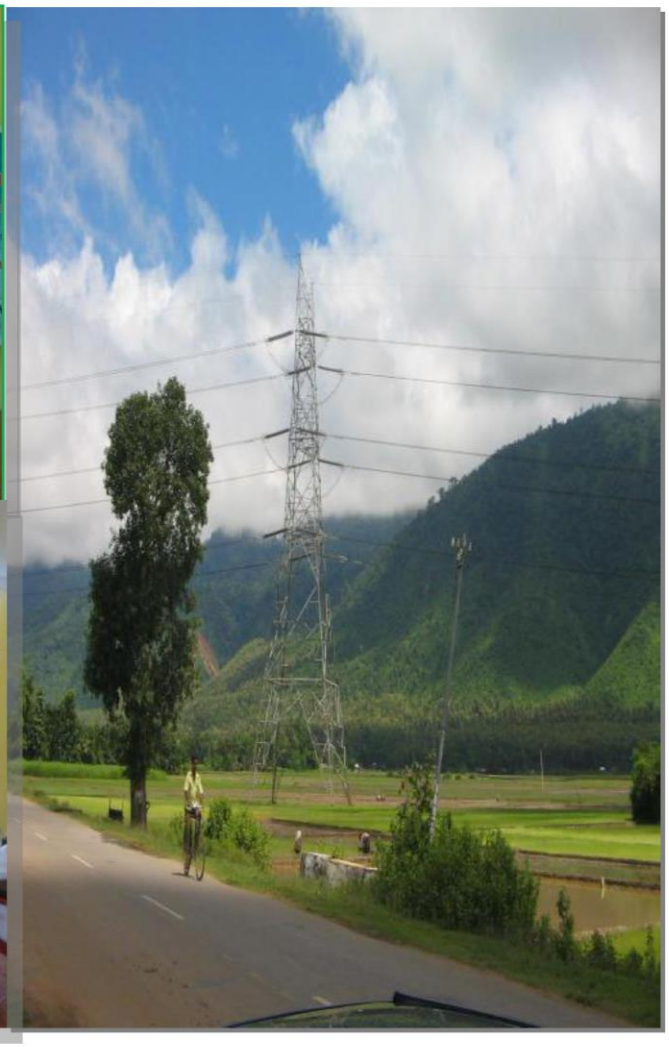
INITIAL ENVIRONMENT EXAMINATION REPORT (IEER)
FOR
AC SYSTEM STRENGTHENING AT PUGALUR END



ENVIRONMENT AND SOCIAL MANAGEMENT

POWER GRID CORPORATION OF INDIA LTD.

(A GOVERNMENT OF INDIA ENTERPRISE)

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EXECUTIVE SUMMARY

This Initial Environmental Examination Report (IEER) of the proposed Transmission System Strengthening Project (the Project) in Tamil Nadu State has been carried out in accordance with the Environmental and Social Policy and Procedures (ESPP) of POWERGRID. It also fulfills the provisions of the Asian Infrastructure Investment Bank's (AIIB) Environmental and Social Framework (ESF). The proposed Project is a subset of POWERGRID's "HVDC Bi-pole Link between Western Region (Raigarh, Chhattisgarh) and Southern Region (Pugalur, Tamil Nadu) – North Trichur (Kerala)", which comprises three related schemes to expand the interstate transmission network in western and southern India. These schemes are:

- Scheme 1: a +800 kV HVDC link from Raigarh (Chhattisgarh, Western Region) to Pugalur (Tamil Nadu, Southern Region).
- Scheme 2: 400 kV transmission segments from Pugalur to 5 other grid substations in Tamil Nadu state, and
- Scheme 3: +320 kV HVDC link from Pugalur (Tamil Nadu) to Trichur (Kerala).

The objective of the Project is to enhance the capacity of the electricity supply in the Southern Region. The impact of the Project will be increased availability and sustainability of power supply in India. POWERGRID has requested financing from AIIB for 400 kV transmission lines included in Scheme 2, while the related substations (and Schemes 1 and 3) are being funded by Asian Development Bank (ADB). Schemes 1 and 3 have been the subject of environmental and social assessment consistent with POWERGRID's ESPP and ADB's Safeguard Policy Statement, 2009. This has included preparation of IEERs and CPTDs.

The Project components will include construction of about 619 km of new 400 kV double circuit (D/C) transmission lines (in 5 segments) and 16 nos. of 400 kV line bays at existing substations for terminating 400 kV (quad) D/C lines. The Project components are located in the Southern part (Tamil Nadu State) of India. The alignment of the transmission line does not pass through any environmentally sensitive protected area (such as national parks or wildlife sanctuaries). However, about 5 km length of the proposed alignment of the Pugalur–Thiruvalam line passes through forest area. The rest of the alignment passes through agriculture and open areas. Terrain is plain to hilly.
The Project is classified in Environmental and Social Category B under the provisions of AIIB's Environmental and Social Policy (ESP) and Environmental and Social Standards (ESSs). Accordingly, this IEER has been prepared to meet AIIB's requirements for Category B projects. This IEER includes an Environmental and Social Management Plan (ESMP) for project implementation and monitoring.

As a responsible corporate entity, POWERGRID pays maximum attention to the environmental and social safeguards associated with its operations. To address the environmental and social issues related to its power transmission projects, POWERGRID has developed its corporate ESPP based on the principles of avoidance, minimization, and mitigation. The current ESPP was developed and finalized through a multi-stakeholder and participatory consultation process, including the World Bank. The World Bank's Safeguards Diagnostic Review in 2008 concluded that POWERGRID's ESPP was fully equivalent to World Bank safeguard policies for Environmental Assessment, Natural Habitats, Forests, Physical Cultural Resources, Involuntary Resettlement and Indigenous Peoples.[1]

Transmission line projects are considered environmentally friendly in India and are exempted by the Ministry of Environment, Forests and Climate Change (MoEF&CC) from the

1 World Bank. Piloting the Use of Country Systems to Address Environmental Safeguard Issues at the Power Grid Corporation of India, Ltd., February 2009.

requirements of the Environment (Protection) Act, 1986. However, when transmission projects pass through forest land, clearance must be obtained from relevant authorities under the Forest (Conservation) Act, 1980.

Under the Forest (Conservation) Act, 1980, prior approval from the Regional Offices of MoEF&CC shall be obtained for affected areas classified as forest that will be traversed by the transmission line after detailed survey and finalization of route through the forest area in consultation with local forest authorities. In this case, most of the forests that will be traversed by the transmission line routes are plantations along the road and canal crossings and are already degraded.

Local communities and stakeholders including women's groups were involved in the process of environmental assessment through on-site discussions. Formal public consultations in the Project areas were conducted in the months of May and June 2016 and will continue throughout the Project cycle. As the Project will not have any significant environmental and social impacts, local communities support the Project. The grievance redress mechanism will function according to Powergrid's ESPP procedures, which are consistent with multilateral banks such as the World Bank and the relevant national regulations.

Environmental and social impacts associated with the Project components are restricted to the clearing and maintenance of the right-of-way (RoW). With the development of innovative tower design being implemented by POWERGRID, the RoW requirements for 400 kV D/C lines have been reduced from 52 m to 46 m. Even with ESPP and innovative design, some residual impacts cannot be entirely avoided, as about 20.70 hectares of land designated as forest land by the Government of India (GoI) will be affected by the Project components.

Potential impacts are mostly temporary. The routes of the transmission lines have been finalized so as to avoid any wildlife sanctuary or protected areas and other environmentally sensitive areas as well as settlement areas. Since the Bays extension work is proposed within the boundaries of the existing substations, there is no permanent land acquisition or physical displacement involved in the Project. Impacts are temporary in nature in terms of loss of crops and trees, and use of RoW, land below the transmission lines and footings of the towers. A draft compensation plan for temporary damages (CPTD) has been prepared to compensate these damages. This plan will be finalized following estimation of likely damages as part of detailed surveys, which will take place prior to execution of the work.

Best available technology and best management practices are built-in to the Project design. All Project components will be implemented and monitored in line with POWERGRID's ESPP, which is in line with AIIB's ESP and ESSs.

An ESMP with cost estimates included in the budget as well as environmental and social monitoring plan is an integral part of this IEER. A semi-annual environmental monitoring report will be submitted to AIIB and will be disclosed publicly on the AIIB website.

SECTION – I: INTRODUCTION

1.1 BACKGROUND

The Southern Region of the country is facing power deficit mainly due to (i) delay/deferment of anticipated generation projects and (ii) due to non-availability of gas for existing gas projects in Southern Region. As on date maximum power demand of Southern region is about 39000 MW and faces a deficit of about 3400 MW in spite of import capacity of about 4920 MW from NEW grid. As per 18th EPS of CEA the expected power demand of Southern region by the end of XII and XIII plan would be about 57,200 MW and 82,200 MW respectively. Envisaged generation addition indicates power transfer requirement to Southern Region is expected to increase in coming years particularly under certain scenarios. Therefore, in view of large deficit and requirement of transmission system to meet future requirements, the implementation of HVDC link has been proposed with a capacity of 6000 MW. Also, considering conservation of RoW problem in Kerala and dispersal of power beyond Pugalur, establishment of VSC (Voltage Source Converter) based 2000 MW HVDC link between Pugalur and North Thrissur (Kerala) has also been proposed. As decided during the standing committee meeting the project shall be built as three separate schemes as follows;

Scheme # 1 : Raigarh-Pugalur 6000 MW HVDC System;
Scheme # 2 : AC System strengthening at Pugalur end;
Scheme # 3 **:** Pugalur-Thrissur 2000 MW VSC Based HVDC System.

The scheme has been discussed and agreed in the 37th & 38th meeting of Standing Committee on Power System Planning in Southern Region held on 31st July, 2014 & 7th March, 2015 and in the 26th meeting of Southern Region Power Committee (SRPC) held on 20th December, 2014. Further, the scheme has been discussed and agreed in the Joint meeting of the Standing Committee on Power System Planning of Southern Region meeting and Western Region held on 20th April, 2015. Ministry of Power (MoP) vide letter dated 10/12/2014 has approved the implementation of the scheme by POWERGRID under compressed time schedule through regulated tariff mechanism. Further, the scheme has also been discussed and agreed in the 34th Empowered Committee Meeting on Transmission held on 13th April, 2015 for implementation of the scheme under regulated Tariff mechanism.

Scheme # 2 & Scheme # 3 should be in place before commissioning of 6000 MW Raigarh-Pugalur link (Scheme # 1). The issue of commissioning of Scheme1, 2 & 3 was again discussed in 39th meeting of standing committee of SR held on 28-29 December 2015, where it was agreed that the delivery schedule of scheme 2 & 3 should be kept or at least matching with that of scheme1. In case of any mismatch during execution of these schemes, their usefulness shall be discussed with CEA before their commissioning. Under the present project Scheme # 2: AC System strengthening at Pugalur end has been proposed.

1.2 PROJECT OBJECTIVE

The objective of the Project is to enhance capability of electricity supply in Southern Region. The impact of the Project will be increased availability and sustainability of power supply in India.

1.3 PROJECT JUSTIFICATION

Southern Region is facing power deficit which has arisen mainly due to – (i) delay/deferment of anticipated generation projects for example, Krishnapattam UMPP (4000 MW), Cheyyur UMPP(4000 MW), Udangudi TPS, IPP projects in Nagapatanam/ Cuddalore area (3000 to 4000 MW), Kundankulam APP (2000MW), Kalpakkam PFBR (500 MW), East coast project in

Srikakulam (1320 MW), Gas based projects in Vemagiri (about 3000 MW) etc. and (ii) due to non-availability of gas for existing gas projects in Southern Region.

As on date maximum power demand of Southern region is about 39000 MW. As per 18th EPS of CEA the expected power demand of Southern region by the end of XII and XIII plan would be about 57,200 MW and 82,200 MW respectively. Hence power transfer requirement to Southern Region is expected to increase in coming years. Therefore, to facilitate the import of power to Southern region and considering the long distance, it has been proposed that power can be transferred over HVDC system along with the associated A.C Transmission system at 400 kV level. Accordingly, ±800 KV 6000 MW HVDC link with terminals at Raigarh & Pugalur along with VSC based 2000 MW HVDC link between Pugalur and North Trichur (Kerala) has been proposed. As decided during the Joint meeting of the Standing Committee on Power System Planning of Southern Region meeting and Western Region held on 20th April, 2015 the scheme is to be implemented as three separate schemes as discussed above.

The present report deals with transmission system to be implemented under Scheme-2 i.e. AC System strengthening at Pugalur end. The proposed system would help in direct supply to Tamil Nadu and Kerala relieving the tie line flow from NEW grid to Southern region and tie line flow between S1-S2. HVDC with its control features shall provide flexibility during operation and help in controlling the power flow on parallel AC lines and provide damping as and when need arises.

1.4 PREPARATION AND OBJECTIVES OF THE IEER

The present Initial Environmental Examination Report (IEER) is a document developed to identify possible environmental and social issues associated with construction of 5 transmission lines & associated 16 nos. of line bays at different substation in Tamil Nadu State under “Scheme # 2 of the HVDC project. The IEER provides insight on possible environmental and social issues and lists management measures to minimize/mitigate them based on POWERGRID’s Environment and Social Policy & Procedures (ESPP).

This IEER has been prepared by POWERGRID as part of detailed project preparation for Scheme 2 in the year 2016. The Project is currently at investment stage, and although there are no major changes in the Project design and location are anticipated, this IEER may need updating following detailed surveys of alignment by the Contractor (prior to installation) in accordance with the environmental and social requirements of POWERGRID and AIIB.

This IEER has been prepared in accordance with the ESPP of POWERGRID and also with the provisions of AIIB’s Environmental and Social Framework (ESF), 2016.

The IEER aims to ensure good environmental and social practices. The specific objectives of this IEER are to:

- provide an environmental and social baseline description of the Project;
- identify and describe the potential environmental and social impacts of the Project;
- design mitigation measures to minimize adverse environmental and social impacts;
- describe the public consultation process and Grievance Redress Mechanism; and
- provide an Environmental and Social Management and Monitoring Plan for the project (including defining institutional responsibilities, capacity building and training, and the required budget).

The scope of this IEER is based on POWERGRID’s ESPP as well as AIIB’s ESF. Transmission line projects are considered environmentally friendly in India and are exempted by the Ministry of Environment, Forests and Climate Change (MoEF&CC) from the requirements of the Environment (Protection) Act, 1986. Therefore, environmental impact assessment for transmission lines projects is not required in India. However, when transmission projects pass through forest land, clearance has to be obtained from relevant authorities.

This IEER is prepared to fulfill the provisions of AIIB's ESF, including the ESP and applicable Environmental and Social Standards (ESSs). The Project is classified in Environmental and Social Category B under the provisions of the ESP. Accordingly, this IEER has been prepared to meet the requirements for Category B projects. AIIB has determined that ESS 1 on Environmental and Social Assessment and Management, and ESS 2 on Involuntary Resettlement will apply to the Project. Following review by POWERGRID and AIIB, it was concluded that ESS 3 on Indigenous Peoples will not apply. The IEER includes an Environmental and Social Management Plan (ESMP) for project implementation and monitoring.

The scope of this IEER is limited to the areas where project facilities will be installed, i.e., alignment through which transmission line will pass and existing substations where lines will be terminated. The purpose of this IEER is to assess potential environmental, health, safety and social risks and impacts of the proposed intervention in the Southern Region of India and propose suitable mitigation measures where required.

This IEER consists of a Project description and assessment sections. The Project will construct only transmission lines under Scheme 2. Associated substations are being supported by other financiers for which environmental and social impact assessments have already been performed, consistent with POWERGRID's ESPP and the environmental and social policies of the participating international development partners.

This IEER study is conducted based on review of existing IEERs for Scheme 1 and Scheme 3, primary data collected from site visits (including consultations) and secondary information collected from various sources. During site visits, the specialists consulted with key stakeholders and local authorities to seek their opinions on the Project. Formal public consultations at villages along the proposed alignment of the transmission lines have also been conducted. The results of the consultations as well as an evaluation of the institutional framework have been incorporated into this assessment.

1.5 STRUCTURE OF THE IEER

In line with provisions of the AIIB ESP, this IEER is organized into sections which covers (i) sub-project description; (ii) description of the baseline environment; and (iii) impact assessment and mitigation measures. The IEER has following sections:

- Executive Summary
- Introduction
- Policy, Legal, and Administrative Framework
- Project Description
- Baseline Environment
- Potential Impacts, their Evaluation and Management
- Analysis of Alternatives and Route/Site Selection
- Consultation and Information Disclosure
- Implementation Arrangement, Mitigation & Monitoring
- Conclusions.

SECTION – II: POLICY, LEGAL & REGULATORY FRAMEWORK

Power transmission project activities by their inherent nature and flexibility have limited impacts on environmental and social attributes. Indian laws relating to environmental and social issues have strengthened in the last decade both due to local needs and international commitments. POWERGRID undertakes its activities within the purview of Indian and State specific laws keeping in mind appropriate international obligations and directives and guidelines with respect to environmental and social considerations of Multilateral Funding Agencies.

2.1 ENVIRONMENTAL (National)

2.1.1 Constitutional Provisions

Subsequent to the first 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* provide:

> *"The State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country". (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". {Article 51A (g)}*
>
> *Article 21 of the constitution provides, "no person shall be deprived of his life or personal liberty except according to procedure established by law".*

Article 21 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 guarantee fundamental right to life – a life of dignity to be lived in a proper environment, free of danger of disease and infection. Recently, Supreme Court has broadly and liberally interpreted the Article 21, transgressing into the area of protection of environment, and held the protection of environment and citizen's right to live in eco-friendly atmosphere as the basic right guaranteed under Article 21.

Thus the Indian Constitution has now two fold provision:

(a) On the one hand, it gives directive to the State for the protection and improvement of environment.

(b) On the other hand the citizens owe a constitutional duty to protect and improve natural environment.

2.1.2 Mandatory Requirements (National)

- **Ministry of Power (MoP) Order/ Sanction under The Electricity Act, 2003**

Sanction of Ministry of Power (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. Electricity act does not explicitly deal with environmental implications of activities related to power transmission. However, POWERGRID always integrates environmental protection within its project activities.

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

When transmission projects pass through forest land, clearance has to be obtained from relevant authorities under the Forest (Conservation) Act, 1980. This Act was enacted 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 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 Forest & Climate Change (MoEFCC), GoI before starting any construction activity in designated forest area.

- **Environmental Clearances under Environment (Protection) Act**, **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 (EPA)**.** However, amendment in the Environment (Protection) Act, 1986 on 7th May' 1992 made it necessary to obtain clearance from MoEFCC for power transmission projects in three districts in the Aravalis (*viz.*, Alwar in Rajasthan and Gurgaon & Nuh-Mewat in Haryana). The Aravali range, in these areas, is heavily degraded; hence, any industrial activity there becomes critical. Environment Impact Notification, 1994 & 2006 lays down specific project categories that require clearance from MoEFCC Power transmission projects are not included in this list.

