.

Protected areas There are three national parks and 11 wildlife sanctuaries covering an area of 0.29 million ha and 0.36 million ha, respectively. Thus, a total of 0.65 million ha, constituting about 4.79% of the State's geographical area, are under the protected area network.

The transmission line (T/L) of the proposed project shall pass through the three districts of Chhattisgarh with forest cover ranging from 4.08% to 50.83% of the geographical area of the districts. The forest cover is a mixture of both dense and open/degraded forest which require extra precaution in routing the transmission line. Details of forest cover of these districts are given below:

Table 5.3 Forest Cover of Districts along the T/L Route in Chhattisgarh, km^2

District	Geographic Area	Dense forest	Mod. forest	Open forest	Total	% Forest Cover
Janjgir-Champa	3,852	4	26	127	157	4.08
Korba	6,599	204	2,308	842	3,354	50.83
Bilaspur	8,270	336	1,631	531	2,498	30.21

5.1.7 Human and Economic Development

Chhattisgarh constitutes 2.0795 Crore according to 2001 Census with a population density of 154 per square kilometer. Agriculture is the main occupation where nearly 80% of the population is engaged in cultivation. The major crop grown in Chhattisgarh is paddy especially in the central plains with crop grown in about 37 lakhs ha. This covers about 77% of the net sown area and is popularly known as rice bowl of central India. Apart from paddy, other crops grown are oilseeds, wheat, coarse grains, groundnut, maize and pulses. There is substantial area under maize during kharif season (45,000 ha.) in Northern Hills and about 25,000 ha in Bastar plateau. The soil of the state is suitable for cultivation of horticultural plants such as guava, mango, banana etc. and various types of vegetables. It is also rich in mineral resources and about 20% of the country's steel and cement are produced in Chhattisgarh. Forest products and mining are the other sources of income. It has large supply of power which can be easily transmitted to any of the four grids of India. About 90% of the villages in Chhattisgarh have been electrified.

5.2 MADHYA PRADESH

Madhya Pradesh, which literally means "central province", is located almost in the middle of India. It lies between latitude $21^{o}17'$ and 26^{0} 52'N and longitude $74^{0}08'$ and $88^{0}49'$ E.

It shares its northern border with Rajasthan and Uttar Pradesh. On its western border, lies part of Rajasthan and part of Maharashtra with Gujarat in between. On the southern part, lies the Maharashtra and Andhra Pradesh. The entire eastern border is bounded by Chhattisgarh and Jharkhand.

5.2.1 Physiography

The state can be divided into four regions namely; the low lying areas in the north and northwest of Gwalior, Malwa plateau, Satpura and Vindhyan ranges. The general land use pattern of the state is given below:

Table 5.4 Land Use Pattern in Madhya Pradesh

Land use	Area in '000 ha	Percentage
Total Geographic Area	30,825	
Reporting area for land utilization	30,756	100.00

Land use	Area in '000 ha	Percentage
Forests	8,699	28.28
Not available for land cultivation	3,398	11.05
Permanent pastures and other grazing lands	1,348	4.38
Land under misc. tree crops & groves	19	0.06
Culturable Wastelands	1,177	3.83
Fallow land other than current fallows	612	1.99
Current fallows	769	2.50
Net area sown	14,735	47.91

Source: Land Use Statistics, Ministry of Agriculture, GOI, 2006

5.2.2 Climate

Madhya Pradesh experiences extreme temperatures both during summer and winter. In summer, the temperature goes up to 42^{o}C and in winter, it falls tremendously down. From March, the temperature starts rising and from October the temperature starts falling. The average temperature in winter hovers around 10^{o}C. Madhya Pradesh receives maximum rainfall from June to September. The average rainfall varies from 112 cm in eastern Madhya Pradesh to 50-62.5 cm in the northern and western Madhya Pradesh.

5.2.3 Water Resources

The Narmada and Tapti Rivers and their basins divide the state into two, with the northern part draining largely into the Ganga Basin and the southern part into the Godavari and Mahanadi River systems. The Chambal, Sone, Betwa, Mahanadi and Indravati rivers flow from the western side of the state to the east, while Narmada and Tapti Rivers flow from the eastern side to the west.

5.2.4 Mineral Resources

Madhya Pradesh is endowed with rich mineral resources. The diamond mine at Panna near Khajuraho is the largest mine in the country which has recoverable reserves of about one million carats. The share of Madhya Pradesh in India's production of vital minerals include diamond (100%), dolomite (39%), bauxite (28%), iron ore (24%), coal (23%), and limestone (23%).

The state's other mineral deposits include high-grade limestone, dolomite, iron ore, manganese ore, copper, coal, rock phosphate and bauxite. Madhya Pradesh is country's only producer of tin ore.

5.2.5 Soil

The soil of Madhya Pradesh is rich and fertile. Categorically, Madhya Pradesh has two zones namely: (i) Central Plateau and Hill Region; and, the (ii) Western Plateau and Hill Region. These two zones have been further sub-grouped and the description regarding area and soil is given in below:

Table 5.5 Geological Features of Madhya Pradesh

Zone	Sub-group (Region)	Type of Soil
Central Plateau and Hill Region	1. Bundelkhand	Mixed red and black
	2. Keymore Plateau and Satpura Hills	Medium Black
	3. Vindhya Plateau	Shallow to Medium Black

Zone	Sub-group (Region)	Type of Soil
	4. Satpura Plateau	Shallow to Medium Black
	5. Central Narmada Valley	Deep Black
	6. Gird	Medium Black alluvial
Western Plateau and Hill Region	7. Jhabua Hills	Medium to deep black
	8. Malwa and Nimar Plateau	Medium to deep black

5.2.6 Ecological Resources

The forest cover, based on the satellite data in October-December 2006, is 77,700 km^2, which constitutes 25.21% of the geographic area. Out of these forest cover, 6, 647 km^2 is very dense forest and 35, 007 km^2 constitutes moderately dense forest which are having crown density of more than 40%. Open or degraded forest consists of 36,046 km^2 having crown density ranging between 10-40%.

As per recorded data, the forest area of Madhya Pradesh is 94, 689 km^2 representing RF at 65.36%, Protected Forests (PF) at 32.84%, and Unclassified Forests (UF) at 1.8 %. The forests are the main source of supply of fodder and fuel and subsistence for the poorest sections of the people and tribal population in the interior underdeveloped areas. The forest can be broadly classified in to 3 forest type groups: (i) Tropical Moist Deciduous, (ii) Tropical Dry Deciduous, and (iii) Tropical Thorn.

Forests are largely distributed in central, southern and eastern parts of the undivided state of Madhya Pradesh. Northern and western parts are deficient in forest vegetation. Teak and Sal are the two most important forest formations covering 18.0% and 16.7% forest area, respectively while miscellaneous forests cover 65.3%. Madhya Pradesh forest reserves are logged for Teak, Sal, Bamboo and Salai. These forests catered to the needs of the people and cattle for generations, largely because they contained good cropping species. However, population explosion and developmental needs have exerted a steadily increasing demand on the ever-diminishing extent of forests. Over-exploitation resulted in reduction of area under forests. There are 9 national parks and 25 wildlife sanctuaries covering an area of 10, 814 km^2 which constitutes 3.51% of the State's geographical area. The Protected Areas include the 5 Tiger Reserves, where Kanha tiger reserve in Jabalpur district, is considered the most important national park in Madhya Pradesh.

The T/L of proposed project shall pass through mainly six districts in Madhya Pradesh namely; Anuppur, Dindori, Jabalpur, Damoh, Mandla, and Chhatarpur with forest cover ranging from 20.12% to 37.04% of the geographical area. Details of forest cover of these districts are as follows:

Table 5.6 Forest Cover of Districts along the T/L Route in Madhya Pradesh, km^2

District	Geographic area	Dense forest	Mod. forest	Open forest	Total	% forest cover
Anuppur						Not Available
Dindori	7,470	1,033	1,175	559	2,767	37.04
Jabalpur	5,211	36	514	619	1,169	22.43
Damoh	7,036	2	862	1,741	2,605	35.66
Mandla	5,800	751	1,207	876	2,834	48.86
Chhatarpur	9,687	184	822	742	1748	20.12

5.2.7 Human and Economic Development

As per census 2001, the total population of Madhya Pradesh is 60.35 million of which the rural population constituted 73.54%. The population density is 196 persons per km^2. The scheduled tribes constitute 22.3% of the population. The livestock population, based on 2003 census, is 35.6 million.

The economy of Madhya Pradesh is mainly dependent on agriculture which comprises predominant crop production of millet, wheat, maize (corn), rice, gram, soybean, cotton, groundnuts, pulses etc. The total cultivable area is 18,704,000 hectares and the net area sown is about 14,975,000 hectares. Tourism is also one of the important sources of economic activities. Madhya Pradesh is privileged to have the largest production of soybean. Its natural wheat production has been progressively growing. Madhya Pradesh is rich in low-grade coal suitable for power generation and has potential sources for hydro-energy.

5.3 UTTAR PRADESH

The Northern state of Uttar Pradesh is situated between 23^0 52' and 30^0 24' N latitudes and 77^0 05' and 84^0 38' E longitude. It is bounded Uttarakhand and Nepal in the north; Madhya Pradesh and Chhattisgarh in the south; Rajasthan, Haryana and Delhi in the West; and Bihar and Jharkhand in the east.

5.3.1 Physiography

Uttar Pradesh can be divided into two distinct regions: (i) Indo-Gangetic plain, and (ii) Southern Hills. The general land use pattern of the state is given below:

Table 5.7 Land Use Pattern in Uttar Pradesh

Land use	Area in '000 ha	Percentage
Total Geographic Area	24,093	
Reporting area for land utilization	24,201	100
Forests	1,654	6.83
Not available for land cultivation	3,215	13.28
Permanent pastures and other grazing lands	65	0.27
Land under misc.tree crops & groves	376	1.55
Culturable Wastelands	439	1.81
Fallow land other than current fallows	550	2.27
Current fallows	1,270	5.25
Net area sown	16,633	68.73

Source: Land Use Statistics, Ministry of Agriculture, GOI, 2006

5.3.2 Climate

The climate in Uttar Pradesh varies substantially. The Gangetic plain, which covers three-quarters of the state, is dry and dusty in summer. But during the monsoons, between June and September, it is transformed into lush green fields. The monsoons also spell disaster for some regions, when the Ganga and its tributaries overflow their banks and flood large tracts of land. Winter is severe and the Gangetic plains are fairly cold during winter. Summers are extremely hot in the plains with maximum temperatures reaching as high as 45^oC. The intensity of the summer months is magnified by the hot winds called 'loo' that blows across the plains in May

and June, the two hottest months of the year. The average annual rainfall ranges between 1,000 to 1,200 mm while the temperature varies from a maximum of 45°C to 35°C during summer and 25°C to 3°C during winter.

5.3.3 Mineral Resources

Uttar Pradesh is poor in mineral resources. Only considerable deposits are limestone, edalusite and red sandstone. Dolomite occurs in small quantities including pyrophyllite and diaspore. Coal is also available in the state.

5.3.4 Soil

Much of the area of Uttar Pradesh is covered by a deep layer of alluvium. These extremely fertile alluvial soils range from sandy to clayey loam. The soils in the southern part of the state are generally mixed red and black or red-to-yellow.

5.3.5 Water Resources

The main rivers of the state from west to east are the Yamuna, the Ganga, the Ramganga, the Gomati, and the Ghaghara. All the rivers, except the Gomati, emerge from the Himalayas. The Yamuna and the Ganga Rivers flow from north-east to south-west in their upper mountainous courses, from north to the south in western parts of the state and thereafter from north-west to south-east joining at Allahabad.

5.3.6 Ecological Resources

The forest cover, based on the satellite data of October-December 2006, is 14,341 km^2 which constitutes 5.95% of the geographic area. Out of these forest cover, 1,626 km^2 is very dense forest; 4,563 km^2 constitutes moderately dense forest, and 8,152 km^2 as open or degraded forest. Reserved Forest constitutes 70.31%, PF is 8.56% while UF is 12%. There are 5 types of forests found in Uttar Pradesh namely; tropical semi evergreen, tropical moist deciduous, littoral and swamp, tropical dry deciduous, and tropical thorny forests.

Uttar Pradesh has one national park and 23 wildlife sanctuaries covering an area of about 5,712 km^2 which constitute 2.37% of its geographic area. Uttar Pradesh has one tiger reserve, Dudhwa Katerniaghat (extension), which is also famous for swamp deer and rhinoceros.

The proposed transmission line shall pass through twelve districts in Uttar Pradesh having forest cover ranging from 0.51% to 8.05% of its geographical area. In all the districts, the forest cover is mostly open/degraded forest. Details of forest cover of these districts are given below.

Table 5.8 Forest Cover of Districts along the T/L Route in Uttar Pradesh, km^2

District	Geographic area	Dense forest	Mod. forest	Open forest	Total	% forest cover
Banda	4,532	0	26	77	103	2.27
Hamirpur	4,282	0	66	108	174	4.06
Jalaun	4,565	0	65	179	244	5.35
Auriya	2,054					Data Not Available
Etawa	2,311	0	44	142	186	8.05
Mainpuri	2,760	0	1	13	14	0.51

District	Geographic area	Dense forest	Mod. forest	Open forest	Total	% forest cover
Etah	4,446	0	9	90	99	2.23
Aligarh	3,650	0	7	59	66	1.81
Bulandshahar	2,910	0	33	82	115	3.95
Ghaziabad	2,590	0	18	31	49	1.89
Meerut	2,590	0	34	32	66	2.55
Muzaffarnagar	4,008	0	14	27	41	1.02

5.3.7 Human and Economic Development

The population in Uttar Pradesh is 166.05 million (Census 2001) constituting 16.2% of the country's population. Rural and urban population is 79.22% and 20.78%, respectively. Population density is 689 persons per km^2. Population of the scheduled tribe in the state is negligible and is confined to a few districts. The livestock population of the state is 58.53 million (Livestock census 2003), which is the largest in the country and constitutes nearly 12% of the country's total livestock.

Most of the State's farmland is well watered and naturally fertile. Uttar Pradesh is the largest producer of food grains and oilseeds in the country. It leads all the states in India in the production of wheat, maize, barley, gram, sugarcane and potatoes. Uttar Pradesh (India's sugar bowl) produces about one half of the total sugarcane output in the country. The western region of the State is more advanced in terms of agriculture. Majority of the population depends upon farming as its main occupation. Sugar cane is an important cash crop almost throughout the State and sugar mills and other cane crushers, who produce Gur and Khandsari, are common throughout the State. Uttar Pradesh is important insofar as horticulture is concerned.

5.4 HARYANA

Haryana lies in northern India and is situated between $27^o37'$ to $30^o35'$ latitude and between $74^o28'$ to $77^o36'$ longitude. Haryana has Uttar Pradesh on its eastern border, Punjab on its western border; Uttaranchal and Himachal Pradesh on its northern border, and Delhi and Rajasthan on its southern border. The altitude of Haryana varies between 700 ft to 900 ft above the sea level.

5.4.1 Physiography

Haryana can be divided into four regions namely; Shivalik Hills, Ghaggar Yamuna Plain, Semi-desert sandy plain, and Aravalli Hills. The altitude in Shivalik Hills varies from between 900 to 2300 meters. These hills are the source of the rivers like Saraswati, Ghaggar, Tangri and Markanda. The Ghaggar Yamuna Plain is divided into two parts; the higher one called 'Bangar' and the lower part called 'Khadar'. This alluvium plain is made up of sand, clay, silt and hard calcareous balls like gravel known locally as kankar. The semi-desert sandy plain shares border with Rajasthan while the Aravali Hills is dry irregular hilly area. The land use pattern of the state is given below:

Table 5.9 Land Use Pattern in Haryana

Land use	Area in '000 ha	Percentage
Total geographical area	4,421	
Reporting area for land utilisation	4,372	100.00

Land use	Area in '000 ha	Percentage
Forests	39	0.89
Not available for cultivation	524	11.99
Permanent pasture and other grazing lands	27	0.62
Land under misc. tree crops & groves	12	0.27
Cultivable wasteland	65	1.49
Fallow land other than current fallows	8	0.18
Current fallow land	141	3.23
Net area sown	3,556	81.34

Source: Land Use Statistics, Ministry of Agriculture, GOI, 2006

5.4.2 Climate

Haryana is very hot in summer (up to 50^{o}C) and cold in winters (down to a low of 1^{o}C). The hottest months are May and June while the coldest is in December and January. Rainfall is varied, with Shivalik Hills region being the wettest and the Aravali Hills region being the driest. About 80% of the rainfall occurs in the monsoon season (July-September) and sometimes causes local flooding.

5.4.3 Water Resources

The Yamuna River flows along its eastern boundary. The Ghaggar River is its main seasonal river. It rises up in the outer Himalayas between the Yamuna and the Sutlej and enters Haryana near Pinjore, Panchkula district. Passing through Ambala and Hissar it reaches Bikaner in Rajasthan and runs a course of 290 miles before disappearing in the deserts of Rajasthan. The Markanda River originates from the lower Shivalik hills and enters Haryana near Ambala. During monsoons, this stream swells up into a raging torrent notorious for its devastating power. The surplus water is carried on to the Sonia Lake, an important tributary is the Tangri River. The Sahibi River originates in the Mewat hills near Jitgarh and Manoharpur in Rajasthan. Gathering volume from about a hundred tributaries, it reaches voluminous proportions, forming a broad stream around Alwar and Patan. On reaching Rohtak it branches off into two smaller streams, finally reaching the outskirts of Delhi and flowing into the Yamuna. There are three other rivulets in and around the Mewat hills – Indori, Dohan and Kasavati and they all flow northwards from the south.

5.4.4 Mineral Resources

The principal minerals produced in Haryana are kaolin, limestone, lime kankar, saltpetre, tin and tungsten.

5.4.5 Soil

Most of the land in Haryana is flat, covered with loamy soil which is very suitable for agriculture.

5.4.6 Ecological Resources

Haryana, an intensively cultivated state, is deficient in natural forests. The forest cover of the state based on the satellite data of October-December, 2006, is 1,594 km^2 which constitutes 3.61% of its geographic area. Out of these forest cover, 27 km^2 is very dense forest, 463 km^2 constitutes moderately dense forest and 1,104 km^2 open forest. As per legal classification, Reserved Forest constitutes 15.97%, Protected Forest 74.28% and Unclassified Forest 9.75%.

Forests are mainly distributed in the north-eastern and south-eastern districts of the State. Three types of forest are recorded and these are: Tropical Dry Deciduous in the eastern part, Tropical Moist Deciduous in the Shiwalik region, and Tropical Thorn Forest in the western part of the State.

Protected areas There are two national parks and eight wildlife sanctuaries in Haryana which cover an area of 303.92 km^2 constituting 0.69% of the State's geographical area.

The proposed transmission line shall pass through the districts of Karnal and Kurukshetra which has a forest cover of 1.60% and 1.90% of the geographical area of the districts, respectively. The table below shows that the forest cover is mostly open/degraded forest. Details of forest cover of these districts are as follows:

Table 5.10 Forest Cover of Districts along the T/L Route in Haryana, km^2

District	Geographic area	Dense forest	Mod.forest	Open forest	Total	% forest cover
Karnal	2,317	0	6	31	37	1.60
Kurukshetra	1,530	0	10	19	29	1.90

5.4.7 Human and Economic Development

As per census 2001, the total population of Haryana is 21.14 million of which the rural population constitutes 70.08%. The population density is 478 persons per km^2.