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

MoEFCC vide its notification dated 17th 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 Montreal Protocol adopted on 16th September 1987. As per the notification certain control and regulation has been imposed on manufacturing, import, export and use of these compound. POWERGRID shall follow provisions of notification and phase out all equipments which uses these substances and planning to become a CFC free organization in near future.

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

MoEFCC vide its notification dated 16th May, 2001 under the section of 6, 8 and 25 of the Environment (Protection) Act, 1986 has put certain restriction on disposal of used batteries and its handling. As per the notification, it is the responsibility of bulk consumer (POWERGRID) to ensure that used batteries are not disposed of, in any manner, other than by depositing 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, Handling & Transboundary Movement) Rules, 2008**

Vide notification dated 24th September, 2008 under the EPA, 1986, MoEFCC notified rules for environmentally sound management of hazardous wastes to ensure that the hazardous wastes are managed in a manner which shall protect health and the environment against the adverse affects that may result from such waste. The used transformer oil has been declared as hazardous wastes vide this notification. As per the notification, all used oil is to be auctioned/sold to registered recyclers only and file annual return on prescribed form to the concerned State Pollution Control Board.

- **E-waste (Management and Handling) Rules, 2011**

Vide notification dated 12th May 2011 under the EPA, 1986, MoEFCC notified rules for environmentally sound management of e-waste to ensure that e-waste are managed in a manner which shall protect health and the environment against the adverse effects that may result from hazardous substance contained in such wastes. Thus, it is the responsibility of the bulk consumer (POWERGRID) to ensure that e-waste generated is channelized to authorized collection center(s) or registered dismantler(s) or recycler(s) or is returned to the pick-up of take back services provided by the producer. POWERGRID, being a bulk consumer of electrical and electronics equipments shall maintain the record as per Form-2 for scrutiny by State Pollution Control Board.

- **The Biological Diversity Act, 2002**

Under the United Nations Convention on Biological Diversity signed at Rio de Janeiro on the 5th June, 1992 of which India is also a party, MoEF has enacted the Biological Diversity Act, 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. As per the provision of act certain areas which are rich in biodiversity and encompasses unique and representative ecosystems are identified and designated as Biosphere Reserves to facilitate their conservation. All restrictions applicable to protected areas like National Parks & Sanctuaries are also applicable to these reserves. POWERGRID will abide by the provision of act, wherever, applicable and try to totally avoid these biosphere reserves while finalizing the route alignment.

- **The Scheduled Tribes & Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006**

This act recognizes and vests the forest rights and occupation in forest land to forest dwelling Scheduled Tribes and other traditional forest dwellers who have been residing in such forests for generations but whose rights could not be recognized.

The definitions of forest dwelling schedule tribes, forestland, forest rights, forest villages, etc. have been included in Section 2 of the Act. The Union Ministry of Tribal Affairs (MoTA) is the nodal agency for implementation of the Act while field implementation is the responsibility of the government agencies. Its implementation has also been linked with forest clearance process under Forest (Conservation) Act, 1980 w.e.f. August 2009 by MoEFCC. POWERGRID shall abide by the provisions of the act if any portion of the transmission line is passing through forest land, in occupation of the forest dwelling scheduled tribes and other traditional forest dwellers for laying of transmission lines. However, for linear projects including transmission lines obtaining of NoC from the gram sabhas has been exempted for the requirement of FRA compliance as per MoEF circular dated 5th February 2013.

2.1.3 Relevant Policies

- National Conservation Strategy and Policy Statement on Environment and Development of 1992
- National Environment Policy of 2006
- Policy Statement for Abatement of Pollution of 1992

2.2 SOCIAL (National)

2.2.1 Constitutional Provisions

Constitutional provisions in regard to social safeguards are well enshrined in the preamble such as **JUSTICE,** social, economic and political; **LIBERTY** of thought, expression, belief, faith and worship; **EQUALITY** of status and of opportunity; **FRATERNITY** assuring the dignity of the individual and the unity and integrity of the Nation. Fundamental Rights and Directive Principles guarantee the right to life and liberty. Health, safety and livelihood have been interpreted as part of this larger right. Social safeguards provisions are dealt in detail in different Article such as Article-14, 15 17, 23, 24, 25, 46, 330, 332 etc. POWERGRID shall implement the said constitutional provision in true sprit to fulfill its environmental and social obligations and responsibilities.

2.2.2 Mandatory Requirements (National/State)

- **The Right to Fair Compensation and Transparency in Land Acquisition Rehabilitation and Resettlement Act, 2013 (RFCTLARRA)**

Govt. of India replaced the old Land Acquisition Act, 1894 and notified the new RFCTLARRA, 2013 which came into force from 1st January 2014. This act ensures appropriate identification of the affected families/households, fair compensation and rehabilitation of titleholders and non-titleholders. However, the new act i.e. RFCTLARRA, 2013 authorizes State Govt. or its authorized Government agency to complete the whole process of acquisition of private land including Social Impact Assessment (SIA), Action Plan for R&R (i.e. Rehabilitation and Resettlement) & its implementation and POWERGRID's responsibility is limited to identification and selection of suitable land based on technical requirement and ensuring budget allocation.

- **Rights of Way and Compensation under Electricity Act, 2003[2]**

The act has a provision for notifying transmission company under section 164 (B) to avail benefits of eminent domain provided under the Indian Telegraph Act, 1885. MoP, GoI vides gazette notification dated 23rd Dec'03 had already notified POWERGRID under this section of said act. Therefore, for the purpose of placing of any wires, poles, etc., POWERGRID has all the powers that the telegraph authority possesses. Thus, POWERGRID can erect and construct towers without actually acquiring the land. However, all damages due to POWERGRID activity are compensated at market rate. Power transmission schemes are always planned in such a way that the power of eminent domain is exercised responsibly.

2.3 POWERGRID'S ENVIRONMENTAL AND SOCIAL POLICY AND PROCEDURES (ESPP)

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 consistent with the World Bank policy of Use of Country System policy[3], and applicable laws, legislation and guidelines of GoI. This is now referred to by POWERGRID as the ESPP 2009.

ESPP 2009 outlines POWERGRID's approach and commitment in dealing with the environmental and social issues relating to its transmission projects, lays down the management procedures and protocols for the purpose that includes the framework for identification, assessment, and management of environmental and social concerns at both organizational and project levels.

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[2] Ministry of Power, Govt. of India vide its notification dated 15th Oct., 2015 has issued guidelines for payment of compensation for damages in regard to RoW for transmission lines. Once the above guidelines are adopted by respective States, compensation shall be paid as per the norms.

[3] Power Grid Corporation of India Ltd. Environment and Social Management Department. *Environmental and Social Policy & Procedures (ESPP),* p5, CC/ESMD/ESPP-09.

Specifically on environment, the following criteria and approach are considered in the ESPP:

i. Avoid operations in environmentally-sensitive areas, eco-sensitive zones, forests, sanctuaries, national parks, tiger/biosphere reserves, and Coastal Regulation Zone covered coastal areas;
ii. Consider environmental implications of location, terrain, and sensitive areas in impact identification and mitigate these with innovative and practical engineering solutions;
iii. Application of efficient and safe technology practices;
iv. Abate pollution in all activities and operations; and,
v. Minimize energy losses and promote energy efficiency.

2.4 AIIB'S ENVIRONMENTAL AND SOCIAL POLICY AND STANDARDS (Funding Agency)

AIIB recognizes that environmental and social sustainability is a fundamental aspect of achieving development outcomes consistent with its mandate to support infrastructure development and interconnectivity in Asia. The Environmental and Social Framework of AIIB (2016), includes an Environmental and Social Policy and Environmental and Social Standards. The Environmental and Social Policy specifies that AIIB conduct environmental and social due diligence as an integral element of its appraisal of the Project, and in a manner that is: (a) appropriate to the nature and scale of the Project; and (b) proportional to the level of the Project's potential environmental and social risks and impacts. In this context, the proposed Scheme-II (AC System Strengthening at Pugalur End) Project has been placed in Category B by AIIB and the Bank has determined that an Initial Environmental Examination Report, Environmental and Social Management Plan and a Compensation Plan for Temporary Damages (CPTD) are appropriate documentation.

2.5 COMPARISON OF POWERGRID'S ESPP AND AIIB'S ESP

The Table below presents a brief comparison of ESPP 2009 and SPS 2009.

Table 2.1: Comparison of POWERGRID ESPP and AIIB ESF

S. No.	PROJECT STAGE	• AIIB ESF 2016	• POWERGRID ESPP 2009	COMMENTS
1	Project Screening and Categorization	• Screening of each proposed project at the concept stage using potential environmental and social risks and impacts. Projects categorized as A, B, C and FI based on potential environmental and social risks and impacts.	• POWERGRID does not categorize projects, and has no legislative provisions for screening and categorization to define the depth of environmental and social assessment. However, it conducts an environmental and social screening at the Project Concept stage in line with international best management practices.	• Under the national policy, it is not required for POWERGRID to categorize its projects to identify the environmental assessment needed.
2	Conduct Environmental and Social Assessment	• Client to undertake an Environmental and Social Assessment of potential physical, biological, socio-economic and cultural risks and impacts from proposed project. The type of instrument and level	• Undertakes environmental assessment for all projects as a standard management procedure (an Initial Environment Assessment Report). • Prepares Environmental Impact Assessment and Management Plan (EIAMP) in consultation with State Forest Dept.	• Prepares Environmental and Social Impact Assessment (ESIA)/Initial Environmental Assessment (IEA) Report/Initial Environmental Examination Report (IEER) of transmission line and substation

S. No.	PROJECT STAGE	• AIIB ESF 2016	• POWERGRID ESPP 2009	COMMENTS
		of detail is determined on the basis of project screening and environmental and social categorization. Client to prepare Environmental and Social Management Plan (ESMP) as appropriate (see below).	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 guidelines. • Conducts cost-benefit analysis as part of Forest Clearance applications. • Uses 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.	upgrade projects. • Process makes use of an Environmental Management Plan (EMP) which includes environmental and social aspects. • Aligned with AIIB's policy provisions.
3	Assessment of Alternatives	• Assessment of alternatives under Environmental and Social Standard 1: Environmental and Social Assessment and Management. Examination to avoid or minimize environmental impacts.	• 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 topography sheets, Forest Atlas, etc., to select three alternative routes for analysis and selects the best route (final) for detailed survey study in consultation with relevant government agencies.	• Prepares two or three route alternatives for detailed design study and therefore, aligned with AIIB's policy provisions. • Aligned with AIIB's policy provisions.
4	Prepare Environmental and Social Management Plan (ESMP) with budget , schedule and institutional arrangements.	• Development and implementation of an Environmental and Social Management Plan (ESMP), which includes an Environmental Monitoring Plan. • ESMP to include budget, schedule and institutional arrangements.	• Develops, implements, and monitors EMP with budget, schedule and proper institutional arrangements. EMP covers both environmental and social aspects.	Aligned with AIIB's policy provisions.
5	Public Consultation and Use of Project-Level Grievance Redress	• Client conducts meaningful consultation with Project-affected people to facilitate their informed	• Public consultation and information disclosure is an integral part of the POWERGRID project cycle and is covered in the ESPP.	Aligned with AIIB's policy provisions.

S. No.	PROJECT STAGE	• AIIB ESF 2016	• POWERGRID ESPP 2009	COMMENTS
	Mechanisms	participation in the consultations. Client continues consultation with stakeholders throughout the Project implementation as appropriate on environmental and social performance. • Client to establish a Project-level Grievance Redress Mechanism.	POWERGRID uses a wide variety of consultation techniques as part of project preparation, implementation and operation. • POWERGRID makes use of a Project-level Grievance Redressal Mechanism (GRM).	
6	Information Disclosure	• Public disclosure of environmental and social documents, including ESMP, on AIIB website as per policy provisions. Regular disclosure of updated environmental and social information, in the same manner, along with information on any material changes in the Project.	• IEER placed in public domain for information. Project details and EMP translated into local language and made available at the village/ community level • Copies of EMP available at local level for access by stakeholders.	Aligned with AIIB's policy provisions.

Based on the brief comparison given in Table 2.1, POWERGRID ESPP is broadly aligned with the provisions of AIIB's ESF 2016.

2.6 INTERNATIONAL AND REGIONAL AGREEMENTS AND CONVENTIONS

India is a party and signatory to several international and regional environmental agreements to which the MoEFCC is the National Focal Point. The interventions proposed under the Project shall be implemented in compliance with applicable international/regional conventions and declarations to which India is a party.

SECTION – III: PROJECT DESCRIPTION

The present report deals with transmission system to be implemented under Scheme-2 i.e. AC System strengthening at Pugalur end. The proposed system would help in direct supply to Tamil Nadu and Kerala relieving the tie line flow from NEW grid to Southern region and tie line flow between S1-S2. HVDC with its control features shall provide flexibility during operation and help in controlling the power flow on parallel AC lines and provide damping as and when need arises. The objective of the Project is to enhance capacity of electricity supply in Southern Region. The impact of the Project will be increased availability and sustainability of power supply in India.

3.1 PROJECT HIGHLIGHTS

a)	Project Name	:	HVDC Bipole link between Western region (Raigarh, Chhattisgarh) and Southern region (Pugalur, Tamil Nadu)- North Thrissur (Kerala) - **Scheme # 2: AC System strengthening at Pugalur end.**
b)	Location	:	Southern Region (Tamil Nadu State)
c)	Beneficiary States/UT	:	Tamil Nadu and Kerala
d)	Project Cost	:	Rs. 1929.39 Crores
e)	Commissioning Schedule	:	30 months from the date of Investment approval

3.2 PROJECT SCOPE AND COMPONENTS

The scope of Project includes construction of about 619 km of new 400 kV double circuit (D/C) transmission line (in 5 segments) and 16 nos. of 400 kV line bays at existing substations for terminating 400 kV (quad) D/C lines. The proposed Project covers following components under the scope of works:

A. Transmission lines

1. Pugalur HVDC Station – Pugalur (Existing) 400kV (quad) D/c line – **55 km** approx.;
2. Pugalur HVDC Station – Arasur 400kV (quad) D/c line - **58 km** approx.;
3. Pugalur HVDC Station – Thiruvalam 400kV (quad) D/c line – **390 km** approx.;

   with 2x80 MVAR line reactor at Pugalur HVDC Station end and 2x63 MVAR line reactor at Thiruvalam 400kV end (existing 1x63 MVAR bus reactor shall be utilized as line reactor in one circuit and the second circuit shall have new 63 MVAR line reactor);
4. Pugalur HVDC Station – Edayarpalayam (TANTRANSCO) 400kV (quad) D/c line- **56 km** approx.;
5. Edayarpalayam (TANTRANSCO) Udumulpet 400kV (quad) D/c line- **56 km** approx.

B. Substations

1. 8 nos. of 400kV line bays at Pugalur HVDC Station for termination of 4 nos. of 400kV Quad lines. 2x80 MVAR line reactor at Pugalur HVDC Station end for Pugalur HVDC Station – Thiruvalam 400kV (quad) 400kV D/c line.
2. 2 nos. of 400kV line bays at Arasur for terminating Pugalur HVDC Station – Arasur 400kV (quad) D/c line
3. 2 nos. of 400kV line bays at Thiruvalam for terminating Pugalur HVDC Station – Thiruvalam 400kV (quad) D/c line along with line reactors as mentioned above.

4. 2 nos. of 400kV line bays at Pugalur (Existing POWERGRID stn) for terminating Pugalur HVDC Station – Pugalur (Existing) 400kV (quad) D/c line.
5. 2 nos. of 400kV line bays at Udumulpet for terminating Edayarpalayam – Udumulpet 400kV (quad) D/c line.

The proposed project activities include the survey for finalizing the route alignment and construction of above transmission lines and line bays at connecting substations. Lattice towers are erected on designated places using normal excavation and foundations, thereafter conductors are strung across these using manual/stringing machines.

3.3 LOCATION OF PROJECT COMPONENTS

The project components are located in Southern Part (Tamil Nadu State) of India. The alignment of the transmission line does not pass through any environmental sensitive protected area (such as national parks or wildlife sanctuaries). However about 5 km length of the proposed alignment of Pugalur – Thiruvalam line passes through forest area. Rest of the alignment passes through agriculture and open areas. Terrain is plain to hilly.

The schematic showing the transmission grid of Southern Region highlighting the proposed line covered under the subject IEER is presented in **Figure 1.**

3.4 IMPLEMENTATION PLAN

The Project will be implemented within 30 months from the approval of investment proposal.

POWERGRID has a functional corporate structure with clearly defined roles and responsibilities for all project related positions. This structure has been proved effective by its successful track records in terms of implementing large transmission projects in the past decades. The Project's implementation arrangements will make best use of POWERGRID's existing integrated project management and control system.

As the implementing agency (as well as a Borrower), POWERGRID will take full responsibility of the implementation of the Project. The Department of Corporate Planning will be the interface between POWERGRID and AIIB, and also the internal coordinator among the functional departments to lead the preparation and implementation of the Project. While environmental and social aspects of the Project are managed by POWERGRID's Environmental and Social Management Department, the regional offices will be responsible for construction and commissioning of different line segments and for submitting monthly implementation progress reports to the Department of Corporate Planning.