Haryana is often called the "Food Mine" of the country. About 80% of the population of the state is agriculture-dependent, directly or indirectly. Haryana is self sufficient in producing food grains and is also a major contributor of food grains in meeting the needs of the other states of the country. The world famous Basmati Rice is produced here in abundance. The major cereals produced in the state include wheat, rice, maize and bajra.

The crop production of Haryana can be broadly divided into Rabi and Kharif. The main kharif crops include sugarcane, groundnut, maize and paddy etc. The minor kharif crops are chili, bajra, jawar, pulses and vegetables.

The north western part is suitable for the cultivation of rice, wheat, vegetable and temperate fruits and the south-western part is suitable for high quality agricultural produce, tropical fruits, exotic vegetables and herbal and medicinal plants.

Diary farming is mostly seen in the rural areas and the economy depends largely on it. The other crops which are grown in the state include cotton, jute, sugarcane, sesame, groundnut, oilseeds and tobacco.

The major industries are cement, sugar, paper, cotton, textiles, glassware, brassware, cycles, tractors (largest production in the country), motorcycles, timepieces, automobile tires and tubes, sanitary ware, television sets, steel tubes, hand tools, cotton yarn, refrigerators, vanaspati, ghee and canvas shoes. A factory of the Hindustan Machine Tools producing tractors is located at Pinjore. Gurgaon is a fast-growing industrial hub where Maruti Udyog is the central piece. There are 79,678 small-scale industrial units in Haryana in addition to 1,023 large and medium industries. There are also five civil aerodromes located in Haryana.

Haryana is also well known for its handloom products. Panipat has earned the reputation of being the "weavers' city" of India for its exquisite hand- tufted woolen carpets and colourful handloom products.

Haryana became the first state in country to achieve 100% rural electrification. Per capita electricity consumption in the state is 530 kW. About 78.50% of rural households in the state are electrified.

5.5 PUNJAB

Punjab lies in the North-west part of India. It extends from the latitudes 29.30° North to 32.32° North and longitudes 73.55° East to 76.50° East. It is bounded on the west by Pakistan, on the north by Jammu and Kashmir, on the northeast by Himachal Pradesh and on the south by Haryana and Rajasthan.

5.5.1 Physiography

Punjab can be divided into: Malwa, a region between the Sutlej and Yamuna Rivers; Majha lies between Ravi River and Sutlej River; and Doaba, the region of Indian Punjab surrounded by Beas River and Sutlej River. Its average elevation is 300 m from the sea level.

5.5.2 Climate

Punjab has a subtropical climate with hot summers and cold winters. The minimum temperature in winter falls to 0^0C and the maximum in summer reaches 47^0C. The average annual rainfall varies from 480 mm in plains to 960 mm in the hilly regions.

5.5.3 Water Resources

Satlaj, Beas, Ravi and Ghaggar Rivers are four important rivers in Punjab.

5.5.4 Mineral Resources

The mineral resources of the state include mainly rock salt, limestone, sandstone, gypsum, chloride of sodium and red tenacious clay. Apart from these, the state has some petroleum deposits.

5.5.5 Soil

The soil of Punjab is rich and fertile. South-western Punjab is mainly dominated by calcareous soil which includes desert soil and sierozem soil. It also has grey and red desert soil, calsisol soil, regosol soil and alluvial soil. The soil of central Punjab ranges from sandy loam to clayey. The alluvial soil of this zone can be widely described as arid and brown soil or tropical arid brown soil. The soil in Eastern Punjab is loamy to clayey.

5.5.6 Ecological Resources

The recorded forest area of the state is 3,058 km^2 which is only 6.07% of the State's geographical area. RF constitutes 1.44%, PF 37.70%, and the unclassified forest 60.86% of the total forest areas.

Protected Areas Punjab has a total of 12 wildlife sanctuaries and two conservation reserves spread over an area of 340 km^2 constituting 0.68% of its geographical area. The state has internationally-recognised wetlands at Harike, Kajli and Ropar which has been declared as RAMSAR sites.

5.5.7 Human and Economic Development

As per census 2001, the total population in Punjab is 24.29 million of which the rural population constitutes 66.10%. The population density is 484 persons per km^2. The livestock population of the state is 8.61 million (Livestock census 2003) which has decreased by nearly 15% since the census of 1992.

Punjab is well-known for its agriculture and plantations. The major agricultural products in Punjab comprise of wheat, maize, rice, and bajra. Punjab is the largest producer of wheat in India and it produces around 2 million tonnes every year. The leading cash crop cultivated in Punjab is cotton. Other important crops of Punjab agriculture include sugarcane, potatoes, and groundnuts.

6.0 SCREENING OF POTENTIAL IMPACTS AND MITIGATION MEASURES

6.1 Impacts due to Project Location and Design

Environmental impact of transmission line projects are not far reaching and are mostly localized to ROW compared to other "linear" infrastructure (e.g., expressways and other roads which typically alter topography and drainage in an irreversible manner). However, transmission line project has some effects on natural and socio-cultural resources. These impacts can be minimized by careful route selection. The process of selecting the route of transmission line project is discussed in Section 4.0.

Some of the potential impacts due to location and design of transmission project include the following:

(i) Land value depreciation Based on experience of POWERGRID, land prices are generally expected to rise in the areas receiving power. However, the proposed project will generally pass through uninhabited area, agriculture fields, and forests, where the land use is not going to change in foreseeable future. Therefore, the value of land will not be adversely affected to a significant degree.

(ii) Historical/cultural monuments/value POWERGRID's policy of route selection is to avoid all historical and cultural monuments. The determination of the optimum alignment is done in consultation with relevant government agencies such as MoEF, Department of Revenue and the Archeological Society of India to ensure that no historical or cultural monuments will be affected.

(iii) Encroachment into precious ecological areas All precautions have been taken to avoid routing of T/L through forest and ecologically-sensitive areas such as national parks and sanctuaries. However, given the distance of the T/L involved in this project, it was not possible to avoid forests completely but no national park or sanctuaries will be affected.

Out of the 1286.7 km surveyed, thus far, for the HVDC transmission line, about 75.514 km will pass through forest area estimated at 521.4 ha which consists of about 207 ha in Chhattisgarh,

303.6 ha in Madhya Pradesh, 9.8 ha in Uttar Pradesh, and 1.0 ha in Haryana. For the 400 kV D/C, it was estimated to be 15 ha of forest area in Punjab and 2.6 ha in Haryana from the 296 km surveyed so far. **Table 6.1** presents the potential reserved forests that may be affected by the transmission line route from Chhattisgarh to Punjab.

Table 6.1 Reserved Forests along the Proposed Transmission Line

Project Name	T/L Project	Total length, km	Forest, ha	Forest, km
HVDC interregional transmission system between the Western region and Northern region	800 kV HVDC Champa Pooling Station to Kurushetra (WR-I)	145	207	30
	800 kV HVDC Champa PS to Kurushetra (WR-II)	460	303.6	44
	800 kV HVDC Champa PS to Kurushetra (NR-I Portion I)	315.2	0	0
	800 kV HVDC Champa PS to Kurushetra (NR-I Portion II)	333.5	9.8	1.37
	800 kV HVDC Champa PS to Kurushetra (NR-II)	33	1	0.144
Transmission system strengthening in the Northern region	400 kV D/C Kurushetra – Jalandhar (Quad)	264	15	3.261
	LILO 400 kV D/C Abdullapur-Sonepat	32	2.6	0.562

Sources: DPR April 2011 and walkover survey, POWERGRID

Based on the survey, the forests to be traversed by the lines are already degraded and wildlife species that may be present are those who have already adapted to open or disturbed habitat. With the provision of Compensatory Afforestation (CA), the overall forest condition is expected to improve.

If tree felling for the right-of-way (ROW) is needed in the forest areas affected, it will be done under the supervision of Forest Department. Some low canopy seed trees and shrubs may be kept intact, if they do not interfere with tower erection and installation of transmission lines. The wood, if any, will be sold by the Forest Department, who will also retain the sale proceeds.

Seven (7) meter-wide strips of forestland under each conductor will be cleared and maintained as maintenance rows, but the remaining land will be allowed to regenerate to a permissible height (2 to 3 meter maximum). Lopping of trees to maintain required electrical clearance will be done under the direction of Forest Department.

POWERGRID will provide construction workers with fuel wood or alternative fuels to prevent collection of fuel wood from nearby forest (if any). Transmission lines can serve as new access routes into previously inaccessible or poorly accessible forests, thereby accelerating forest and wildlife loss. In such cases, POWERGRID cannot take action itself, but local Forest Department personnel will normally assess the dangers and take appropriate action, such as establishing guard stations at the entrance to the forest.

Given the already easy access and degraded conditions at the proposed projects sites, this problem is not expected to be encountered. Nonetheless, POWERGRID staff will report to the Forest Department any noticeable encroachment induced by the Project.

(iv) Encroachment into other valuable lands Impacts on agricultural land will be restricted to the construction phase and when large-scale maintenance measures are required. Some stretch of the transmission line will pass through agricultural lands. Agricultural land will be lost at the base of the tower, which is estimated to be 0.2-1 m^2 per average farm holding. It is estimated that the construction of approx.1300 km of HVDC and approx. 300 km of 400 kV D/C transmission line would involve about 3878 towers resulting to a loss of about 3960 m^2 or 0.396 ha of land.

About 90% of the transmission line route will pass through plains having crops. However, the exact number of towers coming on such field which may impact crops and number of families likely to be affected shall be ascertained only after the detailed/check survey, and fixing of tower locations. The detailed/check survey activity is part of erection contract and will be finalized only after award of contract and completion of detailed/check survey and tower spotting.

Compensation will be paid to owners for any crop damage or any other temporary damages incurred as a result of construction activities. POWERGRID field staff will consult affected villagers and local revenue department and apprise them about the project and tower location, which shall be erected in the agricultural land, for compensation. The Revenue Department, after evaluating the loss due to construction activity and productivity of land, determines the compensation that will be paid to farmers.

Agricultural activities will be allowed to continue after construction. If bunds or other on-farm works are disturbed during construction or maintenance, they will be restored to the owner's satisfaction following completion of construction or maintenance activities. In the event that private trees are felled during construction or maintenance operations, compensation will be paid to the owner in an amount determined by the estimated loss from the tree/plant to be assessed by Revenue/Forest authorities.

For fruit bearing trees, estimation of loss of products would be done over an eight year period. Agricultural lands under private ownership will be identified, and in accordance with normal POWERGRID procedures, compensation will be paid to the affected villagers as per compensation plan for temporary damages (CPTD) prepared separately.

(v) Interference with other utilities and traffic POWERGRID is required to seek clearance prior to construction from Department of Railways, Telecommunications and wherever necessary, from aviation authorities that are likely to be affected by the construction of transmission lines. The transmission line affects nearby telecommunication circuits by causing electrical interference.

A standing committee - Power Telecom Co-ordination Committee (PTCC) has been constituted by GOI to plan and implement the mitigating measures for the induced voltage which may occur to nearby telecom circuit and suggest necessary protection measures to be adopted. Mitigation measures could be rerouting of the telecom circuits, conversion of overhead telecom circuits into cables, etc. to minimize the interference. The cost of such measures is determined by PTCC and is shared by POWERGRID and Telecom Department on the basis of prevailing norms and guidelines. Though the exact cost to mitigate the impacts of induction in neighboring telecom circuits would vary from case to case, the cost on average, is estimated at Rs 50,000 per km for POWERGRID.

Wherever the transmission line passes near the airports the towers beyond specified height are painted in alternate orange and white stripes for easy visibility and warning lights (aviation) are placed atop these towers.

(vi) Interference with drainage pattern As the transmission lines are constructed aerially and the blockage of ground surface is limited to area of tower footings which is very small; there is little possibility of affecting drainage pattern. In the infrequent instances where the drainage is affected, flow will be trained and guided to safe zones.

(vii) Explosion/fire hazards The route and site selection for the transmission lines and substations considered the distance away from oil or gas pipelines and other sites with potential for creating explosions or fire. Fire due to flashover from lines can be a more serious problem in deciduous forest. Since forest involved is mostly degraded and scattered in the proposed project, fire from flashover is unlikely. State of the art safety instruments will be installed in the Champa and Kurukshetra substations so that line gets tripped within milliseconds in case of any fault.

6.2 Impacts and Mitigation Measures during Construction

(i) Clearing of vegetation During construction of transmission lines, vegetation along the ROW with a maximum width of 69 meters for HVDC and 46 meters for 400 kV D/C line will be cleared. Clearing of trees will be done under the supervision of MoEF.[7]

(ii) Uncontrolled silt runoff The Project involves only small-scale excavation for tower foundations at scattered locations that are re-filled with excavated material, thus, uncontrolled silt run off is not expected.

(iii) Nuisance to nearby properties Route selection is determined by keeping the transmission line and substations away from settlements. All the construction activities will be undertaken through the use of small mechanical devices e.g. tractors and manual labour, therefore, nuisance to the nearby properties if any, is not expected.

(iv) Interference with utilities and traffic and blockage of access way Access to the site will be along existing roads or village paths; minor improvements to paths may be made where necessary, but no major construction of roads will be required either during construction or as part of maintenance procedures during operation.

As and when a transmission line crosses any road/railways line, the terminal towers are located at sufficient distance so as not to cause any hindrance to the movement of traffic. Stringing at the construction stage is carried out during lean traffic period in consultation with the concerned authorities and angle towers are installed to facilitate execution of work in different stages.

(v) Erosion hazards due to inadequate provision for resurfacing of exposed area Adequate measures are taken to re-surface the area where excavation works are done. Topsoil disturbed during the development of sites will be used to restore the surface of the platform. Infertile and rocky material will be dumped at carefully selected dumping areas and used as fill for tower foundations.

[7] IS: 5613, 1989, Bureau of Indian Standards, Code of Practice for Design, Installation and Maintenance of Overhead Power Lines.

(vi) Inadequate resurfacing for erosion control The proposed transmission line is to be constructed mostly in plain area, thus, erosion problem is not anticipated. However, if due to terrain at some point in the alignment, transmission towers may be placed on slopes and erosion prone soils, internationally-accepted engineering practices will be undertaken to prevent soil erosion. This will include cutting and filling slopes wherever necessary. The back cut slopes and downhill slopes will be treated with revetments.
Wherever sites are affected by active erosion or landslides, both biological and engineering treatment will be carried out, e.g. provision of breast walls and retaining walls, and sowing soil binding grasses around the site. Construction is avoided during the rainy season.

(vii) Inadequate disposition of borrow area Transmission tower foundations involve small-scale excavations and the excavated soil is utilized for backfilling. In substations, the sites are generally selected such that the volume of cutting is equal to volume of filling to avoid borrow area.

(viii) Protection of workers' health and safety Provisions for workers' health and safety will be guided by the Safety Regulations/Safety Manual of POWERGRID, and included in tender documents. Various aspects such as, work and safety regulations, workmen's compensation, insurance are adequately covered under the Erection Conditions of Contract (ECC) which is part of bidding documents.

In addition, training will be conducted to the workers on fire-fighting and safety measures. Safety tools like helmet, safety belt, gloves etc. will be provided to workers in accordance with the Safety Manual. First aid facilities will be made available to workers and doctors called in from nearby towns when necessary. The number of outside (skilled) labourers is expected to be about 25-30 people per group.

The remaining workforce of unskilled labourers will be local people. Workers are also covered by the statutory Workmen (Compensation) Act. POWERGRID has a dedicated unit to oversee all health and safety aspects of its project under the Operation Services. POWERGRID has framed guidelines/checklist for workers' safety as its personnel are exposed to live EHV apparatus and transmission lines.

This guidelines/checklist includes work permits and safety precautions for work on the transmission lines both during construction and operation and is monitored regularly by site in-charge and corporate Operation Services.

Regular health checkups will be conducted for construction workers. The construction sites and construction workers' houses will be disinfected regularly, if required. In order to minimize/checking of spread of socially transmitted diseases e.g. HIV/AIDS etc., POWERGRID will conduct awareness building programs on such issues for construction workers.

6.3 Impacts and Mitigation Measures during Operation

The O&M program in POWERGRID is normally implemented by substation personnel for both the transmission lines and substations. For long distance transmission lines such as this project, there are monitoring/maintenance offices which are located at various points en-route. Monitoring measures include patrolling and thermo-vision scanning.

The supervisors and managers entrusted with O&M responsibilities are trained for the required skills and expertise in handling these aspects. A monthly preventive maintenance program will

be carried out to disclose problems related to cooling oil, gaskets, circuit breakers, vibration measurements, contact resistance, condensers, air handling units, electrical panels and compressors. Any sign of soil erosion is also reported and rectified. Monitoring results are published monthly, including a report of corrective action taken and a schedule for future action.

(i) Noise and/or vibration nuisance The equipment installed at sub-station are mostly static and are designed to keep the noise level within permissible limits i.e. 85 dB as per GOI and International standard-7194. POWERGRID had monitored noise/sound level at different places in and around reactor and transformer (at 1 m distance). Noise level was found to be ranging from 75 to 83 dB, well within the permissible limit of 85 dB.

If noise level increases beyond permissible limits, measures such as provisions of sound and vibration dampers and rectification of equipments will be undertaken. Planting of sound-absorbing species like casuarinas, tamarind, banyan and neem will be done at Champa and Kurukshetra substations to help reduce the sound level. It was reported that a belt of trees dense enough can reduce noise levels by as much as 6-8 dB for every 30 m-width of woodland.[8]

(ii) Escape of polluting materials The equipment that will be installed to transmission lines and substations are static in nature and do not generate any fumes or waste materials.

(iii) Blockage of wildlife passage Transmission lines are constructed aerially and usually run above 7-8 m from ground level. However, the blockage of ground surface is limited to the area of tower footings which are very small and are placed far away from each other. Therefore, the possibility of disturbance to wild life passage is remote.

(iv) Environmental aesthetics Since normal spacing between the towers in case of ± 800 kV HVDC and 400 kV D/C lines is approx. 350 meters, these towers will not affect the visual aesthetics of the localities particularly when it is ensured to route the lines as far away from the localities as possible. POWERGRID plants trees to buffer the visual effect around its substations and to provide better living conditions. Wherever POWERGRID feels it appropriate, discussions will be held with local Forest Department officials to determine feasibility of planting trees along roads running parallel to transmission lines to buffer visual effect in these areas. If needed, towers may be painted grey or green to merge with the background.

(v) Exposure to electromagnetic fields (EMF) There have been some concerns about possible increased risk of cancer from exposure to electromagnetic radiation from overhead transmission lines and research have been undertaken worldwide. A World Health Organization (WHO) review was held in 1996 as part of an nternational EMF Project and concluded that, "from the current scientific literature, there is no convincing evidence that exposure to radiation field shortens the life span of humans or induces or promotes cancer."