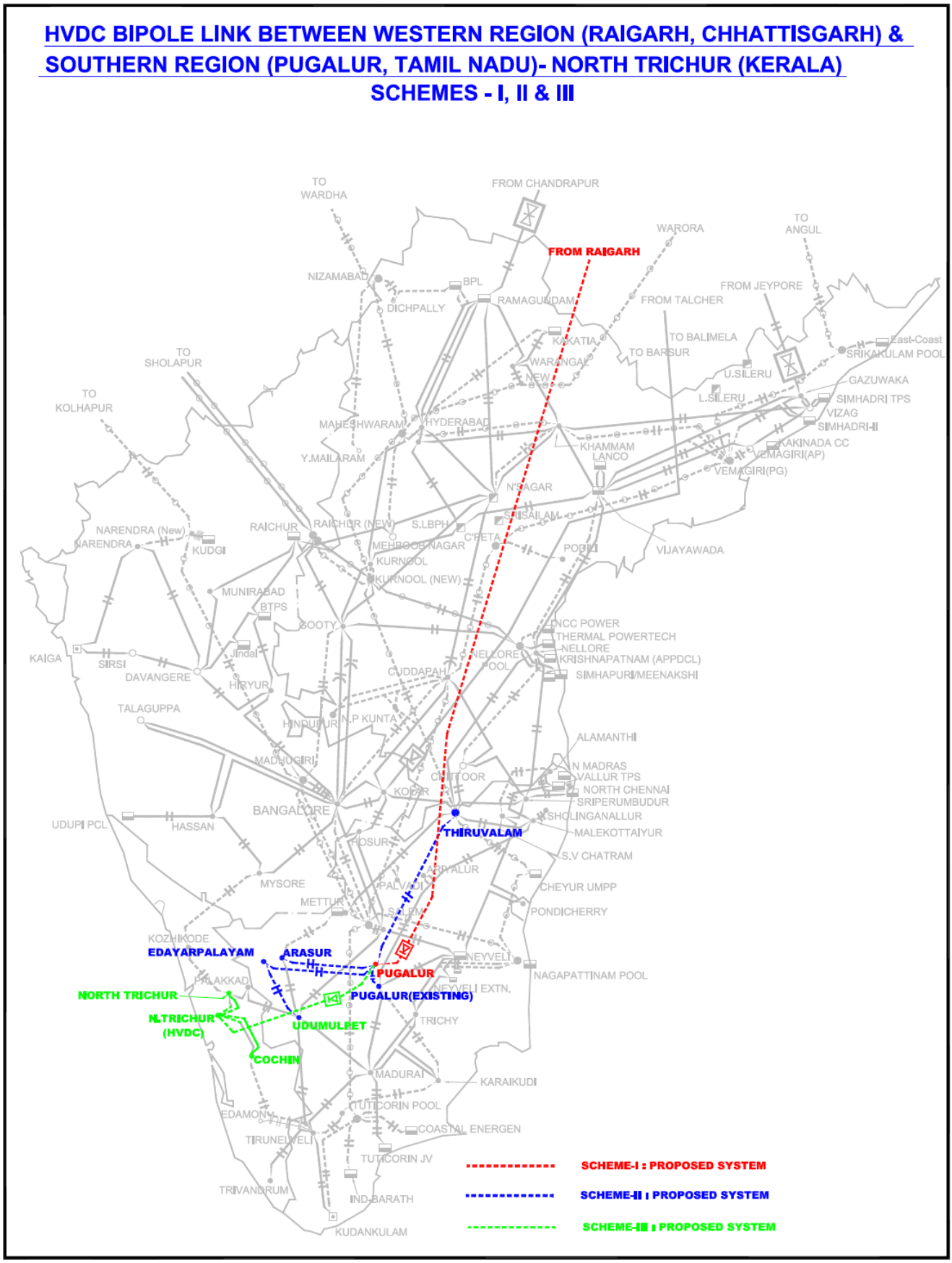

Figure 1: Schematic Showing the Transmission Grid of Southern Region highlighting the Proposed lines under Scheme II

SECTION - IV: BASELINE ENVIRONMENT

The proposed scheme is located Tamil Nadu State covering Coimbatore, Tirupur, Karur, Namakkal, Erode, Salem, Dharmapuri, Thiruvanamalai & Vellore districts. The basic environmental and social settings of the State and subproject districts in particular are discussed in this section.

4.1 PHYSICAL RESOURCES

4.1.1 Physiography, Landuse and Demography

Tamil Nadu is situated on the south-eastern side of the Indian peninsula. It is bounded on the east by Bay of Bengal, in the south by the Indian Ocean, in the west by the states of Kerala and Karnataka and in the north by the Karnataka and Andhra Pradesh. Tamil Nadu has a geographic area of 130,058 sq. km, which constitutes 3.96% of the land area of the country. It lies between 08°04' N and 13°34' N latitude and 76°14'E and 80°21'E longitude.

Physiographically the state can be divided into two natural divisions: the eastern coastal plain and the hilly region along the north and the west. Along the whole length of the western part, at a distance from the sea varying from 80 to 160 km runs the range of the Western Ghats, a steep and rugged mass averaging 1220 meters above the sea level and rising to 2440 metres at the highest point. The slopes of the Western Ghats are covered with heavy evergreen forests. The Nilgiris and the Anamalai are the hill groups with the maximum height. The general land use pattern of the State is given in **Table 4.1.**

Table 4.1: Landuse Pattern

Land use	Area in '000 ha	Percentage
Total Geographical area	13,006	
Reporting Area for land utilization	13,033	100.00
Forests	2,125	16.31
Not available for cultivation	2,672	20.50
Permanent Pasture & Grazing land	110	0.84
Land under misc. tree crops & groves	250	1.91
Culturable waste land	328	2.52
Fallow land & other than current fallows	1,696	13.01
Current fallows	1,308	10.04
Net area Sown	4,544	34.87

Source: Landuse Statistics, Ministry of Agriculture, GOI, 2012-13

Coimbatore district lies between 10°10"-11°30" N latitude and between 76° 40"-77°30" E longitude. It has an area of 7469 sq km and is bounded by the Nilgiris on the north, Erode district on the east, Dindigal district on the south and the State of Kerala on the west.

Tiruppur district has been carved out of Coimbatore and Erode districts in the year 2008. The district has total geographical area of 5186.34 sq km and lies between 11°06′27″N-11°10′75″N latitude and 77°20′23″E-77°33′98″E longitude. Tiruppur district is bounded by Coimbatore district in the west side, Erode district to the north and northeast side and Karur district in the east side and Dindigul district in the south east side and to the south side, it is surrounded by Idukki district of Kerala.

Karur district lies between 11°00′N-12°00′N latitude and 77°28′E-77°50′E longitude. The district has a total geographic area of 2895.57 sq. km. and is surrounded by Erode district in the east,

Tiruchirapalli district in the west, Namakkal district in the north and by Dindigul district in the south.

Namakkal district was created by bifurcating the erstwhile Salem district and created in 1997. The geographical area of the district is 3363.35 sq km and lies between 11°13′-11°36′N latitude and 77°28′-78°30′E longitude. The district is bounded by Perambalur & Salem districts in the east, Erode district in the west, Salem district in the west & Karur district in the south.

Erode district lies on the extreme north of Tamil Nadu having geographical area of 5722 sq km and is located between 10°36′N-11°58′N latitude and 76°49′E-77°58′E longitude. The district is surrounded by Karnataka state in north-west, Coimbatore district in the west, Dindugal district and Karur District in the south and Salem and Namakkal district in the east.

Salem district is located between 11°14′N-12°53′N latitude and 77°44′E-78°50′E longitude with a total geographic area of 5237 sq kms. Salem District is bordered by the districts of Dharmapuri in the north, Erode in the west, Namakkal in the south, Perambalur in the south and south-east and Viluppuram in the east.

Dharmapuri district lies between 11°47′N-12°33′N latitude and 77°28′E-76°45′E longitude and has a geographic area of 9622 sq kms. The district is surrounded by Vellore, Villupuram and Thiruvannamalai districts in the east, by Erode district and the state of Karnataka in the west, by Andhra Pradesh and Karnataka state in the north and by Salem district in the south.

Tiruvannamalai came into existence as a separate district of Tamil Nadu on 30th Sept. 1989 by the bifurcation of the erstwhile North Arcot District. It is located between 11°55′N -13°15′N latitude and 78°20′E-76°45′E longitude and has a geographic area of 9622 sq km. The district is bounded on the north and west by Vellore District, on the south-west by Krishnagiri district, on the south by Villupuram district and on the east by Kanchipuram district.

Vellore district lies between 12° 15’ -13° 15’N latitude and 78° 20’ - 79° 50’E longitudes in Tamilnadu State. The geographical area of this district is 6077 sq km. It is bounded on north by Chittoor district of Andhra Pradesh, on the south by Thiruvannamalai district and on the west by Krishnagiri district, and on the east by Thiruvallr and Kanchipuram districts. The western parts of the district are endowed with pleasing hilly sceneries like Yelagiri Hills while the Eastern side of the District is mostly covered by rocky bases.

4.1.2 Meteorology and Climate

The climate of Tamil Nadu is characterized as tropical with little variation in summer and winter temperatures. The hottest period is April-June, with the temperature rising up to 40°C. November-February is the coolest period with average temperature hovering around 20°C. Tamil Nadu gets its rain from North-East Monsoons between October and December. The average annual rainfall in Tamil Nadu ranges between 635-1905 mm. The coastal region of Tamil Nadu becomes uncomfortably warm and humid during summers; however, nights are cool and pleasant due to sea breezes.

Coimbatore district has a pleasant climate with mild winter and moderate summer. During summer, the maximum temperature goes up to 34.7°C, while minimum temperature hovers around 21°C. In winters, the recorded maximum and minimum temperatures are 32.2°C and 19.2°C respectively. Rainy season extends from September to November. Average annual rainfall is 61.22 cms.

Tirupur has a salubrious climate, which prevents temperature going to extreme levels. March, April and may are summer months. Temperature ranges from 29°C - 35°C, which is much lower than the rest of Tamil Nadu. Monsoon season consisting of months of June, July and August is characterized by mild showers and a fall in temperature. The average annual rainfall of the district is 700 mm. September to January is considered as winter months. Maximum

temperature during winter is 29°C, while minimum is 24°C. In the months of October and Early November, some rainfall occurs due to North-East Monsoon.

Karur district enjoys a tropical climate. The period from March to May is generally hot and dry. The mean maximum temperature ranges from 26.7 to 38.56 °C and the mean minimum temperature ranges from 18.7 °C to 29.3 °C. The district receives the rain under the influence of both Southwest and Northeast monsoons. The Northeast monsoon chiefly contributes to the rainfall in the district. Most of the precipitation occurs in the form of cyclonic storms caused due to the depressions in Bay of Bengal. The average annual rainfall over the district varies from about 620 mm to 745 mm.

Namakkal district also enjoys a tropical climate. The hot weather begins early in March, the highest temperature being felt in April and May. Weather cools down progressively from about the middle of June and by December. The district receives most of the precipitation in the form of cyclonic storms caused due to the depressions in Bay of Bengal. The Southwest monsoon rainfall is highly erratic and summer rains are negligible. The normal annual rainfall over the district varies from 640 mm to 880 mm.

Erode district in general is characterized with a scanty rainfall and a dry climate. The district has dry weather throughout the year except during the monsoon season. The hot weather begins early in March, the highest temperature being reached in April and May with temperature of 40°C. The district in general is characterized with a scanty rainfall and a dry climate. The normal annual rainfall over the district varies from about 575 mm to about 833 mm. The western part of the Erode district enjoys a salubrious climate because of the hilly region.

Salem district enjoys a tropical climate. The weather is pleasant during the period from November to January. In the period June to November the afternoon humidity exceeds 60% on an average. The hot weather begins early in March, the highest temperature is being reached in April and May. From the middle of June and by December, the mean daily maximum temperature drops to 30.2°C, while the mean daily minimum drops to 19.2°C. The district receives the rain under the influence of both Southwest and Northeast monsoons. The normal annual rainfall over the district varies from about 800 mm to 1600 mm. The Normal Rainfall of the district during Southwest monsoon is 380 mm and during Northeast monsoon is 347 mm.

The climate of the Dharmapuri District is generally warm. The hottest period of the year is generally from the months of March to May, the highest temperature going up to 38°C in April. The Climate becomes cool in December and continuous so up to February, touching a minimum of 17° C in January. On an average the District receives an annual rainfall of 895.56 mm. The normal annual rainfall over the district varies from about 760 mm to about 910 mm.

Tiruvannamalai experiences hot and dry weather throughout the year. The temperature ranges from a maximum of 40 °C to a minimum of 20 °C. Like the rest of the state, April to June are the hottest months and December to January are the coldest. The district receives scanty rainfall with an average of 815 mm (32.1 in) annually, which is lesser than the state average of 1,008 mm (39.7 in). The southwest monsoon with an onset in June and lasting up to August brings scanty rainfall. Bulk of the rainfall is received during the northeast monsoon in the months of October, November and December. The average humidity of the town is 77% and varies between 67% to 86%. During the summer months of April to June, the humidity ranges from 47–63%.

Vellore district experiences a moderately tropical climate. Summer arrives in the month of April and persists till June. The days are hotter. Nights are relatively cooler with a sudden drop in temperature in the evening due to the sea breeze. Vellore experiences hot and dry weather throughout the year. During summer maximum temperature is 39.8°C and minimum is 29.4°C, During winter the maximum temperature is 27.3°C and minimum is 17.9°C. The average annual rainfall is 795mm, out of which Northeast monsoon contributes to 535mm and the Southwest monsoon contributed to 442mm. The bulk of the rainfall is received during the

Northeast monsoon in October, November and December. The humidity ranges from 40%–63% during summer and 67%–86% during winter.

4.1.3 Minerals and Soils

***Minerals**:* Tamil Nadu is the leading holder of country's resources of vermiculite, magnetite, dunite, rutile, garnet, molybdenum and ilmenite. The State accounts for the country's 81% lignite, 75% vermiculite, 69% dunite, 59% garnet, 52% molybdenum and 30% titanium minerals resources. Important minerals and their places of occurrence are given Table 4.2 and shown in Figure 2.

Table 4.2: Important Minerals and Their Locations in Project Areas

S. N.	Mineral	Districts/Places of Occurrence
1	Bauxite	Dindigul, Namakkal, Nilgiris, Salem
2	Feldspar	Coimbatore, Dindigul, Erode, Kanchipuram, Karur, Namakkal, Salem, Tiruchirapalli
3	Fireclay	Cuddalore, Kanchipuram, Perambalur, Pudukottai, Sivaganga, Tiruchirapalli, Vellore, Villupuram
4	Granite	Dharmapuri, Erode, Kanchipuram, Madurai, Salem, Thiruvannamalai, Tiruchirapalli, Tirunelveli, Vellore, Villupuram
5	Graphite	Madurai, Ramnathapuram, Shivganga, Vellore
6	Gypsum	Coimbatore, Perambalur, Ramnathapuram, Tiruchirapalli, Thoothukudi, Virudhunagar
7	Lignite	Cuddalore, Thanjavur, Thiruvarur, Nagapattinam, Ramnathapuram
8	Limestone	Coimbatore, Cuddalore, Dindigul, Kanchipuram, Karur, Madurai, Nagapattinum, Namakkal, Perambalur, Ramnathapuram, Vellore,
9	Dunite	Salem
10	Lignite	Cuddalore, Thanjavur, Thiruvarur, Nagapattinum, Ramnathapuram
11	Vermiculite	Dharmapuri, Tiruchirapalli, Vellore
12	Garnet	Ramnathpuram, Tiruchirapalli, Tiruvarur, Kanyakumari, Thanjavur, Tirunelveli
13	Molybdenum	Dharmapuri, Dindigul, Vellore
14	Titanium	Kanyakumari, Nagapattinum, Ramnathapuram, Thiruvallur, Tirunelveli, Thoothukudi

Figure 2: Important Minerals and Their Locations in Project Areas

Soil: The major soil groups of Tamil Nadu are Red soil (62%), Black soil (12%), Laterite soil (3%) and Coastal soil (7%). As per USDA system of soil classification, the soils of Tamil Nadu are divided into six orders, out of which around 50% of total area of Tamil Nadu is occupied by Inceptisol followed by Alfisols, which occupy 30% of total state area. Vertisols cover around 7% of total state's area, Entisols cover 6% and Ultisols cover 1% of total area. Mollisols cover negligible area of Tamil Nadu.

The soils of Coimbatore district can be broadly classified into 6 major soils types viz., Red calcareous Soil, Black Soil, Red non-calcareous, Alluvial and Colluvial Soil, Brown Soil, and Forest Soil. About 60 per cent of the district is covered by red soils, of which red calcareous soil is predominant.

In Tirupur district, Black soils and Red soils are the major soil types. These two soil types occupy about 96% of total area, with rest 4% shared by other soils.

In Karur, Black soil is the predominant soil type in this district accounting for 35.51% followed by lateritic Soil for 23.85%. The other type of soil is sandy, coastal alluvium for 20.31%.

The soils of Namakkal district can be broadly classified into 5 major soils types viz., Red Soil, Black Soil, Brown soil, Alluvial and Mixed Soil. Major part of the district covered by Red Soil. Mixed soil is the second major soil type occurring in the districts.

The soils of Erode district can be broadly classified into 6 major soils types viz., Red calcareous soil, Red non calcareous soil, Black Soil, Alluvial and Colluvial soils, Brown soil and Forest soil. Major part of the district covered by red calcareous soils. They are mostly sandy to loamy and characterized by the hard and compact layer of lime.

The soil type in Salem district is mostly Red soil, of which Non-Calcareous soil predominant occupying 66.3% of total area of the district. The next type is Red calcareous with 29.3 per cent followed by Black (3.8%) and Alluvial deposits (0.6%).

The soils of Dharmapuri district can be classified into i) Red Soil, ii) Red lateritic soil, (iii) Brown soil and iv) alluvial soil. The soils of the district are mostly in-situ in nature, lateritic, earthy and pale reddish in colour.

The predominant soil type found in Thiruvannamalai district is red loam. Different types of soils like ferrogeneous loamy and sandy loamy are also found extensively in the district. The others major soil types are laterite soil and black soil.

Soils of Vellore district can be classified into 1) Sandy soil 2) Sandy loam 3) Red loam 4) Clay 5) Clayey loam and 6) Black cotton soils. The predominant soil types found in Vellore district is red loam constituting 47.6 % of total geographical area.

4.1.4 Water Resources

Surface Water*:* The total surface water potential of the state is 24864 Million Cubic Metres (MCM). There are 17 major river basins in the State with 61 reservoirs and about 41,948 tanks. Of the annual water potential of 46540 MCM, surface flows account for about half. The rivers of the state flow eastward from the Western Ghats and are entirely rain-fed. The 760 kms long Kaveri River is the longest river of Tamil Nadu. This river is popularly called the "Ganga of the South" or the "Dakshina Ganga" and divides the state in two halves. The other important rivers of the state are Palar, Cheyyar, Ponniyar, Meyar, Bhavani, Amaravati, Vaigai, Chittar and Tamaraparni, Noyil, Suruli, Gundar, Vaipar, Valparai and Varshali.

The major rivers in subprojects area districts are Kaveri, Palar, Ponnaiyar, Bhavani, Noyyal, Amaravathi, Aliyar, Vellar, Nallar etc.

Ground Water*:* The utilizable groundwater recharge in the state is 22,423 MCM. The current level of utilization expressed as net ground water draft of 13.558 MCM is about 60 percent of

the available recharge, while 8875 MCM (40 percent) is the balance available for use. Over the last five years, the percentage of safe blocks has declined from 35.6 per cent to 25.2 percent while the semi-critical blocks have gone up by a similar percentage. Over-exploitation has already occurred in more than a third of the blocks (35.8 percent) while eight blocks (2 percent) have turned saline. The water level data reveals that the depth of the wells ranges from an average of 0.93 metres in Pudukottai district to 43.43 metres in Erode. According to the Central Groundwater Board, there has been a general decline in groundwater level in 2003 due to the complete de-saturation of shallow aquifers.