No EMF exposure guidelines have been drawn in India although exposure guidelines have been drawn up outside of India such as the State Transmission Lines Standards and Guidelines (USA), International Commission on Non-Ionizing Radiation Protection (ICNIRP); US National Council on Radiation, the American Conference on Government and Industrial Hygienist (ACGIH).

[8] R. E. Leonard and S. B. Parr, "Tree as a Sound Barrier," Journal of Forestry, 1970.

The magnetic field below 400 kV overhead power transmission lines is estimated at 40 µT. The ICNIRP guidelines present limiting exposure to EMFs, although it adds that the levels quoted should not be interpreted as distinguishing 'safe' from 'unsafe' EMF levels. The ICNIRP guideline for the general public (up to 24 hours a day) is maximum exposure levels of 1,000 mG or µ100 T.

A study carried out by Central Power Research Institute (CPRI) on POWERGRID lines reveals that the EMF about 1 m above ground near a 400 kV single circuit transmission line range from 3-7.2 µT in the ROW.

The impact of EMF is also dependent on the duration of exposure and therefore no significant adverse impact is envisaged. POWERGRID complies with international norms for field strength limits which are certified by Power Technologies Inc, USA.

POWERGRID is following the approved international standards and design, which are absolutely safe. Based on the studies carried out by different countries on the safety of EHV lines in reference to EMF effects, POWERGRID has also carried out such studies with the help of PTI, USA and CPRI, Bangalore on their design. The studies inferred that POWERGRID design are safe and follow the required international standard.

(vi) Maintenance of ROW for T/L The balance of ROW for T/L will be returned for agricultural use or allowed to naturally recover. Vegetation will be trimmed to ensure that the required vertical spacing between conductors and vegetation are maintained for safety reasons. To minimize the risk of accidents and potential exposure to electrical fields, houses and other structures will not be allowed within the right-of-way, but agricultural activities can be continued.

6.3.1 Enhancement Measures

As part of Corporate Social Responsibility initiatives, POWERGRID plans to provide two water tanks at the proposed Champa substation for village use other than drinking. For the existing pond across the proposed Champa substation, embankment strengthening, de-weeding and desiltation will be proposed to the local administration and local communities to improve and sustain its use.

7.0 INSTITUTIONAL REQUIREMENTS AND ENVIRONMENTAL MONITORING PLAN

7.1 Institutional Mechanism for Mitigation and Monitoring Requirements

Monitoring is a continuous process for POWERGRID at all the stages of its project cycle. Aside from the site managers reviewing the progress on a daily basis, regular project review meetings will be held at least on a monthly basis which will be chaired by the Executive Director of the region wherein apart from construction issues, the environmental aspects of the projects are discussed and remedial measures taken, wherever required. The exceptions of these meetings will be submitted to the Directors and Chairman and Managing Director of POWERGRID. The progress of various ongoing projects is also informed to the Board of Directors. Following is the organization support system for proper implementation and monitoring of the environmental and social management plan.

a) Corporate Level

An Environmental Management Cell at corporate level was created within POWERGRID in 1992 and subsequently upgraded to an Environment Management Department (EMD) in 1993 and in 1997 it has been further upgraded to Environment and Social Management Department (ESMD). A brief description of ESMD's responsibilities includes:

- Advising and coordinating RHQs and Site to carry out environmental and social surveys for new projects.
- Assisting RHQs and site to finalize routes of entire power transmission line considering environmental and social factors that could arise enroute
- Help RHQs and Site to follow-up with the state forest offices and other state departments in expediting forest clearances and the land acquisition process of various ongoing and new projects
- Act as a focal point for interaction with the MoEF for expediting forest clearances and follow-ups with the Ministry of Power.
- Imparts training to POWERGRID's RHQs & Site officials on environment and social issues and their management plan.

b) Regional Level

At each of its nine Regional Offices, POWERGRID has an Environmental and Social Management Cell (ESMC) to manage environmental and social issues and to coordinate between ESMD at the Corporate level and the Divisional Headquarters. The key functions of ESMC include:

- Advising and coordinating field offices to carry out environmental and social surveys for new projects envisaged in the Corporate Investment Plan
- Assisting the ESMD and site to finalize routes of entire power T/L considering the environmental and social factors that could arise en-route
- To follow-up forest clearances and land acquisition processes with state forest offices and other state departments for various ongoing and new projects
- Acting as a focal point for interaction with the ESMD and site on various environmental and social aspects.

c) Site Office

At the sites, POWERGRID has made the Site-Incharge responsible for implementing the environmental and social aspects of project and is known as the Environmental and Social Management Team (ESMT). Key functions of the ESMT are:

- Conduct surveys on environmental and social aspects to finalize the route for the power transmission projects
- Conduct surveys for the sites being considered for land acquisition
- Interact with the Forest Departments to make the forest proposal and follow it up for MoEF clearance.
- Interact with Revenue Authorities for land acquisition and follow it up with Authorized Agencies for implementation of Social Management Plan (SMP)
- Implementation of Environment Management Plan (EMP) and SMP
- Monitoring of EMP and SMP and producing periodic reports on the same.

Monitoring of impacts on ecological resources, particularly in forest, sanctuary or national park, is generally done by the concerned Divisional Forest Officer, Chief Wildlife Warden and their staff as part of their normal duties.

7.2 Environmental Monitoring and Management Plan

Table 7.1 presents the provisions for environmental monitoring. Monitoring activities may be modified during implementation depending on the performance of contractor(s). If field inspections and monitoring indicate good environmental performance, then successive monitoring intensity and frequency made be reduced. Conversely, if environmental performance is less than expected, the ESMT will recommend corrective measures and monitoring activities will be adjusted accordingly to resolve any problems.

Table 7.1 Minimum Provisions for Environmental Monitoring[9]

Project Stage	Mitigation Measure	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
Pre-construction	Route survey to define alternative alignments	Possible encroachment on reserved forests	All transmission and substation sites	Field mapping with Global Positioning System (GPS) equipment	1-time survey to finalize design	POWERGRID or Project Management Unit (PMU) through route survey contractor	n/a
Construction	Dust, equipment emissions, erosion, and noise control Waste management	Incorporation of appropriate clauses in construction contracts	All construction contracts for all substation and transmission sites	Field inspection to ensure that appropriate measures are implemented and facilities are installed	1 time per month	POWERGRID/ PMU to include in bidding documents. ADB to verify through review of bidding documents. [10]	To be included in construction contract
Operations and Maintenance	Dust, equipment emissions, and erosion control Waste management	Same parameters as during construction period	All substations and transmission lines	Spot checks based on visual inspections and any complaints	As necessary based on inspections and complaints	POWERGRID through PMU ADB to audit during project review missions	Included in Environment Cost

Table 7.2 presents the overall EMP. In the pre-construction stage, the ESMD will have primary responsibility for planning and design activities that will minimize project impacts. Detailed design work will follow the recommendations of the IEE and EMP. POWERGRID will certify that the detailed designs comply with IEE and EMP recommendations before contracts can be made effective.

The EMP will be updated during the project inception stage and will be updated afterward if necessary based on field conditions, construction contractor performance, and stakeholder feedback.

[9] Monitoring of issues related to compensation of landowners for land acquisition will be included in the resettlement plan.

[10] ADB will review documents and provide “no objection” at each stage of bidding, contract evaluation, and contract award.

Table 7.2 Environmental Management Plan

Project activity/stage	Potential impact	Proposed Mitigation Measure	Parameter to be monitored	Measurement and frequency	Institutional responsibility	Implementation schedule
Pre-construction						
Location of transmission towers and transmission line alignment and design	Exposure to safety related risks	Setback of dwellings to overhead line route designed in accordance with permitted level of power frequency and the regulation of supervision at sites.	Tower location and line alignment selection with respect to nearest dwellings	Setback distances to nearest houses - once	POWERGRID	Part of tower siting survey and detailed alignment survey and design
Equipment specifications and design parameters	Release of chemicals and gases in receptors (air, water, land)	PCBs not used in substation transformers or other project facilities or equipment.	Transformer design	Exclusion of PCBs in transformers stated in tender specification - once	POWERGRID	Part of tender specifications for the equipment
		Processes, equipment and systems not to use chlorofluorocarbons (CFCs), including halon, and their use, if any, in existing processes and systems should be phased out and to be disposed of in a manner consistent with the requirements of the Government	Process, equipment and system design	Exclusion of CFCs stated in tender specification – once	POWERGRID	Part of tender specifications for the equipment
				Phase out schedule to be prepared in case still in use – once		Part of equipment and process design
Transmission line design	Exposure to electromagnetic interference	Transmission line design to comply with the limits of electromagnetic interference from	Electromagnetic field strength for proposed line design	Line design compliance with relevant standards - once	POWERGRID	Part of detailed alignment survey and design

Project activity/stage	Potential impact	Proposed Mitigation Measure	Parameter to be monitored	Measurement and frequency	Institutional responsibility	Implementation schedule
		overhead power lines				
Substation location and design	Exposure to noise	Design of plant enclosures to comply with noise regulations.	Expected noise emissions based on substation design	Compliance with regulations - once	POWERGRID	Part of detailed siting survey and design
Location of transmission towers and transmission line alignment and design	Impact on water bodies and land	Consideration of tower location at where they could be located to avoid water bodies or agricultural land.	Tower location and line alignment selection (distance to water and/or agricultural land)	Consultation with local authorities and land owners - once	POWERGRID	Part of tower siting survey and detailed alignment survey and design
	Social inequities	Careful route selection to avoid existing settlements	Tower location and line alignment selection (distance to nearest dwellings or social institutions)	Consultation with local authorities and land owners - once	POWERGRID	Part of detailed tower siting and alignment survey and design
		Minimize need to acquire agricultural land	Tower location and line alignment selection (distance to agricultural land)	Consultation with local authorities and land owners - once	POWERGRID	Part of detailed tower siting and alignment survey and design
Involuntary resettlement or land acquisition	Social inequities	Compensation paid for temporary/permanent loss of productive land as per LAA & its process	RAP implementation	Consultation with affected parties – once in a quarter	POWERGRID	Prior to construction phase
Encroachment into precious ecological areas	Loss of precious ecological values/ damage to precious species	Avoid encroachment by careful site and alignment selection	Tower location and line alignment selection (distance to nearest designated ecological protection area)	Consultation with local authorities - once	POWERGRID	Part of detailed siting and alignment survey /design

Project activity/stage	Potential impact	Proposed Mitigation Measure	Parameter to be monitored	Measurement and frequency	Institutional responsibility	Implementation schedule
		Minimize the need by using existing towers and RoW wherever possible	Tower location and line alignment selection	Consultation with local authorities and design engineers - once	POWERGRID	Part of detailed siting and alignment survey/design
Transmission line through forestland	Deforestation and loss of biodiversity	Avoid encroachment by careful site and alignment selection	Tower location and line alignment selection (distance to nearest protected or reserved forest)	Consultation with local authorities - once	POWERGRID	Part of detailed siting and alignment survey/design
		Minimize the need by using existing towers, tall towers and RoW, wherever possible		Consultation with local authorities and design engineers - once		
		Obtain statutory clearances from the Government	Statutory approvals from Government	Compliance with regulations – once for each subproject		
Encroachment into farmland	Loss of agricultural productivity	Use existing tower footings/towers wherever possible	Tower location and line alignment selection	Consultation with local authorities and design engineers - once	POWERGRID	Part of detailed alignment survey and design
		Avoid siting new towers on farmland wherever feasible	Tower location and line alignment selection	Consultation with local authorities and design engineers - once		Part of detailed siting and alignment survey /design

Project activity/stage	Potential impact	Proposed Mitigation Measure	Parameter to be monitored	Measurement and frequency	Institutional responsibility	Implementation schedule
		Farmers compensated for any permanent loss of productive land	Design of Implementation of Crop Compensation (based on affected area)	Consultation with affected parties – once in a quarter		Prior to construction phase
		Farmers/landowners compensated for significant trees that need to be trimmed or removed along RoW.	Design of Implementation of Tree compensation (estimated area to be trimmed or removed)	Consultation with affected parties – once in a quarter		Prior to construction phase
			Statutory approvals for tree trimming /removal	Compliance with regulations – once for each subproject		Part of detailed siting and alignment survey/design
Noise related	Nuisance to neighbouring properties	Substations sited and designed to ensure noise will not be a nuisance.	Noise levels	Noise levels to be specified in tender documents - once	POWERGRID	Part of detailed equipment design
Interference with drainage patterns/Irrigation channels	Flooding hazards/loss of agricultural production	Appropriate siting of towers to avoid channel interference	Tower location and line alignment selection (distance to nearest flood zone)	Consultation with local authorities and design engineers - once	POWERGRID	Part of detailed alignment survey and design
Escape of polluting materials	Environmental pollution	Transformers designed with oil spill containment systems, and purpose-built oil, lubricant and fuel storage system, complete with spill cleanup equipment.	Equipment specifications with respect to potential pollutants	Tender document to mention specifications - once	POWERGRID	Part of detailed equipment design/drawings

Project activity/stage	Potential impact	Proposed Mitigation Measure	Parameter to be monitored	Measurement and frequency	Institutional responsibility	Implementation schedule
		Substations to include drainage and sewage disposal systems to avoid offsite land and water pollution.	Substation sewage design	Tender document to mention detailed specifications - once	POWERGRID	Part of detailed substation layout and design /drawings
Equipment submerged under flood	Contamination of receptors (land, water)	Substations constructed above the high flood level (HFL) by raising the foundation pad.	Substation design to account for HFL (elevation with respect to HFL elevation)	Base height as per flood design - once	POWERGRID	
Explosions/Fire	Hazards to life	Design of substations to include modern fire control systems/firewalls. Provision of fire fighting equipment to be located close to transformers.	Substation design compliance with fire prevention and control codes	Tender document to mention detailed specifications - once	POWERGRID	Part of detailed substation layout and design/drawings
Construction						
Equipment layout and installation	Noise and vibrations	Construction techniques and machinery selection seeking to minimize ground disturbance.	Construction techniques and machinery	Construction techniques and machinery creating minimal ground disturbance - once at the start of each construction phase	POWERGRID (Contractor through contract provisions)	Construction period
Physical construction	Disturbed farming activity	Construction activities on cropping land timed to avoid disturbance of field crops (within one month of harvest wherever possible).	Timing of start of construction	Crop disturbance – Post harvest as soon as possible but before next	POWERGRID (Contractor through contract provisions)	Construction period

Project activity/stage	Potential impact	Proposed Mitigation Measure	Parameter to be monitored	Measurement and frequency	Institutional responsibility	Implementation schedule
				crop - once per site		
Mechanized construction	Noise, vibration and operator safety, efficient operation	Construction equipment to be well maintained.	Construction equipment – estimated noise emissions	Complaints received by local authorities - every 2 weeks	POWERGRID (Contractor through contract provisions)	Construction period
	Noise, vibration, equipment wear and tear	Turning off plant not in use.	Construction equipment – estimated noise emissions and operating schedules	Complaints received by local authorities - every 2 weeks	POWERGRID (Contractor through contract provisions)	Construction period
Construction of roads for accessibility	Increase in airborne dust particles	Existing roads and tracks used for construction and maintenance access to the line wherever possible.	Access roads, routes (length and width of new access roads to be constructed)	Use of established roads wherever possible - every 2 weeks	POWERGRID (Contractor through contract provisions)	Construction period
	Increased land requirement for temporary accessibility	New access ways restricted to a single carriageway width within the RoW.	Access width (meters)	Access restricted to single carriageway width within RoW - every 2 weeks	POWERGRID (Contractor through contract provisions)	Construction period
Temporary blockage of utilities	Overflows, reduced discharge	Temporary placement of fill in drains/canals not permitted.	Temporary fill placement (m^3)	Absence of fill in sensitive drainage areas - every 4 weeks	POWERGRID (Contractor through contract provisions)	Construction period
Site clearance	Vegetation	Marking of vegetation to be removed prior to clearance, and strict control on clearing activities to ensure minimal clearance.	Vegetation marking and clearance control (area in m^2)	Clearance strictly limited to target vegetation - every 2 weeks	POWERGRID (Contractor through contract provisions)	Construction period

Project activity/stage	Potential impact	Proposed Mitigation Measure	Parameter to be monitored	Measurement and frequency	Institutional responsibility	Implementation schedule
Trimming/cutting of trees within RoW	Fire hazards	Trees allowed growing up to a height within the RoW by maintaining adequate clearance between the top of tree and the conductor as per the regulations.	Species-specific tree retention as approved by statutory authorities (average and maximum tree height at maturity, in meters)	Presence of target species in RoW following vegetation clearance – once per site	POWERGRID (Contractor through contract provisions)	Construction period
	Loss of vegetation and deforestation	Trees that can survive pruning to comply should be pruned instead of cleared.	Species-specific tree retention as approved by statutory authorities	Presence of target species in RoW following vegetation clearance – once per site	POWERGRID (Contractor through contract provisions)	Construction period
		Felled trees and other cleared or pruned vegetation to be disposed of as authorized by the statutory bodies.	Disposal of cleared vegetation as approved by the statutory authorities (area cleared in m^2)	Use or intended use of vegetation as approved by the statutory authorities – once per site	POWERGRID (Contractor through contract provisions)	Construction period
Wood and/or vegetation harvesting	Loss of vegetation and deforestation	Construction workers prohibited from harvesting wood in the project area during their employment, (apart from locally employed staff continuing current legal activities).	Illegal wood/vegetation harvesting (area in m^2, number of incidents reported)	Complaints by local people or other evidence of illegal harvesting - every 2 weeks	POWERGRID (Contractor through contract provisions)	Construction period
Surplus earthwork/soil	Runoff to cause water pollution, solid waste disposal	Soil excavated from tower footings disposed of by placement along	Soil disposal locations and volume (m^3)	Acceptable soil disposal sites - every 2 weeks	POWER GRID (Contractor through contract provisions)	Construction period

Project activity/stage	Potential impact	Proposed Mitigation Measure	Parameter to be monitored	Measurement and frequency	Institutional responsibility	Implementation schedule
		roadsides, or at nearby house blocks if requested by landowners.				
Substation construction	Loss of soil	Fill for the substation foundations obtained by creating or improving local water supply ponds or drains, with the agreement of local communities.	Borrow area siting (area of site in m^2 and estimated volume in m^3)	Acceptable borrow areas that provide a benefit - every 2 weeks	POWERGRID (Contractor through contract provisions)	Construction period
Substation construction	Water pollution	Construction activities involving significant ground disturbance (i.e. substation land forming) not undertaken during the monsoon season.	Seasonal start and finish of major earthworks (pH, BOD/COD, Suspended solids)	Timing of major disturbance activities - prior to start of construction activities	POWERGRID (Contractor through contract provisions)	Construction period
Site clearance	Vegetation	Tree clearances for easement establishment to only involve cutting trees off at ground level or pruning as appropriate, with tree stumps and roots left in place and ground cover left undisturbed.	Ground disturbance during vegetation clearance (area, m^2)	Amount of ground disturbance - every 2 weeks	POWERGRID (Contractor through contract provisions)	Construction period
			Statutory approvals	Statutory approvals for tree clearances – once for each site	POWERGRID (Contractor through contract provisions)	Construction period
Tower construction – disposal of surplus earthwork/fill	Waste disposal	Excess fill from tower foundation excavation disposed of next to roads or around houses, in agreement with the local community or	Location and amount (m^3)of fill disposal	Appropriate fill disposal locations - every 2 weeks	POWERGRID (Contractor through contract provisions)	Construction period