The net groundwater availability for Coimbatore district is 792.874 MCM, whereas, existing Gross draft for all uses currently stands at 821.102 MCM, which indicates 104% groundwater development. The estimation of groundwater resources for the district has shown that out of 19 blocks, 11 blocks are overexploited and 4 blocks are under critical category.

The ground water scenario in Tirupur district also not good and requires attention. Out of 13 blocks of the district, 1 block falls in Over-Exploited category and 3 blocks fall in critical category, while 8 blocks are categorized as Semi-critical. Only 1 block is falling under Safe category.

The annual replenishable ground water resources of Karur district stand at 321.45 MCM, while net annual Ground Water draft is 220.15 MCM, which corresponds to 68.5% ground water development. Out of 8 blocks of the district, 2 falls in Over Exploited category, while 2 others are categorized as semi critical.

In Erode district, the total quantity of annual replenishable ground water is 769.62 MCM, while net annual ground water draft is 1268.26 MCM. This indicates 135.29% development of ground water. Out of 20 blocks of the district, 3 are categorized as Over Exploited, 4 blocks as critical and 1 block as semi critical.

In Namakkal district, the total quantity of annual replenishable ground water is 493.51 MCM, while net annual ground water draft is 514.31 MCM. This indicates 104% development of ground water. Out of the 15 blocks of the district, 8 blocks are categorized as over exploited and 2 blocks are under critical category.

The net groundwater availability for Salem district is 855.12 MCM, whereas, existing gross draft for all uses currently stands at 1268.26 MCM, which indicates 148% groundwater development. The estimation of groundwater resources for the district has shown that out of 20 blocks, 14 blocks are overexploited and 1 block is under critical category.

Similarly, the net groundwater availability for Dharmapuri district is 496 MCM, whereas, existing gross draft for all uses currently stands at 737.69 MCM, which indicates 149% groundwater development. The estimation of groundwater resources for the district has shown that out of total 8 blocks, 7 blocks are overexploited and 1 block is under critical category.

In Thiruvannamalai district, the estimated total quantity of annual replenishable ground water is 1439.7 MCM, while net annual ground water draft is 1538.5 MCM which indicates 107% development of ground water. Out of the 18 blocks in the district, 8 blocks are categorized as over exploited, 2 blocks are in critical and 5 blocks are under critical category.

In Vellore district, the total quantity of annual replenishable ground water is 984.84 MCM, while net annual ground water draft is 1377.74 MCM which indicates 149% development of ground water. Out of the 20 blocks of the district, 16 blocks are categorized as over exploited and 1 blocks are under critical category.

4.2 ECOLOGICAL ENVIRONMENT

Forests: The recorded forest area is 22,877 sq. km which constitutes 17.59% of the geographic area of the State. According to legal status, Reserved Forests constitute 84.70% (20,293 sq km), Protected Forests constitute 7.9% (1,782 sq km) and Un-classed Forests constitute 3.50% (802 sq km) of the total forest area. Forest Map of Tamil Nadu is shown in

Figure 3. Tamil Nadu's forests are largely deciduous and thorn types and these two major types account for 87.30 % of the total forest area. Based on interpretation of satellite data, total forest cover is 23,844 sq. km which is 18.33% of State's geographical area. In terms of forest canopy density classes, the State has 2,948 sq. km of very dense forest, 10,199 sq. km of moderately dense forest and 10,697 sq. km of open forest.

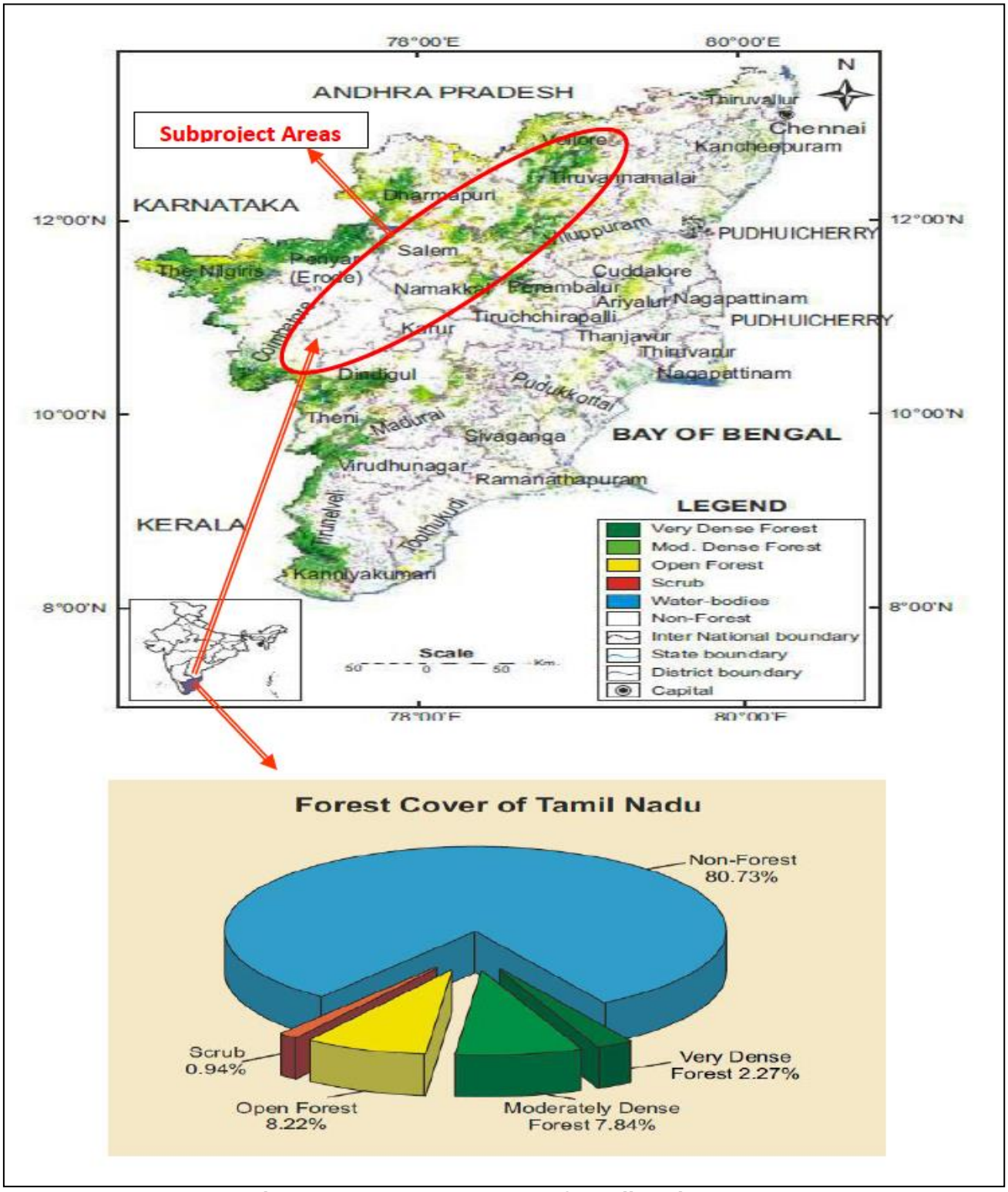

Figure 3: Forest Cover Map of Tamil Nadu State

The proposed transmission lines shall pass through 8 districts of Tamil Nadu having 4.17% and 35.17% respectively. Although forest involvements in the most of the lines are completely avoided through adopting careful route selection technique, some forest stretch (approx. 5 km, 23 ha) could not be avoided in case of 400kV Pugalur- Thiruvalam line due to geographical constraints. The details of forest resources available in the subproject area districts are as presented in Table 4.3.

Table 4.3: Details of Forest Resources available in the Subproject Area Districts

District	Geographic area	(Area in Sq. km)				% Forest cover
		Very Dense forest	Mod. Dense forest	Open forest	Total	
Coimbatore*	7,469	377	943	1,307	2,627	35.17
Erode*	8,209	485	1,285	651	2,421	29.49
Karur	2,901	0	34	87	121	4.17
Namakkal	3,413	54	211	309	574	16.82
Salem	5,235	130	479	826	1,435	27.41
Dharmapuri	9,622	271	1,436	1,573	3,280	34.09
Thiruvanamalai	6,191	174	493	632	1,299	20.98
Vellore	6,077	187	680	990	1,857	30.56

Source: Indian State of Forest Report, 2015

** Tiruppur district was earlier part of Erode and Coimbatore districts*

Protected Areas: The protected areas of Tamil Nadu extend to 6,708 km² constituting 5.16% of the geographic area and 29% of the recorded forest area. Tamil Nadu ranks 14th among all the States and Union Territories of India in terms of protected area. There are 14 Wildlife sanctuaries over 5,707.13 sq. km. and 14 bird sanctuaries over 173.34 sq. km., 5 National Parks over 827.63 sq. km., 4 Tiger Reserves, 4 Elephant Reserves and 3 Biosphere Reserves for in situ conservation of wild fauna and flora. There is one Conservation Reserve in Tamil Nadu. List of protected areas in subproject districts are shown in Table 4.4

Table 4.4: Details of Protected Areas in the Subproject Area Districts

Sl. No	Name of Protected Areas	Year of Establishment	Area (sq km)	District(s)
National Parks (NP)				
1.	Indira Gandhi (Annamalai)	1989	117.10	Coimbatore
Wildlife Sanctuaries (WLS)				
2.	Indira Gandhi (Annamalai)	1976	841.49	Coimbatore
3.	Satyamangalam	2008	524.35	Erode
4.	Vellode	1997	0.77	Erode
5.	Cauvery North	2014	504.33	Dharmapuri

As evident from the above list that five protected areas are located in the subproject districts. However, all these protected areas are completely avoided, while selecting the route of the proposed lines.

Wetlands: The total wetland area of the state is estimated around 902534 ha. (including 18,294 small wetlands of size <2.25 Ha. each) which is 6.92% of the state's geographic area. Major wetland types are Lake/Pond (316091 Ha.), Tank/Pond (237613 Ha.), River/Stream (136878 Ha) and Reservoir/Barrage (56419 Ha). The districts where the present subprojects are envisaged have the wetlands coverage as shown in Table 4.5. *However, none of these wetlands are getting impacted by the routing/RoW of proposed lines.*

Table 4.5: Details of Wetlands in the Subproject Area Districts

District	Geographical area (sq.km.)	Wetland area (Ha.)	% of total wetland area (Ha.)	% of district geographic area
Coimbatore*	7,469	8,070	0.89	1.08
Erode*	8,162	13,570	1.50	1.66
Karur	2,896	16,383	1.82	5.66
Namakkal	3,363	7,687	0.85	2.29
Salem	5,205	15,270	1.69	2.93
Dharmapuri	4,498	18,215	2.02	4.05
Thiruvanamalai	6,191	48,130	5.33	7.77
Vellore	6,077	32,640	3.62	5.37

Source: National Wetland Atlas

** Tiruppur district was earlier part of Erode and Coimbatore districts*

4.3 SOCIO-ECONOMIC ENVIRONMENT

4.3.1 Demographical Features

As per 2011 census, the total population of Coimbatore district is 34,58,045, which constitute 4.79% of the state's population. The district has a population density of 460 persons per square km. The Sex ratio of the district stands at 1000 females for every 1000 males, which is better than the corresponding national figure. The Literacy rate of the district is 83.98%, higher than national literacy average. Around 15.5% population belongs to Schedule Castes and just 0.82% population belongs to Schedule Tribes. Though, the economy of Coimbatore district is mainly driven by industries, Agriculture is still one of the main sources of livelihood in the district with more than 3,00,000 people are engaged in it, either as cultivators or as labourers. Sorghum, Groundnut, Rivce, maize are the main crops of the district. Tomato, Tapoica, Onion, Brinjal and Bhendi are the major vegetables grown in the district. Banana is the main fruit grown in the district followed by Mango, Grapes, Sapota and Amla. Coconut is the prominent cash crop of the district, while Tea, Coffee and cotton also provide cash income in the hands of the farmers. Coimbatore is one of the most industrialized districts of Tamil Nadu. There are more than 25,000 small, medium and large sale industries. Coimbatore houses a large number of small and medium textile mills. It also has central Textile research institutes, such as South India Textile Research Association. Some of the major industries present in Coimbatore are PSG, Sakthi group of Industries, Larsen and Toubro, Lakshmi Machine Works (LMW), Premier Instruments & Control Limited (PRICOL), Premier Evolvics, ELGI Equipments, Shanti Gears, Roots Industries Ltd etc. Coimbatore is also called as the Pump City. The Major Pump industries present in the district such as Suguna pumps, Sharp Industries, CRI Pumps, Texmo Industries, Deccan Pumps & KSB Pumps are renowned worldwide. Coimbatore is also emerging as an IT and BPO city with the presence of companies like Tata Consultancy Services, Cognizant Technology, CSS Corp etc. The city also houses numerous jewelers engaged in jewellery exports and a few Wind Energy Companies.

The total population of Tirupur district is 24,79,052 which forms 3.44% of the state's population(As per 2011 census). About 38.64% of district's population lives in rural areas. The district has a population density of 478 persons per square km. The Sex ratio of the district stands at 989 females for every 1000 males, which is better than the corresponding national figure. The Literacy rate of the district is 78.68%, higher than national literacy average. Around 15.97% population belongs to Schedule Castes and just 0.22% population belongs to Schedule Tribes. Though, Tirupur is largely an industrial district, Agriculture still plays an important role in its economy. In Tirupur, majority of farmers belong to small and marginal category and they play a critical role in ensuring agricultural productivity of the district. The total area of cultivation is around 2,28,556 ha., mainly for food and commercial crops. The chief food crops of the district are paddy, millets and pulses, while cotton, oil seeds and coconut are main non food commercial crops. Coconut is one of the most important plantation crops, which occupies around 16.10% of the total cultivated area. Mango, Banana, Amla and

Guava are the main fruits grown in the district. The economy of the district is largely driven by industries specially those belonging to textile sector. There are 7068 registered industrial units in the district, out of which 69 belong to Medium and Large scale. There are 7 Industrial Areas in the district. Textile has been the back bone of the economy of the district. It is due its textile sector, Tirupur became world famous and popularly known as T-shirt town of India. There are 6250 textile based industries in the district, out of which 1500 are knitting units. Huge numbers of direct and indirect employment is generated due to textile industries in the district.

According to 2011 census, total population of Karur district is 1,076,588 which constitutes 1.48 % of the state's population. Out of the total population, 59.18 % population lives in rural areas & 40.82 % lives in urban regions of district. The district has a population density of 367 persons per square km. With a sex-ratio of 1,015 females for every 1,000 males, the district stands much above the national average of 929. Scheduled Castes and Scheduled Tribes accounted for 20.8% and 0.05% of the population respectively. The average literacy of the district was 68.3%, compared to the national average of 72.99%. The district had a total of 287,095 households. There were a total of 543,298 workers, comprising 83,800 cultivators, 182,639 main agricultural labourers, 10,162 in house hold industries, 231,906 other workers, 34,791 marginal workers, 2,072 marginal cultivators, 18,198 marginal agricultural labourers, 1,178 marginal workers in household industries and 13,343 other marginal workers. Karur District is a part of cauvery delta region and utilization of land area in the district is up to 44.59%. 45% of land in Karur is used for agricultural activities to produce Paddy, Banana, Sugarcane, Beetle Leaf, Grams & Pulses, Tapioca, Kora grass, Groundnuts, Oilseeds, Tropical vegetables, Garland flowers, and Medicinal herbs. Karur contributes USD 1.1 billion in GDP of Tamil Nadu. Service industry has been playing a vital role in the economy of this District. It has contributed 67% to the district's GDP in 2011-12. Karur is famous for its home textiles. Maximum units have been established in Textile & Apparels Based category followed by Chemicals & Petro Chemicals units. Karur has a niche in five major product groups — bed linens, kitchen linens, toilet linens, table linens and wall hangings. Overall Karur generates around Rs.6000 crores in foreign exchange through direct and indirect exports. Allied industries like ginning and spinning mills, dyeing factories, weaving etc., employs around 450,000 people in and around Karur. Karur District is renowned for its Bus Body building industry throughout South India. The presence of 200 builders of Bus body in the region attracts the investments in Automobile sector.

As per 2011 census, Namakkal district has a population of 1,726,601 which is 2.39% of State's population. Out of the total population, 59.68 % population lives in rural areas & 40.32 % lives in urban regions of district. The district has a population density of 367 persons per square km.. The district has a sex-ratio of 986 females for every 1,000 males, much above the national average of 929. Scheduled Castes and Scheduled Tribes accounted for 20.% and 3.3% of the population respectively. The average literacy of the district was 68.12%, compared to the national average of 72.99%. The district had a total of 475,511 households. There were a total of 898,245 workers, comprising 152,497 cultivators, 228,614 main agricultural labourers, 35,156 in house hold industries, 422,885 other workers, 59,093 marginal workers, 5,976 marginal cultivators, 25,112 marginal agricultural labourers, 3,641 marginal workers in household industries and 24,364 other marginal workers. The main occupation in the district is agriculture. The cultivation generally depends on monsoon rains. Nearly 90 percent of the cultivated area is under food crops. The principal cereal crops of this district are paddy, Cholam, cumnu and ragi. Panivaragu, Kuthiraivali, Samai Varagu and Thinai are some of themillets cultivated. Among pulses, the major crops redgram, blackgram, greengram and horsegram. Among oil, seeds, groundnut, castor, and gingelly (sesame) occupy important places. Of the commercial crops, sugarcane, cotton and tapioca are some of the important crops. Namakkal finds a place of importance in the map of India because of its Lorry body building industry, a unique feature of the town. More than 150 Lorry body building workshops and with a number of subsidiary industries of auto body works are operating since 1960's. There are Lorries, Trailers and L.P.G. Tanker Lorries. Therefore it is called as "Transport City". Finished trucks and Rig Units are even exported to foreign countries from Namakkal. Nearly 25000 people are employed, both directly and indirectly, in truck body building activity and about 300 units in Namakkal and 100 Units in Tiruchengode are engaged in this activity. Besides, Poultry development has been rather phenomenal in the district of Namakkal. The

district is also well known for its poultry and dairy industries, accounting for a bulk of supply of poultry products to neighbouring industries. In fact, Namakkal produces about 65% of the egg output of Tamil Nadu. Hence, called as 'Egg City'. There are 21457 registered industrial units in the district, out of which 80 belong to Medium and Large scale. There are 2 Industrial Areas in the district. It is one of the most vital and vibrant districts in terms of Industrial development in the state. The district provides enough scope for the development and growth of Industries engaged in the textile garments, Power loom, Automobile body building, Poultry Feed, Sago manufacturing and Rig Manufacturing unit.