Project activity/stage	Potential impact	Proposed Mitigation Measure	Parameter to be monitored	Measurement and frequency	Institutional responsibility	Implementation schedule
		landowner.				
Storage of chemicals and materials	Contamination of receptors (land, water, air)	Fuel and other hazardous materials securely stored above high flood level.	Location of hazardous material storage; spill reports (type of material spilled, amount (kg or m^3) and action taken to control and clean up spill)	Fuel storage in appropriate locations and receptacles - every 2 weeks	POWERGRID (Contractor through contract provisions)	Construction period
Construction schedules	Noise nuisance to neighbouring properties	Construction activities only undertaken during the day and local communities informed of the construction schedule.	Timing of construction (noise emissions, [dB(a)])	Daytime construction only - every 2 weeks	POWERGRID (Contractor through contract provisions)	Construction period
Provision of facilities for construction workers	Contamination of receptors (land, water, air)	Construction workforce facilities to include proper sanitation, water supply and waste disposal facilities.	Amenities for Workforce facilities	Presence of proper sanitation, water supply and waste disposal facilities - once each new facility	POWERGRID (Contractor through contract provisions)	Construction period
Encroachment into farmland	Loss of agricultural productivity	Use existing access roads wherever possible	Usage of existing utilities	Complaints received by local people /authorities - every 2 weeks	POWERGRID (Contractor through contract provisions)	Construction period
		Ensure existing irrigation facilities are maintained in working condition	Status of existing facilities			
		Protect /preserve topsoil and reinstate after construction completed	Status of facilities (earthwork in m^3)			

Project activity/stage	Potential impact	Proposed Mitigation Measure	Parameter to be monitored	Measurement and frequency	Institutional responsibility	Implementation schedule
		Repair /reinstate damaged bunds etc after construction completed	Status of facilities (earthwork in m^3)			
	Social inequities	Compensation for temporary loss in agricultural production	Implementation of crop compensation (amount paid, dates, etc.)	Consultation with affected parties – once in a quarter	POWERGRID	Prior to construction
Uncontrolled erosion/silt runoff	Soil loss, downstream siltation;	Need for access tracks minimized, use of existing roads.	Design basis and construction procedures (suspended solids in receiving waters; area re-vegetated in m^2; amount of bunds constructed [length in meter, area in m^2, or volume in m^3])	Incorporating good design and construction management practices – once for each site	POWERGRID (Contractor through contract provisions)	Construction period
		Limit site clearing to work areas				
		Regeneration of vegetation to stabilise works areas on completion (where applicable)				
		Avoidance of excavation in wet season				
		Water courses protected from siltation through use of bunds and sediment ponds				
Nuisance to nearby properties	Losses to neighbouring land uses/values	Contract clauses specifying careful construction practices.	Contract clauses	Incorporating good construction management practices – once for each site	POWERGRID (Contractor through contract provisions)	Construction period

Project activity/stage	Potential impact	Proposed Mitigation Measure	Parameter to be monitored	Measurement and frequency	Institutional responsibility	Implementation schedule
		As much as possible existing access ways will be used.	Design basis and layout	Incorporating good design engineering practices – once for each site		
		Productive land will be reinstated following completion of construction	Reinstatement of land status (area affected, m^2)	Consultation with affected parties – twice – immediately after completion of construction and after the first harvest		
	Social inequities	Compensation will be paid for loss of production, if any.	Implementation of Tree/Crop compensation (amount paid)	Consultation with affected parties – once in a quarter	POWERGRID	Prior to construction
Flooding hazards due to construction impediments of natural drainage	Flooding and loss of soils, contamination of receptors (land, water)	Avoid natural drainage pattern /facilities being disturbed /blocked /diverted by the on-going construction activities		Incorporating good construction management practices – once for each site	POWERGRID (Contractor through contract provisions)	
Equipment submerged under flood	Contamination of receptors (land, water)	Equipment stored at secure place above the high flood level (HFL).	Store room level to be above HFL (elevation difference in meters)	Store room level as per flood design - once	POWERGRID	Construction period
Siting of borrow areas	Inadequate siting may result in Loss of land values	Existing borrow sites will be used to source aggregates, therefore, no need to develop new sources of aggregates	Contract clauses	Incorporating good construction management practices – once for each	POWERGRID (Contractor through contract provisions)	Construction period

Project activity/stage	Potential impact	Proposed Mitigation Measure	Parameter to be monitored	Measurement and frequency	Institutional responsibility	Implementation schedule
				site		
Health and safety	Injury and sickness of workers and members of the public	Contract provisions specifying minimum requirements for construction camps	Contract clauses (number of incidents and total lost-work days caused by injuries and sickness)	Contract clauses compliance – once every quarter	POWERGRID (Contractor through contract provisions)	Construction period
		Contractor to prepare and implement a health and safety plan.				
		Contractor to arrange for health and safety training sessions				
Construction stage monitoring	Inadequate monitoring and mitigation leading to environmental impairments at and around project sites	Training of POWERGRID environmental monitoring personnel	Training schedules	Number of programs attended by each person – once a year	POWERGRID /ADB Review Mission	Routinely throughout construction period
		Implementation of effective environmental monitoring and reporting system using checklist of all contractual environmental requirements	Respective contract checklists and remedial actions taken thereof.	Submission of duly completed checklists of all contracts for each site - once		
		Appropriate contact clauses to ensure satisfactory implementation of contractual environmental mitigation measures.	Compliance report related to environmental aspects for the contract	Submission of duly completed compliance report for each contract - once		
Operation and Maintenance						
Location of transmission towers and transmission	Exposure to safety related risks	Setback of dwellings to overhead line route designed in accordance with	Compliance with setback distances (“as-built” diagrams)	Setback distances to nearest houses – once	POWERGRID	During operations

Project activity/stage	Potential impact	Proposed Mitigation Measure	Parameter to be monitored	Measurement and frequency	Institutional responsibility	Implementation schedule
line alignment and design		permitted level of power frequency and the regulation of supervision at sites.		in quarter		
Equipment submerged under flood	Contamination of receptors (land, water)	Equipment installed above the high flood level (HFL) by raising the foundation pad.	Substation design to account for HFL ("as-built" diagrams)	Base height as per flood design - once	POWERGRID	During operations
Oil spillage	Contamination of land/nearby water bodies	Substation transformers located within secure and impervious bunded areas with a storage capacity of at least 100% of the capacity of oil in transformers and associated reserve tanks.	Substation bunding ("as-built" diagrams)	Bunding capacity and permeability - once	POWERGRID/ADB Review Mission	During operations
provision of staff/workers health and safety during operations	Injury and sickness of staff /workers Soil and water contamination from domestic wastewater and solid wastes	Careful design using appropriate technologies to minimize hazards	Usage of appropriate technologies (lost work days due to illness and injuries)	Preparedness level for using these technologies in crisis – once each year	POWERGRID/ADB Review Mission	Design and operation
		Safety awareness-raising for staff	Training and/or awareness programs and mock drills	Number of programs and % of staff/workers covered – once each year		
		Preparation of fire emergency action plan and training given to staff on implementing emergency action plan				
		Provide adequate sanitation and water supply facilities	Provision of facilities	Complaints received from staff/workers every 2 weeks		

Project activity/stage	Potential impact	Proposed Mitigation Measure	Parameter to be monitored	Measurement and frequency	Institutional responsibility	Implementation schedule
Electric Shock Hazards	Injury/mortality to staff and public	Careful design using appropriate technologies to minimize hazards	Usage of appropriate technologies (number of injury incidents, lost work days)	Preparedness level for using these technologies in crisis – once a month	POWERGRID	Design and Operation
		Security fences around substations	Maintenance of fences	Report on maintenance – every 2 weeks		
		Barriers to prevent climbing on/dismantling of transmission towers	Maintenance of barriers			
		Appropriate warning signs on facilities	Maintenance of warning signs			
		Electricity safety awareness raising in project areas	Training /awareness programs and mock drills for all concerned parties	Number of programs and % of total persons covered – once each year		
Operations and maintenance staff skills	Potential lost-time accidents and injuries, and possible environmental losses of various types	Adequate training in O&M to all relevant staff of substations and transmission line maintenance crews.	Training/awarenes s programs and mock drills for all relevant staff	Number of programs and percent of staff covered – once each year	POWERGRID	Operation
		Preparation and training in the use of O&M manuals and standard operating practices.				
periodic environmental monitoring.	Inadequate monitoring may result in diminished ecological and social values.	Power Grid staff to receive training in environmental monitoring of project operations and maintenance activities.	Training and awareness programs and mock drills for all relevant staff	Number of programs and percent of staff covered – once each year	POWERGRID/ADB Review Mission	Operation

Project activity/stage	Potential impact	Proposed Mitigation Measure	Parameter to be monitored	Measurement and frequency	Institutional responsibility	Implementation schedule
Equipment specifications and design parameters	Release of chemicals and gases in receptors (air, water, land)	Processes, equipment and systems using chlorofluorocarbons (CFCs), including halon, should be phased out and to be disposed of in a manner consistent with the requirements of the Government.	Process, equipment and system design	Phase out schedule to be prepared in case still in use – once in a quarter	POWERGRID/ADB Review Mission	Operations

7.3 Institutional Mechanism for Reporting and Review

POWERGRID, through the PMU, will be responsible for internal monitoring of EMP implementation, and will forward semiannual progress reports of Component 1 (or the part of the Project financed by ADB) to ADB and the GOI (if required). The reports will cover EMP implementation with attention to compliance and any needed corrective actions. Ongoing consultation measures will be incorporated in the EMP.