According to 2011 census, total population of Erode district is of 2,251,744 which form 3.12% of State's population. Out of the total population, 48.57 % population lives in rural areas & 51.43 % lives in urban regions of district. The district has a population density of 391 persons per square km.. The district has a sex-ratio of 993 females for every 1,000 males, much above the national average of 929. Scheduled Castes and Scheduled Tribes accounted for 16.41% and 0.97% of the population respectively. The average literacy of the district was 66.29%, compared to the national average of 72.99%. The district had a total of 658,071 households. There were a total of 1,195,773 workers, comprising 173,376 cultivators, 331,414 main agricultural labourers, 48,960 in house hold industries, 557,301 other workers, 84,722 marginal workers, 4,794 marginal cultivators, 38,798 marginal agricultural labourers, 5,362 marginal workers in household industries and 35,768 other marginal workers. Agriculture is the most important income source of the district. Paddy, plantain, silk, cotton, turmeric, coconut and sugarcane are some of the major products from agriculture and allied industries. Erode is also known as Turmeric city as it is an important market center for turmeric and produce around 43% total turmeric of the State. Erode district is also the leading producer of plantain, coconuts and white silk. The country's first automated silk reeling unit is located in the district at Gobichettipalayam. Bhavani & Chennimalai are well known for handloom powerloom textile products and ready-made garments. The district is also rich in its natural cattle wealth and has carved out an enviable position for itself in the field of dairy development industry in the State. The Tamil Nadu Milk Producers Federation has a milk collection center and processing plant at Erode from where pasturised milk is transported in cases to different parts of the State every day.. There are also three Poultry Extension centres in the district. There are at Chengampalli, Polavakalipalayam and Bhavani Sagar. In the Industrial map of Tamil Nadu, Erode district has a place of unique importance with 40.32% of population depending on non-agricultural sector. Industries and trade naturally occupy a place of prominence in the economy of the district. Industries that flourished in early days in the area were handloom weaving, carpet manufacturing, cart manufacturing, oil-pressing, brass vessel manufacturing etc. The cotton textile industry in Coimbatore and handloom industry in Erode district have encouraged the growth of various ancillary industries to meet the needs of the textile mills. There are a number of leather tanneries in Erode area. Large quantities of leather are brought here for tanning and later exported to foreign countries. The Government has also come forward to provide incentives to small enterprenuers. Industrial estates have been set up at Erode and other places where full facilities are offered to small industrialists. Small units have been set up here for the manufacture of steel furniture, nuller screen, etc.

Salem district has a population of 3,482,056 which forms 4.83% of State's population (2011census). Out of the total population of the district, 49.05 % population lives in rural areas & 50.95 % lives in urban regions. The district has a population density of 655 persons per square km.. The district has a sex-ratio of 954 females for every 1,000 males, much above the national average of 929. Scheduled Castes and Scheduled Tribes accounted for 16.67% and 3.43% of the population respectively. The average literacy of the district was 65.64%, compared to the national average of 72.99%. There were a total of 1,694,160 workers, comprising 247,011 cultivators, 396,158 main agricultural labourers, 132,700 in house hold industries, 785,161 other workers, 133,130 marginal workers, 9,993 marginal cultivators, 58,052 marginal agricultural labourers, 8,803 marginal workers in household industries and 56,282 other marginal workers. Agriculture is the main source of livelihood of the people in this district and about 70 % of the population is engaged in agriculture. The food crops are sown in more than 72 % of the cultivated land. The major food crops are paddy, cholam, cumbu, ragi, redgram, greengram, blackgram and horsegram Turmeric, sugarcane, mango, bannana, tapiaco, groundnut & gingelly, and the famous mango fruits are the cash crops. Paddy, jowar,

tapioca, sugarcane, groundnut and cotton are the major commercial crops & plantation crops like coffee, areca nut and betel vine. The district is rich in mineral deposits like Magnesite, Bauxite, Granite, Limestone, Quartz and Iron ore. Allied industries like Magnesite mining, Cement manufacture, bricks manufacture, Aluminum smelting etc thrive well. The Salem Steel Plant was an ambitious project started with a view to utilize the locally available iron-ore from Kanchamalai to produce steel. Now it is a public sector company engaged in rolling out cast steel blacks into sheets of required dimensions. It has many magnesite factories operated by private and public sectors such as Burn Standard & Co, Dalmia Magnesites and Tata Refractories, SAIL refractories. Rope making is another major cottage industry. Ropes are made by people out of the fibres of coconut, aloe, cotton and jute. Salem has a sizeable weaver population and weaving is an important house hold industry here. Both silk and cotton fabrics woven in Salem find popular market throughout the state. Making of silver ornaments and artifacts by hand work is an important cottage industry in Salem. The district has 48 Medium Scale Industries, 32,561 Small Scale Industries and 5826 Cottage Industries.

According to 2011 census, Dharmapuri district has a population of 1,506,843 which constitutes 2.09% of State's population. Out of the total population, 82.68 % population lives in rural areas & 17.32 % lives in urban regions of district. The district has a population density of 655 persons per square km.. The district has with a sex-ratio of 946 females for every 1,000 males, much above the national average of 929. . Scheduled Castes and Scheduled Tribes accounted for 16.29% and 4.18% of the population respectively. The average literacy of the district was 60.9%, compared to the national average of 72.99%.[3] The district had a total of 375,873 households. There were a total of 751,170 workers, comprising 191,080 cultivators, 217,062 main agricultural labourers, 11,308 in house hold industries, 233,546 other workers, 98,174 marginal workers, 10,248 marginal cultivators, 50,283 marginal agricultural labourers, 4,033 marginal workers in household industries and 33,610 other marginal workers. The district economy is mainly agrarian in nature. Nearly 70% of the workforce is dependent on agriculture and allied activities. The district is one among most backward and drought prone area in the state. It also forms a major horticultural belt in the state. As the area is drought – prone it has become essential to switch over to cultivation of drought tolerant perennial fruit crops in this district. Mango is the main horticulture crop of this District. It has the highest area under the fruit crops. The district accounts for nearly one-third area under mango and nearly one-half of the mango yield in the state. The district is an industrially backward one. However, after the formation of the SIPCOT industrial Complex in Hosur, a number of medium and large-scale units were started, most of them in and around Hosur. Presently 112 large-scale units are located in the district. Besides these, there were 10880 SSI units in the district. Besides, availability of huge granite reserves helped the growth of quarries and granite polishing industry in the district.

As per 2011 census, Thiruvannamalai district has a population of 2,464,875 which forms 3.42% of State's population. Out of the total population, 79.92% population lives in rural areas & 20.08 % lives in urban regions of district. The district has a population density of 655 persons per square km. The sex-ratio of 994 females for every 1,000 males, much above the national average of 929. Scheduled Castes and Scheduled Tribes accounted for 22.94% and 3.69% of the population respectively. The average literacy of the district is 66%, compared to the national average of 72.99%. The district has a total of 588,836 households. There are a total of 1,238,177 workers, comprising 265,183 cultivators, 351,310 main agricultural labourers, 37,020 in house hold industries, 316,559 other workers, 268,105 marginal workers, 27,458 marginal cultivators, 173,753 marginal agricultural labourers, 9,700 marginal workers in household industries and 57,194 other marginal workers. Tiruvannamalai district is known for its two major businesses, agriculture and silk saree weaving. Paddy, sugarcane and groundnut are the major crops grown in the district. Rice cultivation and processing is one of the biggest businesses in this district. The modern rice mill near Cheyyar is the biggest government owned mill and Arani has around 278 rice mills. Kalambur is also has around 20 Rice mills and known for variety of rice called Kalambur Ponni rice. Dairy farming is an important source of subsidiary income to small and marginal farmers. Poultry is also an important occupation. The district is suitable for promotion of floriculture. Chengam, Arni, Polur, Thandarampet, Cheyyar blocks are potential blocks to promote horticulture and floriculture activities. With such a high work force in agriculture and low work force engaged in industrial /

service front, the district has failed to achieve a high level of industrialization. The industrial activities are in low profile activities such as flourmills, silk reeling and footloose industries. The concentration of such traditional units is centred around Tiruvannamali, Polur and Arni. . Out of 6078 units concentrated in this district, 41 % are falling under the category of cottage and rural industries. Most of the units are based on local resources. Fruit, vegetable and floriculture are the major thrust sectors that are considered as sleeping giants in the district. The availability of rare herbs and medicinal plants in Jawadhu Hills and in melchengam offers promotion of medicinal extraction units in a big way. The concentration of neem trees in Thiruvannamalai and adjoining district of Villupuram offers promotion of neem based industries in this district. By and large, the district is suitable for promotion of agro-based industries. The construction of SIPCOT Complex is under way and it is hoped that it will attract huge investment opportunities in future

The population of Vellore district as per census 2011 was 3,936,331, with a density of 648 persons per square km. It constitutes 5.46% of State's population. Around 56.76% population lives in rural areas & 20.08 % lives in urban area. The district has a sex ratio of 1,007 females for every 1,000 males, much above the national average of 929. The average literacy of the district was 70.47%, compared to the national average of 72.99%. The district has 929,281 households. There are 1,689,330 workers, comprising 153,211 cultivators, 254,999 main agricultural labourers, 106,906 in household industries, 845,069 other workers, 329,145 marginal workers, 21,897 marginal cultivators, 136,956 marginal agricultural labourers, 29,509 marginal workers in household industries and 140,783 other marginal workers. The district is primarily agrarian with a majority of its population involved in agriculture. 56% of land in Vellore is used for agricultural activities to produce Paddy, Millets & other Cereals, Pulses, Sugarcane and Cotton. Vellore is one of the top producers of sugarcane and cocunut in the state. Oil seeds that are cultivated are groundnut, coconut, sunflower and gingelly. Vellore is among the top 10 contributors to GDP of the State, it contributes USD 3.8 billion in GDP of Tamil Nadu. Service industry has been playing a vital role in the economy of this district. It has contributed 56% to the district's GDP in 2011-12. Tertiary and Secondary sector are growing at the rate of 10.5% & 9%. The investments have been observed to be happening in Trade, Hotel & Restaurants, Banking & Insurance, Real estate, Construction and Manufacturing. The district is vibrant in terms of economic activity with leather and leather based industrial activity being the prominent ones. The district accounts for more than 37% of the country's leather export. Asia's biggest explosives manufacturing company, Tamil Nadu Explosives Limited (TEL), is in Vellore at Katpadi. This is India's only government explosives company with more than a thousand employees. BHEL - Boiler Auxiliaries Plant at Ranipet is a major heavy engineering unit of Tamil Nadu. There are three industrial estates: SIDCO at Katpadi, SIPCOT at Ranipet and SIDCO at Arakkonam. The government also plays an active role in promoting the same and hence further growth is expected in the leather industry. The district has seen significant growth in the past few years with around 3000 units established with an investment of $ 51 Million. Some of the prominent MSME clusters are leather, textile and handloom & safety match industries. The district also has 12 large scale and 300 medium scale industries.

4.3.2 Economic Development

Tamil Nadu has achieved reasonable economic growth in past few years. With a population of around 7, 21,47,030 as per 2011 census, it is one of the populous states of India. The population density is 555 per square km, which is higher than the national average. The sex ratio of the state is healthy 996 females per 1000 males, which is better than the corresponding national figure. People belonging to Schedule Castes constitute around 20% of total population, whereas, share of people belonging to Schedule Tribes is a miniscule 1.1%. The state enjoys a reasonably good literacy rate of 80.09% which is better than National Average of 74.04%. The Human Development Index of the state is 0.570, which also compares favorably with national average of 0.467.

Agriculture is the main source of livelihood with around 5139832 ha. of area under cultivation. http://www.webindia123.com/tamilnadu/images/teaplantations.jpgPaddy is the main crop. It is raised in three crops. The first crop is known as 'Kuruvali' (the short term crop) with a duration

of three and a half to four months from June - July to Oct-Nov. The second crop called 'Thaladi' has a duration of 5 to 6 months Oct -Nov to Feb -March. Third is 'Samba '(the long term) crop and has a duration of almost 6 months from Aug to January. Chief sources of irrigation are the rivers tanks and wells. Other major food crops are jowar, ragi, bajra, maize and pulses. Cotton, sugarcane, coconut, tea and coffee as well as a number of horticultural products like bananas and mangoes are cash crops while ground nuts, sesame, sun flower are important oil seeds crops. Major Industries in Tamil Nadu are cotton, heavy commercial vehicles, auto components, railway coaches, power pumps, leather tanning industries, cement, sugar, paper, automobiles and safety matches. Global auto majors Hyundai Motors, Ford, Hindustan Motors and Mitsubishi have commenced production plants. Ashok Leyland and TAFE have set up expansion plants in Chennai. The state is an important exporter of tanned skin and leather goods, yarn, tea, coffee, spices, engineering goods, tobacco, handicrafts and black granite. Tamil Nadu contributes to 60 per cent of the tannery industry in India. In recent times knowledge based industries like I.T. and Biotechnology have become the thrust area in the industrial scene in Tamil Nadu. TIDEL, a software technology park, has been established in Tharamani, Chennai. The software exports from the State during the year 2012-13 is expected to be around Rs. 50,000 crores with an impressive growth rate of more than 10%. Top I.T. and Telecom companies such as Nokia, Motorola, Foxcon, Flextronic and Dell have commenced production. Handloom is another important cottage industry. Silk sarees of Kancheepuram are famous all over India. Cottage units produce cotton sarees, dhoties, towels and lungies.

4.3.3 Historical and Cultural Values

The proposed project sites and the surrounding areas are generally rural areas. A preliminary assessment has been carried along the proposed alignments to identity presence of historical and cultural sites along the project facilities. Based on review of published information, walk over surveys, consultation with State Revenue authorities and Archaeological Survey of India (ASI), it is envisaged that no such monuments are coming in the proposed route alignments.

SECTION V: ANALYSIS OF ALTERNATIVES AND ROUTE/SITE SELECTION

Several alternatives were considered in the process of planning and design of the proposed project components. It includes route selections assessment and management process, evaluation of route alignments and sites for substations etc. as discussed on following sections.

5.1 ROUTE SELECTION - ASSESSMENT & MANAGEMENT PROCESS

At the system planning stage itself one of the factors that govern the evolution of system is the possible infringement with the forest. Wherever such infringements are substantial, different alternative options are considered. The route/ site selection criteria followed is detailed below:

While identifying the transmission system, preliminary route selection is done by POWERGRID based on the Survey of India Topo sheets, Forest Atlas (Govt. of India's Publication) and Google Maps etc. During route alignment all possible efforts are made to avoid the forest involvement completely or to keep it to the barest minimum, whenever it becomes unavoidable due to the geography of terrain or heavy cost involved in avoiding it. *Presence of protected areas like National Parks, Wildlife Sanctuaries and other ecological sensitive areas are verified by superimposing the proposed alternative alignment on the Protected Area Network Geospatial Map of Wildlife Institute of India (WII), GoI.*

5.1.1 Environmental Criteria for Route Selection

For selection of optimum route, the following points are taken into consideration:

(i) The route of the proposed transmission lines does not involve any human displacement/rehabilitation.
(ii) Any monument of cultural or historical importance is not affected by the route of the transmission line.
(iii) The proposed route of transmission line does not create any threat to the survival of any community with special reference to Tribal Community.
(iv) The proposed route of transmission line does not affect any public utility services like playgrounds, schools, other establishments etc.
(v) The line route does not pass through any National Parks, Sanctuaries etc.
(vi) The line route does not infringe with area of natural resources.

In order to achieve this, POWERGRID undertakes route selection for individual transmission line in close consultation with representatives of concerned Forest Department and the Department of Revenue. Although under the law, POWERGRID has the right of eminent domain yet alternative alignments are considered, keeping in mind, the above-mentioned factors during site selection**,** *with minor alterations often added to avoid environmentally sensitive areas and settlements at execution stage.*

- As a rule, alignments are generally cited away from major towns, whenever possible, to account for future urban expansion.
- Similarly, forests are avoided to the extent possible, and when it is 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 for both financial and environmental reasons.

In addition, care is also taken to avoid National parks, Sanctuaries, Eco-sensitive zones, Tiger reserves, Biosphere reserves, Elephant corridors and IBA sites etc. Keeping above in mind the routes of proposed lines under the project have been so aligned that it takes care of above factors. As such different alternatives for transmission lines were studied with the help of Govt. published data like Forest atlas, Survey of India and Google Maps etc.to arrive at most optimum route which can be taken up for detailed survey and assessment of environmental & social impacts for their proper management.

5.2 EVALUATION OF ALTERNATIVES ROUTES

Three different alternate routes/alignments (for each line) were evaluated the help of published data/maps and walkover survey to arrive at most optimum route for detailed survey. The evaluation involved analysis of various techno-economic as well as environmental and social safeguard parameters. These alternate alignments are shown in Figure 4 and discussed for each line individually in subsequent sections.

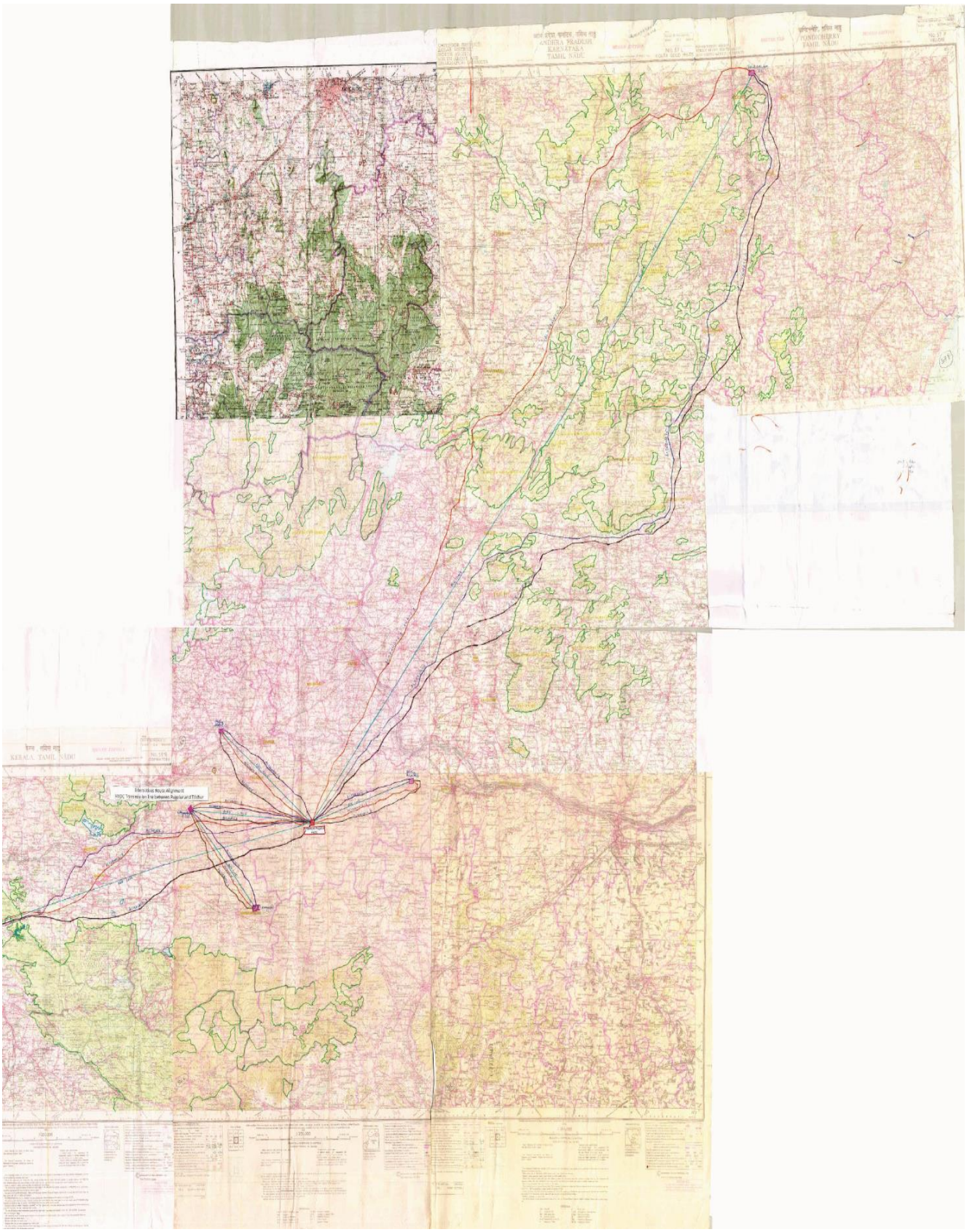

Figure 4: Map showing alternate alignments on toposhooet

5.2.1 Evaluation of Alternatives Route Alignment for 400 kV Pugalur- Pugalur Line

The comparative details of three alternatives in respect of the proposed 400 kV Pugalur-Pugalur Line is as detailed in Table 5.1.

Table 5.1: Comparative Details of three alternatives for 400 kV Pugalur- Pugalur Line

S.N	Description	Alternative-I	Alternative-II	Alternative-III
1.	**Route particulars**			
i.	Route Length (km)	58	55	60
ii.	Terrain			
	Hilly	Nil	Nil	Nil
	Plain	100%	100%	100%
2.	**Environmental impact**			
i.	Name of District(s) through which the line passes	Karur & Tirupur	Karur & Tirupur	Karur & Tirupur
ii.	Town in alignment	Kammarayakampatti Kodandur, Malaikovil, K.Paramatti	Kambaliyampatti, Vellakovil, Karukattu, Kunampatti, Munnur	Ollapalaiyam, Mulayampudi, Gudalur, Nedungur, Pavitram
iii.	House within RoW	Shall be ascertained after detailed survey	Shall be ascertained after detailed survey	Shall be ascertained after detailed survey
iv.	Forest involvement (km/ha.)	Nil	Nil	Nil
v.	Type of Forest (RF/PF)& whether part of Wildlife Area/ Elephant corridor/ Biodiversity Hotspots/ Biosphere Reserve/ Wetlands or any other environmentally sensitive area, if any	N.A	N.A	N.A
vi.	Density of Forest	N.A	N.A	N.A
vii.	Type of flora	Coconut (*Cocos nucifera*), Neem (*Azadirachta indica*), Areca Nut (*Areca catechu*), Papaya(*Carica papaya),* Banana (*Musa acuminate*)etc.	Coconut (*Cocos nucifera*), Neem (*Azadirachta indica*), Areca Nut (*Areca catechu*), Papaya(*Carica papaya),* Banana (*Musa acuminate*)etc.	Coconut (*Cocos nucifera*), Neem (*Azadirachta indica*), Areca Nut (*Areca catechu*), Papaya(*Carica papaya),* Banana (*Musa acuminate*) etc.
viii.	Type of fauna	Domestic species like Goat (Capra hircus), Sheep (Ovis aries), Cow (Bos indicus), Buffalo (Bubalus bubalis) etc.	Domestic species like Goat *(Capra hircus)*, Sheep *(Ovis aries),* Cow (*Bos indicus*), Buffalo *(Bubalus bubalis) etc.*	Domestic species like Goat *(Capra hircus)*, Sheep *(Ovis aries),* Cow (*Bos indicus*), Buffalo *(Bubalus bubalis) etc.*
ix.	Endangered species, if any	Nil	Nil	Nil
x.	Historical/cultural Monuments, if any	Nil	Nil	Nil
3.	**Compensation Cost:**			

S.N	Description	Alternative-I	Alternative-II	Alternative-III
i.	Crop (Non Forest)	290.00 lakhs (@ 5 lakhs/km)	275.00 lakhs (@ 5 lakhs/km)	300.00 lakhs (@ 5 lakhs/km)
ii.	Land for Tower Base & RoW Corridor	2007.17 lakhs	1903.00 lakhs	2076.00 lakhs
iii.	Forest (CA+NPV)	Nil	Nil	Nil
4.	**Major Crossings:**			
i.	Highway(NH/SH)	Nil	1(NH)	Nil
ii.	Power Line (Nos.)	5	4	5
iii.	Railway Line (Nos.)	Nil	Nil	Nil
	River Crossing(Nos.	1	Nil	1
5.	**Overall remarks**	Line length is more and also involves moderate RoW issues due to habitation area & river crossing.	Line length is less and involves relatively less ROW issues & fewer habitats.	Line length is longest and also involves moderate RoW problems due to proximity of habitation area & river crossing.

From the comparative analysis of three alternative routes, it is evident that none of the three alternative routes studied involves forest or wildlife area. However, Alternative-II is shorter in length and involves less RoW issues as the line is not passing through major habitation areas as compared to Alternative-I & III. Since the route length is shorter, it will involve minimum tree felling & lesser degree of environmental impact is anticipated. Hence, Alternative - I is considered as the most optimum route and recommended for detailed survey.

5.2.2 Evaluation of Alternatives Route Alignment for 400 kV Pugalur- Arasur Line

The comparative details of three alternatives in respect of the proposed 400 kV Pugalur-Arasur Line is as detailed in Table 5.2.

Table 5.2: Comparative Details of three alternatives for 400 kV Pugalur- Arasur Line

S.N	Description	Alternative-I	Alternative-II	Alternative-III
1.	**Route particulars**			
i.	Route Length (km)	58	60	62
ii.	Terrain			
	Hilly	Nil	Nil	Nil
	Plain	100%	100%	100%
2.	**Environmental impact**			
i.	Name of District(s) through which the line passes	Tirupur & Coimbatore	Tirupur & Coimbatore	Tirupur & Coimbatore
ii.	Town in alignment	Karumatampati, Palipalayam, Velampalayam, Palladam, Pongalur	Karumatampati, Mangalam, Tiruppur, Eilapalaiyam Avanashipalayam	Karumatampati, Soma-nur, Kalivelampatti, Vadugapalaiyam, Tayampalaiyam
iii.	House within RoW	Shall be ascertained after detailed survey	Shall be ascertained after detailed survey	Shall be ascertained after detailed survey
iv.	Forest involvement (km/ha.)	Nil	Nil	Nil

S.N	Description	Alternative-I	Alternative-II	Alternative-III
v.	Type of Forest (RF/PF)& whether part of Wildlife Area/ Elephant corridor/ Biodiversity Hotspots/ Biosphere Reserve/ Wetlands or any other environmentally sensitive area, ifany	N.A	N.A	N.A
vi.	Density of Forest	N.A	N.A	N.A
vii.	Type of flora	Coconut (*Cocos nucifera*), Neem (*Azadirachta indica*), Areca Nut (*Areca catechu*), Paddy (*Oryza sativa)*, Banana (*Musa acuminate*) etc.	Coconut (*Cocos nucifera*), Neem (*Azadirachta indica*), Areca Nut (*Areca catechu*), Paddy (*Oryza sativa)*, Banana (*Musa acuminate*) etc.	Coconut (*Cocos nucifera*), Neem (*Azadirachta indica*), Areca Nut (*Areca catechu*), Paddy (*Oryza sativa)*, Banana (*Musa acuminate*) etc.
viii.	Type of fauna	Domestic fauna species like Goat *(Capra hircus)*, Sheep *(Ovis aries), C*ow (*Bos indicus*), Buffalo *(Bubalus bubalis)*	Domestic fauna species like Goat *(Capra hircus)*, Sheep *(Ovis aries), C*ow (*Bos indicus*), Buffalo *(Bubalus bubalis)*	Domestic fauna species like Goat *(Capra hircus)*, Sheep *(Ovis aries), C*ow (*Bos indicus*), Buffalo *(Bubalus bubalis)*
ix.	Endangered species, if any	Nil	Nil	Nil
x.	Historical/cultural Monuments, if any	Nil	Nil	Nil
3.	**Compensation Cost:**			
i.	Crop (Non Forest)	290.00 lakhs (@ 5 lakhs/km)	300.00 lakhs (@ 5 lakhs/km)	310.00 lakhs (@ 5 lakhs/km)
ii.	Land for Tower Base & RoW Corridor	2846.00 lakhs	2946.60 lakhs	3041.72 lakhs
iii.	Forest (CA+NPV)	Nil	Nil	Nil
4.	**Major Crossings:**			
i.	Highway(NH/SH)	Nil	1(NH)	Nil
ii.	Power Line (Nos.)	1	3	3
iii.	Railway Line (Nos.)	Nil	Nil	Nil
iv.	River Crossing (Nos	Nil	Nil	Nil
5.	**Overall remarks**	Line length is more and also involves moderate RoW issues due to habitation area & river crossing.	Line length is less and involves relatively less ROW issues & fewer habitats.	Line length is longest and also involves moderate RoW problems due to proximity of habitation area & river crossing.

From the above comparison of the three (3) different alternatives, it is evident that although there is no forest involvement in all the three routes, Alternative- I is found to be shortest route and also less RoW issues due to involve fewer habitation areas & crossings as compared to other two alternatives. Hence, lesser degree of environmental impacts like minimum tree felling as well as construction and O&M problems are anticipated. Hence, Alternative - I is considered as the most optimized route and recommended for detailed survey.

5.2.3 Evaluation of Alternatives Route Alignment for 400 kV Pugalur- Thiruvalam Line

The comparative details of three alternatives in respect of the proposed 400 kV Pugalur-Thiruvalam Line is as detailed in Table 5.3.

Table 5.3: Comparative Details of three alternatives for 400 kV Pugalur- Thiruvalam Line

S.N	Description	Alternative-I	Alternative-II	Alternative-III
1.	**Route particulars**			
i.	Route Length (km)	410	390	420
ii.	Terrain			
	Hilly	10%	10%	10%
	Plain	90%	90%	90%
2.	**Environmental impact**			
i.	Name of District(s) through which the line passes	Karur, Tirupur, Namakkal, Erode, Salem, Dharmapuri, Thiruvanamalai, Vellore	Karur, Tirupur, Namakkal, Erode, Salem, Dharmapuri, Thiruvanamalai, Vellore	Karur, Tirupur, Namakkal, Erode, Salem, Dharmapuri, Thiruvanamalai, Vellore
ii.	Town in alignment	Gudiyatatm, Makur Vanyambadi, Erode, Tiruppattur, Uttan-garai, Dharampuri,	Tiruvannamalai, Kaliakurichchi, Kambaliyumpatti,	Arcot, Tiruvannamalai, Arani, Kaliakurichchi, Kambaliyumpatti, Polur, Palipuram
iii.	House within RoW	Shall be ascertained after detailed survey	Shall be ascertained after detailed survey	Shall be ascertained after detailed survey
iv.	Forest involvement (km/ha.)	Approx. 4 km (18.4 Ha.)	Approx. 5 km (23 Ha)	Approx. 5 km (23Ha)
v.	Type of Forest (RF/PF)& whether part of Wildlife Area/ Elephant corridor/ Biodiversity Hotspots/ Biosphere Reserve/ Wetlands or any other environmentally sensitive area, if any	Reserve Forest	Reserve Forest	Reserve Forest
vi.	Density of Forest	Medium dense	Medium dense	Medium dense
vii.	Type of flora	*Mango (Mangifera indica), Arjuna (Terminalia arjuna), Jamun (Syzygium cumini), Coconut (Cocos nucifera*), Neem (*Azadirachta indica*), Areca Nut (*Areca catechu*), Paddy (*Oryza sativa)*, Banana (*Musa acuminate*) etc.	*Mango (Mangifera indica), Arjuna (Terminalia arjuna), Jamun (Syzygium cumini), Coconut (Cocos nucifera), Neem (Azadirachta indica), Areca Nut (Areca catechu), Paddy (Oryza sativa), Banana (Musa acuminate) etc.*	*Mango (Mangifera indica), Arjuna (Terminalia arjuna), Jamun (Syzygium cumini), Coconut (Cocos nucifera), Neem (Azadirachta indica), Areca Nut (Areca catechu), Paddy (Oryza sativa), Banana (Musa acuminate) etc.*

S.N	Description	Alternative-I	Alternative-II	Alternative-III
viii.	Type of fauna	Fox (*Vulpes benghalensis,* Wild boar (*Sus scrofa*) & domestic species like Goat *(Capra hircus)*, Sheep *(Ovis aries),* Cow (*Bos indicus*), Buffalo *(Bubalus bubalis)*	Fox (*Vulpes benghalensis,* Wild boar (*Sus scrofa*) & domestic species like Goat *(Capra hircus)*, Sheep *(Ovis aries),* Cow (*Bos indicus*), Buffalo *(Bubalus bubalis)*	Fox (*Vulpes benghalensis,* Wild boar (*Sus scrofa*) & domestic species like Goat *(Capra hircus)*, Sheep *(Ovis aries),* Cow (*Bos indicus*), Buffalo *(Bubalus bubalis)*
ix.	Endangered species, if any	Nil	Nil	Nil
x.	Historical/cultural Monuments, if any	Nil	Nil	Nil
3.	**Compensation Cost:**			
i.	Crop (Non Forest)	2030.00 lakhs (@ 5 lakhs/km)	1925.00 lakhs (@ 5 lakhs/km)	2075 lakhs (@ 5 lakhs/km)
ii.	Land for Tower Base & RoW Corridor	17283.00 lakhs	16390.00 lakhs	17667.00 lakhs
iii.	Forest (CA+NPV)	368.00 lakhs (@ 20 lakhs/ha.)	460.00 lakhs (@ 20 lakhs/ha.)	460.00 lakhs (@ 20 lakhs/ha.)
4.	**Major Crossings:**			
i.	Highway(NH/SH)	2(NH)	2(NH)	2(NH)
ii.	Power Line (Nos.)	40	37	40
iii.	Railway Line (Nos.)	2	5	5
iv.	River Crossing (Nos.)	2	2	2
5.	**Overall remarks**	Line length is more and also involve moderate RoW issues as the line route is passing close to habitation area.	Shortest in line length and involve minimum RoW problems due to avoidance major habitation area.	Line length is longest and also involve moderate RoW problems due to proximity of habitation area.

From the above comparison of three (3) different alternatives, it is evident that although Alternative- II involves forest area like other alternatives but it found to be shortest route having minimum RoW issues. Further, lesser degree of environmental impacts like minimum tree felling as well as construction and O&M problems are anticipated as the line route of Alternative- II doesn't involve any major habitation areas like in other two alternatives. Hence, Alternative - II is considered as the most optimized route and recommended for detailed survey.

5.2.4 Evaluation of Alternatives Route Alignment for 400 kV Pugalur- Edayarpalayam Line

The comparative details of three alternatives in respect of the proposed 400 kV Pugalur-Edayarpalayam Line is as detailed in Table 5.4.

Table 5.4: Comparative Details of three alternatives for 400 kV Pugalur-Edayarpalayam Line

S.N	Description	Alternative-I	Alternative-II	Alternative-III
1.	**Route particulars**			
i.	Route Length (km)	58	56	60
ii.	Terrain			
	Hilly	Nil	Nil	Nil
	Plain	100%	100%	100%
2.	**Environmental impact**			

S.N	Description	Alternative-I	Alternative-II	Alternative-III
i.	Name of District(s) line passes	Tirupur & Coimbatore	Tirupur & Coimbatore	Tirupur & Coimbatore
ii.	Town in alignment	Chettipalayam, Laxminayakan-palaiyam, Vadamalaipalayam, Tayampalaiyam Kettanur,	Chettipalayam, Velappanayakkan-palaiyam, Mandripalayam, Vadamalaipalaiyam, Tayampalaiyam	Chettipalayam, Pannapatti, Muttukavundanpudi, Veruvedampaliyam, Kundadam
iii.	House within RoW	Shall be ascertained after detailed survey	Shall be ascertained after detailed survey	Shall be ascertained after detailed survey
iv.	Forest involvement (km/ha.)	Nil	Nil	Nil
v.	Type of Forest (RF/PF)& whether part of Wildlife Area/ Elephant corridor/ Biodiversity Hotspots/ Biosphere Reserve/ Wetlands or any other environmentally sensitive area, ifany	N.A	N.A	N.A
vi.	Density of Forest	N.A	N.A	N.A
vii.	Type of flora	Coconut (*Cocos nucifera*), Neem (*Azadirachta indica*), Areca Nut (*Areca catechu*), Paddy (*Oryza sativa)*, Banana (*Musa acuminate*) etc.	Coconut (*Cocos nucifera*), Neem (*Azadirachta indica*), Areca Nut (*Areca catechu*), Paddy (*Oryza sativa)*, Banan (*Musa acuminate*) etc	Coconut (*Cocos nucifera*), Neem (*Azadirachta indica*), Areca Nut (*Areca catechu*), Paddy (*Oryza sativa)*, Banana (*Musa acuminate*) etc.
viii.	Type of fauna	Domestic fauna species like Goat *(Capra hircus)*, Sheep *(Ovis aries), C*ow (*Bos indicus*), Buffalo *(Bubalus bubalis)*	Domestic fauna species like Goat *(Capra hircus)*, Sheep *(Ovis aries), C*ow (*Bos indicus*), Buffalo *(Bubalus bubalis)*	Domestic fauna species like Goat *(Capra hircus)*, Sheep *(Ovis aries), C*ow (*Bos indicus*), Buffalo *(Bubalus bubalis)*
ix.	Endangered species, if any	Nil	Nil	Nil
x.	Historical/cultural Monuments, if any	Nil	Nil	Nil
3.	**Compensation Cost:**			
iv.	Crop (Non Forest)	290.00 lakhs (@ 5 lakhs/km)	280.00 lakhs (@ 5 lakhs/km)	300.00 lakhs (@ 5 lakhs/km)
v.	Land for Tower Base & RoW Corridor	1785.82 lakhs	1724.34 lakhs	1847.40 lakhs
vi.	Forest (CA+NPV)	Nil	Nil	Nil
4.	**Major Crossings:**			
i.	Highway(NH/SH)	2(NH)	2(NH)	2(NH)
ii.	Power Line (Nos.)	8	8	8
iii.	Railway Line (Nos.)	Nil	Nil	Nil
iv.	River Crossing (Nos	Nil	Nil	Nil

S.N	Description	Alternative-I	Alternative-II	Alternative-III
5.	**Overall remarks**	Line length is relatively more and involves moderate RoW issues due to presence of habitation areas.	Line length is less and involves relatively less ROW issues due to fewer habitats.	Line length is longest and also involves moderate RoW problems due to proximity of habitation area & plantation.