Construction contractors will be responsible for implementation of mitigation measures during the construction stage. The environmental engineer of the ESMT will ensure inclusion of environmental mitigation measures in contract documents, including reporting requirements. The IEE will be made publicly available by POWERGRID on its website.

ADB will (i) review and endorse IEEs and EMPs before contracts are finalized and work begins; (ii) review monitoring reports; and (iii) officially disclose environmental safeguards documents on its website as necessary.

Periodic review by corporate ESMD and higher management including review by POWERGRID CMD of all environmental issues will be undertaken to ensure that EMP and other measures are implemented at site.

7.4 Preliminary Cost Estimates

Table 7.3 presents the estimated costs for implementing the EMP.

Table 7.3 Cost estimates for implementing the EMP[11]

	Particulars	Cost (INR) lakhs
A.	Mitigation Measures/Compensation	
1.00	Compensation towards forest area	
	i) Champa-Kurushetra 800 kV HVDC Transmission Line	469.23
	ii) Kurushetra-Jallandhar 400 kV Transmission Line (Including LILO of 32 km)	13.50
2.00	Compensation towards net present value	
	i) Champa-Kurushetra 800 kv HVDC Transmission Line	5437.82
	ii) Kurushetra-Jallandhar 400kV Transmission Line(Including LILO of 32 km)	138.00
3.00	Compensation for PTCC	
	i) Champa-Kurushetra 800 kv HVDC Transmission Line	605.72
	ii) Kurushetra-Jallandhar 400kV Transmission Line(Including LILO of 32 Kms)	130.37
4.00	Cost towards implementation of EMP (Contractor's Scope)	
	Sub-stations (2 x Rs. 500,000/-)	10.00
(a)	Sub-total	6804.64
B.	Implementation Monitoring & Audit	
a.	Man-power involved for EMP implementation and monitoring	77.84
b.	Independent Audit (Lumpsum)	10.00
(b)	Sub-total	87.84
C.	Contingency cost	

[11] Cost estimates cover both Component 1 and Component 2.

	Particulars	Cost (INR) lakhs
(c)	3% (a)+(b)	206.77
	Total Cost (a)+(b)+(c)	7099.25

Estimated costs are indicative only for expected implementation effort based on experience.

Assumptions are:
1. Compensation for forest area @ Rs 90000 per hectare of forest
2. Compensation for Net Present Value traversed by HVDC line @ Rs 10.43 lakhs per hectare
3. Compensation for Net Present Value traversed by 400 kV line @ Rs 9.2 lakhs per hectare
4. Compensation for PTCC @ Rs 50000/km

8.0 INFORMATION DISCLOSURE, CONSULTATION, AND PARTICIPATION

8.1 Introduction

Public consultation[12] is highly mandatory for any investment in infrastructural development program. This is an important tool to ensure peoples' participation in the planning and implementation phase of this project. The aim of the public consultation is to make the people aware about the developmental activities being undertaken in their locality and to incorporate their views for making a sustainable plan during the design to the successful completion of the project. Various consultations with all stakeholders at different stage of the project preparation were undertaken and issues related to local needs, environment, problem and prospects of resettlement, compensation options etc. were discussed. The project will therefore ensure that the affected people and other stakeholders are informed, consulted, and allowed to participate actively in the development process. This will be done throughout the project, both during preparation, implementation, and monitoring of project results and impacts.

8. 2 POWERGRID's Process of Public Consultation

During the survey, POWERGRID site officials meet people and inform them about the routing of transmission lines. During construction, every individual, on whose land, transmission tower will be erected, and people affected by the ROW, will be consulted.

Public consultation, using different techniques such as public meeting, small group meeting, and informal meeting based on the ESPP 2009, shall be carried out during the different activities of the project cycle. During such consultation, the public will be informed about the project in general and in particular about the following:

- Disseminating information on the complete project components (i.e. its route and terminating point and substations, if any, in between) to the stakeholders;
- Project plan
- POWERGRID design standards in relation to approved international standards;
- Gaining a better understanding of existing environmental conditions
- Health impacts in relation to EMF;
- Measures taken to avoid public utilities such as school, hospitals, etc.;
- Other impacts associated with transmission lines and POWERGRID's approach to minimizing and solving them;

[12] Informal Consultations were held during field visits, but the people consulted had reservations in identifying themselves in the absence of POWERGRID personnel who will initiate the official consultations after Section 4 of the Land Acquisition Act is notified.

- Temporary land acquisition details, proposed compensation packages in line with POWERGRID's policy;
- Understand the views of the people affected, with reference to use of land and its due compensation
- Trees and crop compensation and its process.

8.3 Continuation of Public Consultations

The consultation process will continue during project implementation. The progress and proposed plan for public consultation is presented in **Table 8.1**.

Table 8.1 Plan for Public Consultation

S.No.	Activity	Technique	Schedule
1.	Detailed survey	Public Meeting at different places (50-100 km) en-route final route alignment of line	During Detailed Survey
2.	Construction Phase	Localized group meeting, Pamphlet/Information brochures, Public display etc.	During entire construction period
3.	O&M Phase	Information brochures, Operating field offices, Response to public enquiries, Press release etc.	Continuous process as and when required.

8.4 Public Disclosure

The safeguards documents will be disclosed to the affected people in a language understandable to them. The IEE will be translated into local language (Hindi) to be made available at the PMU/Line Offices of POWERGRID and online at the website of POWERGRID.

During implementation and monitoring, information will be disseminated to project APs and other key stakeholders. Information will include the main project features and entitlement framework. The GOI Right to Information Act (2005) provides an additional legal channel for affected to people to obtain information about the proposed project.

9.0 GRIEVANCE REDRESS MECHANISM

Grievance redressal is normally built in the process of crop and tree compensation. However, other complaints and/or concerns related to environmental aspect and the overall project's environmental performance will be governed also by this grievance redress mechanism.

Generally, for the compensation to crops and trees, after the notice as required by Sect. 4 of the LAA, the Revenue officials assess the damages based on actual site conditions and the version of landowner. After the preliminary assessment, the owner is given a chance to substantiate the claim if he is not satisfied with the assessment. If the owner is not satisfied he/she is allowed to access the higher authority for any grievance towards compensation that is generally addressed in an open forum and in the presence of many witnesses. Process of spot verification and random checking by the district collector (DC) also provides forum for raising the grievance towards any irregularity/complain. Apart from this, POWERGRID officials also listen to the complaints of affected farmers and the same are forwarded to revenue official to do what is needed.

Complaints and concerns raised by project-affected persons and other stakeholders will be addressed by POWERGRID promptly to the extent possible.

9.1 Grievance Redress Procedure

Grievances of APs will be first brought to the attention of the Site Office of the POWERGRID for resolution. If the complaint/grievance is unresolved at the Site Office level, it will be raised to the Grievance Redress Committee (GRC). Other than disputes relating to ownership rights under the court of law, GRC will review grievances involving all resettlement benefits, compensation, relocation, replacement cost and other assistance.

The GRC will (if grievances are brought to the Committee), determine the merit of each grievance, and resolve grievances within the stipulated time of receiving the complaint—failing which the grievance will be referred to appropriate Court of Law for redressal. Records will be kept of all grievances received including: contact details of complainant, date the complaint was received, nature of grievance, agreed corrective actions and the date these were effected, and final outcome. The GRC will continue to function until the completion of the project.

9.2 Grievance Redress Committee

Consistent with ESPP 2009 of POWERGRID, a Grievance Redress Committee (GRC) will be set up comprising of POWERGRID, representatives of local authorities, APs, Gram Panchayat or any well-reputed person as mutually agreed by with the local authorities and APs. This committee will address the grievances of APs and its main responsibilities are to:

(i) provide support to APs on problems arising from the use of their land/property;
(ii) record APs grievances, categorize, and prioritize grievances and resolve them;
(iii) immediately inform POWERGRID of serious cases; and,
(iv) report to APs on developments regarding their grievances and GRC's decisions.

Local people particularly the APs are informed about the existence of GRC during the consultation process. Meeting of the GRC shall be convened within 15 days of receiving a grievance for its discussion/solution. GRC aims to complete its decision within 45-90 days of receiving the grievance.

10.0 FINDINGS AND RECOMMENDATIONS

The project has been planned and is being designed with careful attention to environmental and social safeguards issues. Environmentally-sensitive areas are avoided as a routine engineering design objective, and potential impacts are minimized during the siting and routing stage. Project components will not be sited in protected areas. Reserved forest areas will be avoided as well. If reserved forest land is required due to technical design constraints, forest clearance will be obtained from the MoEF.

The project will have minimal environmental impacts during construction and operation. Negative environmental impacts, mainly during construction, are considered temporary and insignificant provided mitigation measures are implemented as detailed in the EMP. The project will have long-term positive impacts arising from improved quality and reliability of power transmission.

Mitigation and monitoring measures with cost estimates have been developed in the EMP. The EMP will be implemented by POWERGRID and construction contractors, with oversight by state-regulatory agencies, and ADB. Informal public consultation has been undertaken during project preparation and walkover survey. POWERGRID maintains an open-door policy for receiving complaints, and will conduct additional consultations as necessary during project implementation.

11.0 CONCLUSIONS

None of the project components are in environmentally-sensitive areas. The project will not result in any long-term significant adverse impacts. Minimal negative environmental impacts are anticipated, mostly during construction. These can be mitigated successfully by implementing the EMP with estimated costs for implementation. Environmental and social benefits of the project and long-term investment program objectives outweigh the temporary negative impacts.