From the above comparison of three (3) different alternatives, it is evident that although Alternative- II is found to be shortest route having minimum RoW issues. Further, lesser degree of environmental impacts like minimum tree felling as well as construction and O&M problems are anticipated as the line route of Alternative- II doesn't involve any plantation and habitation area like in other two alternatives. Hence, Alternative - II is considered as the most optimized route and recommended for detailed survey.

5.2.5 Evaluation of Alternatives Route Alignment for 400 kV Edayarpalayam – Udumalpet Line

The comparative details of three alternatives in respect of the proposed 400 kV Edayarpalayam – Udumalpet Line is as detailed in Table 5.5.

Table 5.5: Comparative Details of three alternatives for 400 kV Edayarpalayam - Udumalpet Line

S.N	Description	Alternative-I	Alternative-II	Alternative-III
1.	**Route particulars**			
i.	Route Length (km)	58	56	60
ii.	Terrain			
	Hilly	Nil	Nil	Nil
	Plain	100%	100%	100%
2.	**Environmental impact**			
i.	Name of District(s) line passes	Tirupur & Coimbatore	Tirupur & Coimbatore	Tirupur & Coimbatore
ii.	Town in alignment	Chettipalayam, Pannapatti, Velur, Arasampalayam, Ramchandrapuram, Peddapampati, Udumalpet	Chettipalayam, Purandampalaiyam, Krshnapuram, Chikkanattu, Jallipatti, Tungavi, Udumalpet Gudimangalam,	Chettipalayam, Arasampalaiyam, Vadachittur, Kottampatti, Valakondapuram, Pukkalam, Udumalpet
iii.	House within RoW	Shall be ascertained after detailed survey	Shall be ascertained after detailed survey	Shall be ascertained after detailed survey
iv.	Forest involvement (km/ha.)	Nil	Nil	Nil
v.	Type of Forest (RF/PF)& whether part of Wildlife Area/ Elephant corridor/ Biodiversity Hotspots/ Biosphere Reserve/ Wetlands or any other environmentally sensitive area, ifany	N.A	N.A	N.A
vi.	Density of Forest	N.A	N.A	N.A

S.N	Description	Alternative-I	Alternative-II	Alternative-III
vii.	Type of flora	Coconut (*Cocos nucifera*), Neem (*Azadirachta indica*), Areca Nut (*Areca catechu*), Paddy (*Oryza sativa)*Banana (*Musa acuminate*) etc	Coconut (*Cocos nucifera*), Neem (*Azadirachta indica*), Areca Nut (*Areca catechu*), Paddy (*Oryza sativa)*, Banana (*Musa acuminate*) etc.	Coconut (*Cocos nucifera*), Neem (*Azadirachta indica*), Areca Nut (*Areca catechu*), Paddy (*Oryza sativa)*, Banana (*Musa acuminate*) etc.
viii.	Type of fauna	Goat *(Capra hircus)*, Sheep *(Ovis aries), C*ow (*Bos indicus*), Buffalo *(Bubalus bubalis)*	Goat (Capra hircus), Sheep (Ovis aries), Cow (Bos indicus), Buffalo (Bubalus bubalis)	Goat (Capra hircus), Sheep (Ovis aries), Cow (Bos indicus), Buffalo (Bubalus bubalis)
ix.	Endangered species, if any	Nil	Nil	Nil
x.	Historical/cultural Monuments, if any	Nil	Nil	Nil
3.	**Compensation Cost:**			
i.	Crop (Non Forest)	290.00 lakhs (@ 5 lakhs/km)	280.00 lakhs (@ 5 lakhs/km)	300.00 lakhs (@ 5 lakhs/km)
ii.	Land for Tower Base & RoW Corridor	1625.16 lakhs	1569.24 lakhs	1681.20 lakhs
iii.	Forest (CA+NPV)	Nil	Nil	Nil
4.	**Major Crossings:**			
i.	Highway(NH/SH)	2(NH)	2(NH)	2(NH)
ii.	Power Line (Nos.)	10	10	10
iii.	Railway Line (Nos.)	Nil	Nil	Nil
iv.	River Crossing (Nos	Nil	Nil	Nil
5.	**Overall remarks**	Line length is relatively more and also involves moderate RoW issues due to habitation areas.	Line length is less, easy approachability to line route and involves relatively less ROW issues.	Line length is longest and also involve moderate RoW problems due to proximity of habitation areas.

From the comparative analysis of three alternative routes, it is evident that none of the three alternative routes studied involves forest area. However, Alternative-II is shorter in length, involves less RoW issues and also better approachability as compared to Alternative-I & III. Further, lesser degree of environmental impacts like minimum tree felling and construction and operational problems are anticipated. Hence, Alternative -II is considered as the most optimum route and recommended for detailed survey.

5.3 SUBSTATION

No new substation is envisaged under the instant scheme. However, only extension works involving construction 16 nos. line bays in different substations is proposed. Since the above extensions works shall be undertaken in existing substations where lands are already in available and no fresh land required, R & R will not be an issue in the instant project.

SECTION – VI: POTENTIAL IMPACTS, THEIR EVALUATION AND MANAGEMENT

6.1 IMPACTS AND MITIGATION DUE TO PROJECT LOCATION

Environmental impacts of transmission projects are not far reaching and are mostly localized to RoW (refer **Table 6.1**). Actual 400 kV line including tower on ground along with RoW and extent of impact on land/vegetation is placed as **Image 1 and 2** respectively. However, transmission projects have some effects on natural and socio-culture resources. These impacts can be minimized by careful route selection. To get latest information and further optimization of route, modern survey techniques/tools like GIS, GPS are also applied. Introduction of GIS and GPS in route selection result in access to updated/latest information, through satellite images and further optimization of route having minimal environmental impact. Moreover, availability of various details, constraints like topographical and geotechnical details, forest and environmental details etc. help in planning the effective mitigative measures including engineering variations depending upon the site situation/location. In the instant scheme, also these techniques are used and detail survey using GIS/GPS is under progress. Although, all possible measures have been taken during the finalization of route alignment for the proposed transmission lines but due to peculiarity of terrain and demography of the area where subprojects are being implemented, some environmental impacts may be there. The explanations in brief about specific environment review criteria based on preliminary survey are as follows:

Table 6.1: RoW Width & Clearance between Conductors and Trees

Transmission Voltage	Max. RoW (In Meters)	Min. Clearance (in Meters) between conductor & Trees
400 kV	**46**	**5.5**

Note: As per IS:5613 and MoEF guidelines dated 5th May' 2014 finalized in consultation with CEA

Image 1a: Actual 400 kV Transmission Line (1)

Image 1b: Actual 400 kV Transmission Line

Image 2: 400 kV Tower Base Showing Extent of Impact on Agriculture land and Crops

(i) Resettlement

Land is required for a) construction of substations and b) erection of transmission lines. In general requirement of land area for substation varies from 30 to 100 acres depending upon voltage levels, no. of bays, topography of land and other technical parameters.

As already explained above, the Project does not involve construction of any new substations. However, extension works proposed under the Project involving construction of 16 nos. of line

bays shall be undertaken in existing substations where lands are already in possession. Since no fresh land acquisition is involved, R & R will not be an issue in the Project.

In respect of (b), no permanent acquisition is envisaged. Land for tower and right of way is not acquired as agricultural activities can continue. A typical plan of transmission line tower footing indicating the above position along with extent of damage and area of influence are depicted in **Figure 5 & 6** respectively. As described earlier all measures are undertaken by POWERGRID at the line routing stage itself to avoid settlements such as cities, villages etc. It may be seen from the above description of proposed route alignments and keeping in mind that no permanent acquisition of land is involved for tower foundation as per existing law, these subprojects don't require any resettlement of villagers. However, some temporary damages/ disturbances can happen, which will be compensated as per the law of the land and applicable/prevailing guidelines.

A Compensation Plan for Temporary damages (CPTD) has been prepared for the Project (provided as separate document) to compensate likely temporary damages. The guidelines issued in October 2015 by the Ministry of Power on payment of compensation towards damages in regards to Right of Way for transmission lines has suggested state governments to adopt following norms for determining the compensation:

- Compensation at 85% of land value as determined by District Magistrate or any other authority based on Circle rate/Guideline value/Stamp Act rates for tower base area (between four legs) impacted severely due to installation of tower/pylon structure;

- Compensation towards diminution of land value in the width of RoW Corridor due to laying of transmission line and imposing certain restriction would be decided by the States as per categorization/type of land in different places of States, subject to a maximum of 15% of land value as determined based on Circle rate/Guideline value/Stamp Act rates.

The Government of Tamil Nadu has already agreed in principle to adopt the said MoP guidelines and in the process of formal notification to this effect.

In case acquisition of land is required, POWERGRID follows government laws and applicable/prevailing guidelines. Methods generally used for securing land are (a) transfer of government land to utility, (b) voluntary donation, (c) purchase of land on willing buyer-willing seller basis at negotiated price and (d) involuntary acquisition of land.

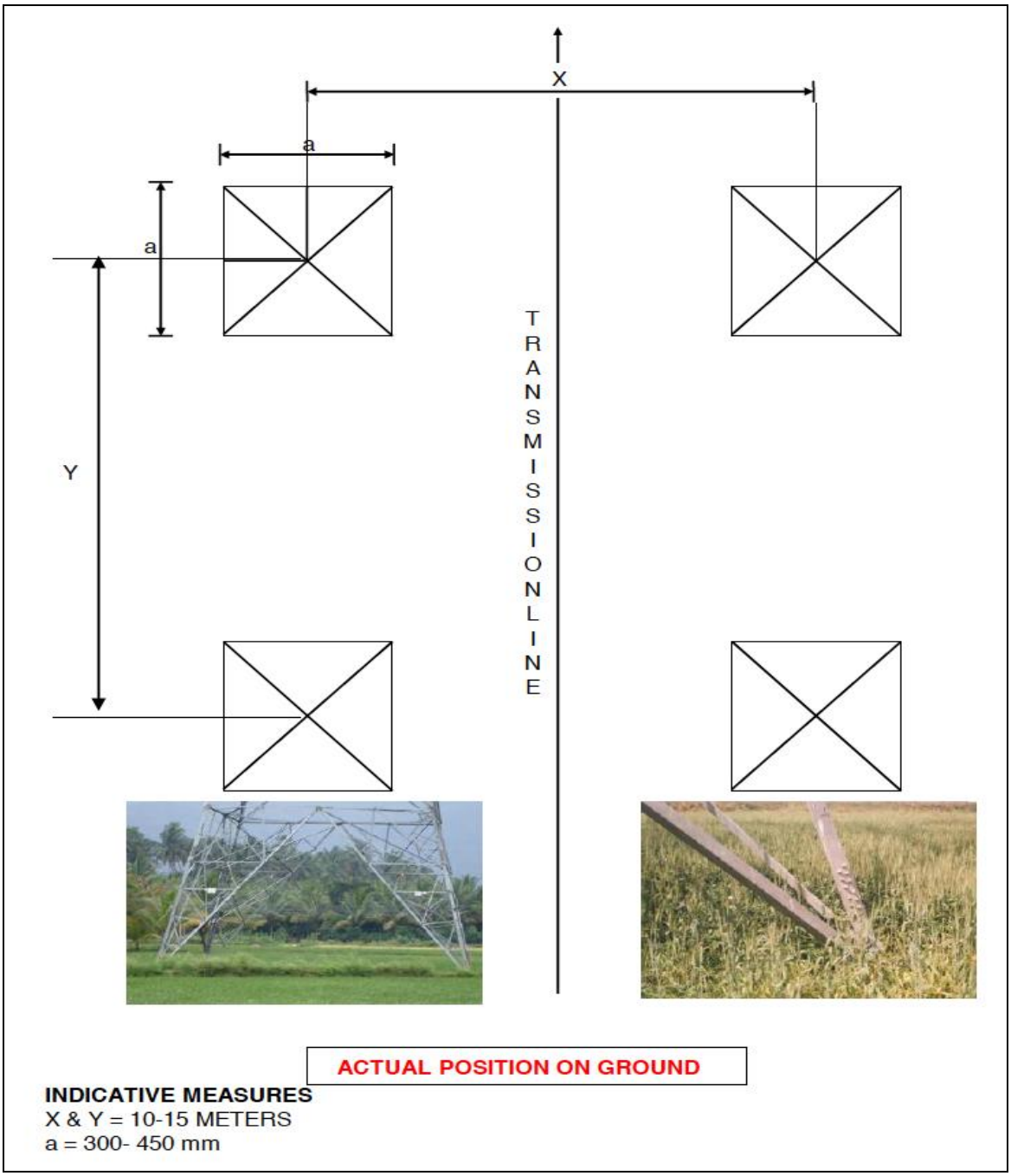

Figure 5: Typical Plan of Transmission Line Tower Footings Showing Actual Ground Position and Extent of Impact

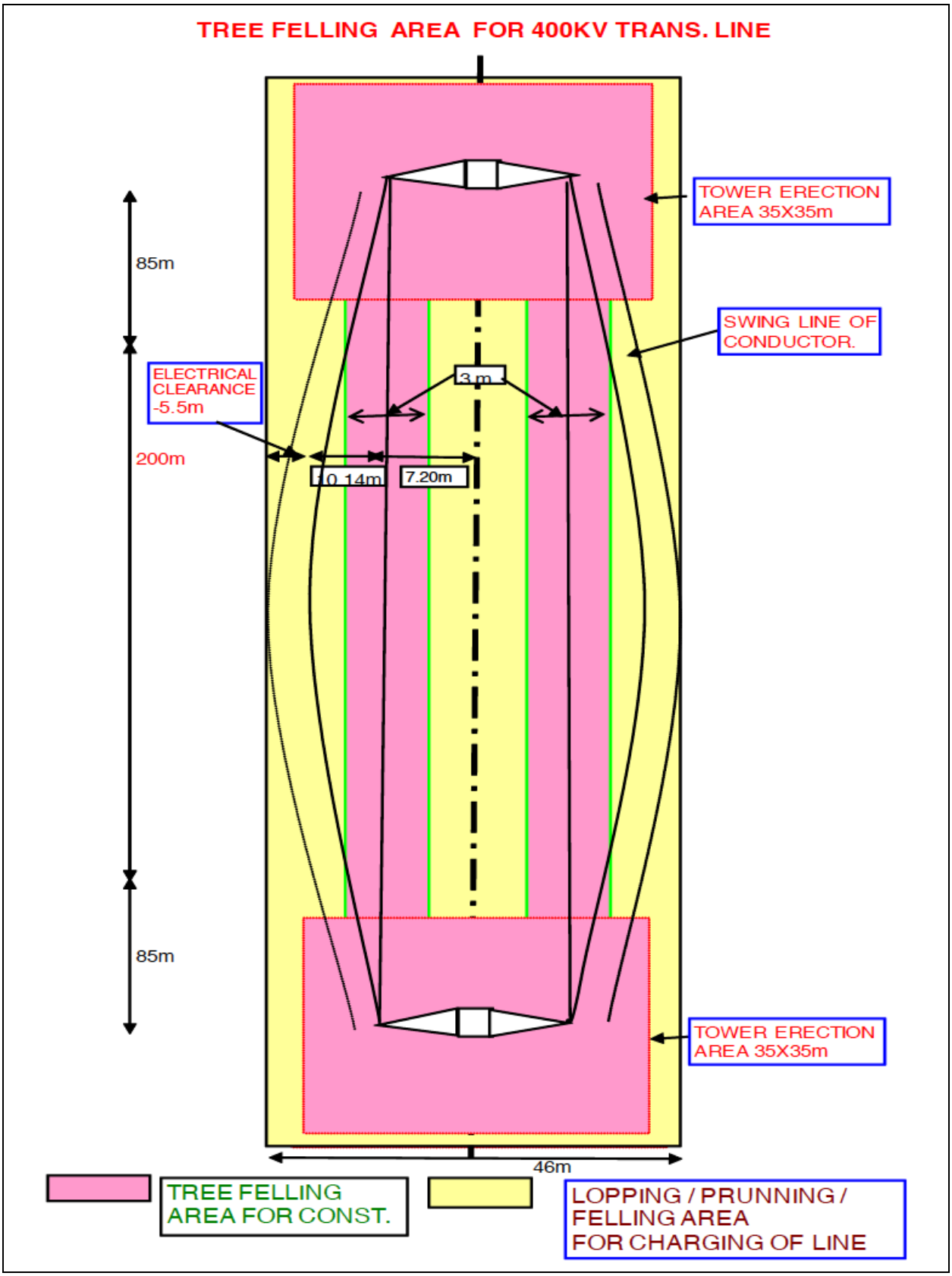

Figure 6: Schematic Diagram Indicating Area of Influence / Impact of 400 kV Transmission Line

(ii) Land Value Depreciation

Based on past experience land prices are generally expected to rise in the areas receiving power. Generally, transmission lines pass through uninhabited areas, 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.

(iii) Historical/Cultural Monuments/Values

As per the policy of route selection, only that route alignment is finalized which avoids all the historical and cultural monuments. As per the preliminary assessment carried out during finalization of route alignment in consultation with State Revenue authorities and Archaeological Survey of India (ASI), no such monuments are coming in the proposed route alignments. Moreover, utmost care shall be taken during detailed survey to avoid such areas. However, during excavation, if any treasure, archaeological artifacts are found the same shall be intimated in writing to Collector/Archaeology department as per the provisions of Section-4 of "Indian Treasure Trove Act, 1878 as amended in 1949". The Collector shall initiate further action for its safe custody or its shifting to Treasury/ Secure place. The construction activity may be suspended temporarily during this process. This is an approach that is similar to the use of archaeological "chance find procedures" that is mandated in ESS 1 of the AIIB.

(iv) Lines into Sensitive Ecological Areas

As already explained all precautions have been taken during route selection to avoid routing of line through forest and protected areas. In the instant case also protected areas like wildlife sanctuary, national parks, biosphere reserves etc have been completely avoided. However, in spite of taking due care during route selection involvement of some forest area (approx. 23 ha. of reserve forest.) could not be avoided in one line i.e. 400 kV Pugalur- Thiruvalam line. As per regulation prior approval from GoI/MoEF shall be obtained under Forest (Conservation) Act, 1980 after detail survey and finalization of route through forest area in consultation with local forest authorities. Moreover, to minimize the loss of vegetation, suitable management measures as specified in EMP[4] (refer clause- 9) like minimizing RoW requirement, use of tall or extended tower etc, wherever feasible will be undertaken.

As per the initial study/assessment, most of the forests to be traversed by the subject line are categorised as Reserve Forest (RF) and found to be in various degree of degradation and even the wildlife species present are those who have adapted to open or disturbed habitat. Nonetheless, to mitigate losses to existing forests, clearing of the transmission line Right-of-Way will be done under supervision of forest department, and some low canopy seed trees and shrubs may be kept intact if they do not interfere with tower erection and line installation. The extracted wood will be sold by the forest department, who will also retain the sale proceeds. Three-meter wide strips of land below each conductor will be cleared during construction and one such strip shall be kept free of vegetation for maintenance purpose and regeneration up to certain height in remaining width of RoW will be allowed after construction activity. Periodical lopping/pruning of trees to maintain line clearance will be done under the direction of forest department (for details refer **Figure 7** for tree felling pattern and refer **Figure 6** for area of influence). Moreover, to prevent unauthorized tree felling in forest area measures like providing construction crews with fuel wood or alternative fuels by Contractor has been specified in EMP (refer clause- 24).

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 etc. cost of which is borne by POWERGRID. Given the already easy access and degraded conditions at the proposed subprojects 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.

[4] ***Environment Management Plan (EMP) is placed at Table 8.1***

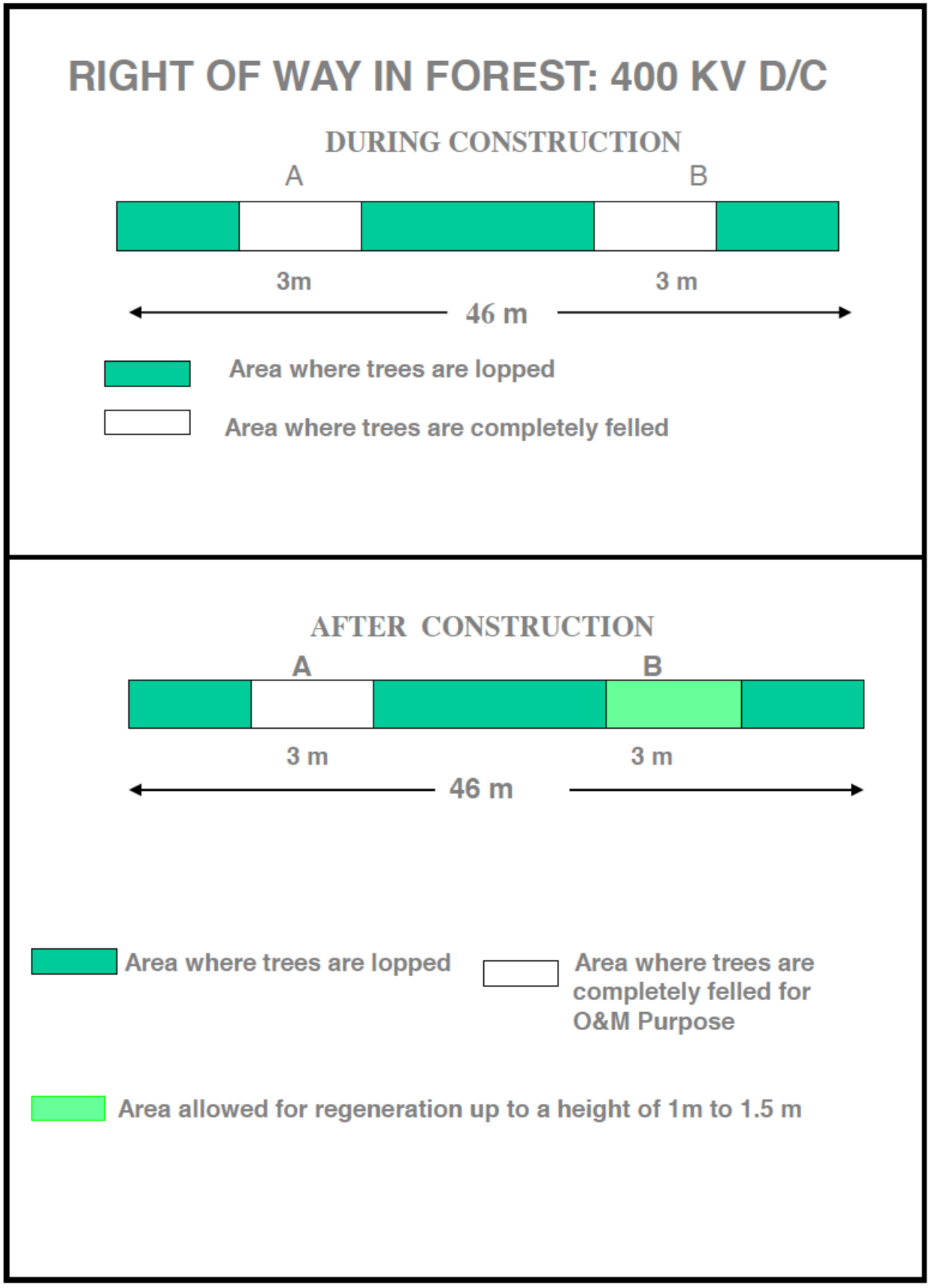

Figure 7: Schematic Diagram Indicating Tree Felling Pattern in Forest Area for 400 kV Transmission Line

(v) Lines into Agricultural Lands

Impacts on agricultural land will be restricted to the construction phase and when large-scale maintenance measures are required. The proposed transmission lines will pass mostly through agricultural fields. As per existing law, land for tower and right of way is not acquired and agricultural activities are allowed to continue after construction activity. POWERGRID pays compensation for all damages as per the law of the land and applicable/prevailing guidelines. Recently, MoP has issued guidelines for payment of compensation toward damages in regard to RoW for transmission lines (**Annexure-1**). However, the said compensation shall be paid to all affected farmers/land owners in addition to normal tree and crop damage compensation, once it is adopted by respective States.

In areas where transmission lines will traverse through agricultural land, compensation will be paid to owners for any crop damage incurred as a result of construction activities. POWERGRID field staff will consult affected villagers and local revenue dept. and apprise them about the project and tower location, which shall be erected in the agricultural land. Revenue dept. after evaluating the land loss due to construction activity and crop damages based on productivity of land arrives at the compensation cost which is paid to farmer. Agricultural activities will be allowed to continue following the construction period. If bunds or other on-farm works are disturbed during construction or maintenance, they will be restored to the owner's satisfaction following cessation 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 of products from the tree over an eight year period (for fruit bearing trees). Agricultural lands under private ownership will be identified, and in accordance with normal POWERGRID procedures compensation will be paid to the affected villagers**.** The procedure for providing compensation is described in **Annexure-2.** Budgetary provision of Rs. 3050.00 lakhs is made in the cost estimate to meet these expenses.

(vi) Interference with Other Utilities and Traffic

As per regulations enacted by Government of India, it is mandatory for POWERGRID 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 lines affect nearby telecommunication circuits by causing electrical interference. A standing committee - Power Telecom Co-ordination Committee (P.T.C.C.) has been constituted by Government of India 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. The committee suggests measures like 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 the Committee 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 an average works out to be Rs. 50,000/- per km. Provision to meet these expenses has been made in the cost estimate for the same for transmission line proposed under the instant scheme.

The main approach road for accessing the construction sites including three new substations are either through National Highways, i.e. NH-40, 44, 83,181 & 544 or through other State/Village Roads bifurcating from these National Highways. The volume of traffic on these roads is found to be of low to medium intensity. Therefore, possibility of any steep rise in volume of traffic due to mobilization for said projects is not envisaged.

Wherever transmission line crosses the railways, clearance is taken from that department. In general, the system is planned and executed in such a way that adequate clearance is maintained between transmission lines on the one hand, and railways, civil aviation and defense installations on the other. Wherever the transmission lines pass near to airports, the

towers beyond specified height are painted in alternate orange and white stripes for easy visibility and warning lights are placed atop these towers.

(vii) 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. Moreover, the proposed transmission lines don't involve any tower to be placed in river beds for river crossing. However, management measures as specified in EMP (refer clause - 5 & 12) like appropriate siting of towers shall be undertaken during detailed alignment survey and design to avoid any incidence of flooding hazards of loss of agricultural production due to interference with drainage patterns or irrigation channels. In the infrequent instances where the natural flow/drainage is affected, flow will be trained and guided to safe zones.

6.2 ENVIRONMENTAL AND SOCIAL PROBLEMS DUE TO DESIGN

(i) Contamination from Polluting Materials

The equipment installed on lines and substations is static in nature and does not generate any fumes or waste materials. However, detailed specification with respect to equipment design has been included in tender document to avoid any incidence of land and water contamination. Apart from this, solid waste like packing materials, cables, aluminium conductor, sand, aggregate material, cement and steel generated during construction is carefully handled and removed from site.

(ii) Explosion/Fire Hazards

During the survey and site selection for transmission lines, it has been ensured that these are kept away from oil/gas pipelines and other sites with potential for creating explosions or fires. Fires due to flashover from lines can be a more serious problem in forest. However, adequate safety measures shall be taken to avoid such incidence and has been included in EMP (refer clause - 15, 23 & 52). Besides this forest authorities also incorporate measures like making fire lines to prevent spreading of fire in the affected forest area. Apart from this, state of art safety instruments are installed in the substations on both the ends so that line gets tripped within milliseconds in case of any fault.

(iii) Erosion Hazards Due to Inadequate Provision for Resurfacing of Exposed Area

The volume of soil excavated in the construction of transmission lines vary significantly depending upon several factors including wind zone, type of towers, type of foundation, topography of the land etc. It is estimated quantity of soil excavation for construction of 400KV Pugalur- Thiruvalam, 400KV Pugalur- Pugalur, 400KV Pugalur- Arasur, 400KV Pugalur-Edayarpalayam & 400KV Edayarpalayam- Udumulpet line would be around 4,83,768m3, 72,274 m3, 74,810 m3, 57,827 m3 and 40,672 m3 respectively. However, most of these excavated materials (about 80-90%) will be used for re-filling after construction work is over and remaining materials will be disposed properly as detailed out in EMP(refer clause - 25, 26 & 28). Moreover, the topsoil disturbed during the development of sites will be stored properly and used to restore the top surface of the platform. Left over infertile and rocky material will be dumped at carefully selected dumping areas and used as fill for foundations and leveling. Further, excavation in the hilly areas is avoided in rainy days. In hill slopes and erosion prone soils, internationally accepted engineering practices including bio-engineering techniques, wherever, feasible shall be undertaken to prevent soil erosion. Hence, possibility of erosion of exposed area due to construction activity is negligible.

(iv) Environmental Aesthetics

Since spacing between the towers in case of 400kV transmission lines is approx. 400 meters, there will be limited adverse affect on the visual aesthetics of the localities particularly when it is ensured to route the lines as far away from the localities as possible. POWERGRID takes up plantation of trees to buffer the visual effect around its substations and to provide better living conditions. Wherever POWERGRID feels 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. In addition, towers may be painted grey or green to merge with the background.

(v) Noise/Vibration Nuisances

The equipment installed at substation are mostly static and are so designed that the noise level always remains within permissible limits i.e. 85 dB as per Indian standards. The noise levels reported during normal operating conditions are about 60 to 70 dB at 2 m. distance from the equipment. To contain the noise level within the permissible limits whenever noise level increases beyond permissible limits, measures like providing sound and vibration dampers and rectification of equipment are undertaken. In addition, plantations of sound absorbing species like Casuarinas, Tamarind and Neem are raised at the substations that reduce the sound level appreciably. It is reported that 93 m3 of woodland can reduce the noise level by 8 dB. Actual noise levels measured at perimeters of existing substations are 35 to 45 dB.

(vi) Blockage of Wildlife Passage

The proposed transmission lines are passing mostly through agricultural land wasteland etc. and only a small portion (5km) Pugalur-Thiruvalam line is passing through reserved forest. Since there are no protected areas, and management measures, such as paths for wildlife like elephant corridors, exist near the subproject project locations, the possibility of any disturbance to wildlife is not anticipated. Another phenomenon reported in some places viz. Bird hit/electrocution by electric lines during landing and takeoff near the water bodies, fly path of birds is also not envisaged in the Project due to routing of line away from such areas.

6.3 ENVIRONMENTAL AND SOCIAL PROBLEMS DURING CONSTRUCTION PHASE

(i) Uncontrolled Silt Runoff

As already explained, during construction a total of approximately 7,29,351 m3 excavated material will be generated from towers and bays foundation. However, adequate measures shall be taken to store excavated materials properly for leveling and refilling after construction is over. In case of hill slopes and erosion prone soils, internationally accepted engineering practices including bio-engineering techniques, wherever, feasible shall be undertaken to prevent soil erosion. Moreover, excavation in the hilly areas is avoided in rainy days. Hence, uncontrolled silt run off is not anticipated.

(ii) Nuisance to Nearby Properties

As already described in preceding paras, during site selection due care is taken to keep the lines away from settlements. Further, 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. Further, line bays extension work in substations shall be confined to existing substations which are already inaccessible for general public due to its separation/demarcation by the boundary wall. Moreover, such areas are declared as prohibited for general public as per the provisions of Electricity Act. Hence, any adverse impact arising during the construction will be temporary and limited to the boundaries of existing substations only and will neither impact nearby habitat/property nor health & safety of neighboring community

(iii) Interference with Utilities and Traffic and Blockage of Access Way

Transportation of construction materials will be mostly through the road network. Access to the site will be along existing National/State highway or village paths. Minor improvements to paths may be made where necessary, but no major construction of roads will be needed either during construction or as a part of maintenance procedures. In case, access road is not available at some places, existing field/path may be utilized and compensation for any damage to crop or field is paid to the owner.

As and when a transmission line crosses any road/ railway line, adequate care/caution is taken 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 planted to facilitate execution of work in different stages.

POWERGRID will follow all applicable standards concerned with safety for transmission and erection of substations. These include IS: 5613 – recommendation on safety procedures and practices in electrical work as per CEA (Measures relating to Safety and Electric Supply) Regulation, 2010 notified in the Gazette on 20th Sept. 2010 (**Annexure-3**). Apart from this, safety precaution like barricading of work area with reflective tape/illumination and placement of visible signage shall be undertaken to avoid any unforeseen incident. Furthermore, speed restrictions are imposed on project vehicles in project/habitation areas. Moreover, the construction activities associated with transmission line projects are not so extensive and only limited excavation is involved in tower foundations. As such, the volume of traffic and movement of construction vehicles laden with construction materials is quite limited and don't pose any safety hazards for local population as well as increase in road accidents. The extension activities in substation area are always undertaken in enclosed/confined area.

(iv) Inadequate Resurfacing for Erosion Control

Since the proposed transmission lines are to be constructed in mostly plain areas, soil erosion will not be a major issue. If due to terrain at some points towers may be placed on slopes and erosion prone soils, internationally accepted engineering practices including bio-engineering techniques wherever feasible shall 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. As explained above adequate steps shall be taken to resurface the area after construction. 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. Further, construction is generally undertaken in dry/non-monsoon period.

(v) Inadequate Disposition of Borrow Areas

As mentioned earlier the transmission line tower and line bays foundation involve excavation small scale basis and the excavated soil is utilized for back filling. Hence, acquisition/opening of borrow area is not needed.

(vi) Protection of Worker's Health/Safety

All health and safety issues and its management aspects are integral part of project/contract specific safety plan (**Annexure-4**) which is also part of contract condition. Various aspects such as work and safety regulations, workmen's compensation, insurance are adequately covered under the General Conditions of Contract (GCC), a part of bidding documents. Project is executed as per the approved plan and is regularly monitored by dedicated Safety personnel. Moreover, for strict compliance of safety standard/plan a special provision as a deterrent has been added in the contract which provides for a heavy penalty of Rs.10 lakhs for each accidental death and Rs1.0 lakh/each for any injury and is deducted from the contractor's payment and paid to the deceased/affected family (**Annexure-5**).

POWERGRID maintains safety as a top priority and has framed guidelines/checklist for workers' safety as its personnel are exposed to live EHV apparatus and transmission lines. These guidelines/checklists include work permits and safety precautions for work on the transmission lines and substation both during construction and operation (**Annexure-6**) and is regularly monitored by site in-charge. In addition training is imparted to the workers in fire fighting and safety measures. Standard safety tools like helmet, safety belt, gloves etc. are provided to them in accordance to the provisions of Safety Rules. First aid facilities will be made available with the labour gangs, and doctors called in from nearby towns when necessary. The number of outside (skilled) labourers will be quite small, of the order of 25-30 people per group and remaining workforce of unskilled labourers will be comprised of mostly local people. As per policy/norms preference shall be given to the eligible local labor having required skills a specific clause has been incorporated in contract conditions (refer clause-

22.2.1 of GCC) for compliance of same by Contractor. Workers are also covered by the statutory Workmen (Compensation) Act. Regular health checkups are 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 the construction workers.

6.4 ENVIRONMENTAL AND SOCIAL PROBLEMS RESULTING FROM OPERATION

The O&M program in POWERGRID is normally implemented by substation personnel for both, the lines as well as substations. However in respect of the long distance transmission lines, there are monitoring offices that are located at various points en-route. Monitoring measures employed include patrolling and ground based thermo-vision scanning.

The supervisors and managers entrusted with O&M responsibilities are intensively trained for necessary skills and expertise for 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.

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 Electric and Magnetic Fields (EMF) affect POWERGRID have also carried out such studies with the help of PTI, USA and CPRI, Bangalore on their design. The studies inferred that the POWERGRID design are safe and follow the required international standard (for details refer **Annexure- 7**).

Additionally, in order to, ascertain the actual value of EMF, studies by independent as well as in house agencies were carried out. The values are presented in **Table 6.2** below:

Table 6.2: Actual values of EMF in POWERGRID lines

S. N.	Name of Line	Maximum Value		ICNIRP Limits		Name of the Agency	Remarks
		Electric Field (KV/m)	Magnetic Field (µT)	Electric Field (KV/m)	Magnetic Field (µT)		
1	400 KV S/C	2.5	--	5	100	CPRI, Bangalore & Osmania University, Hyderabad	All readings at 1.8 meter height.
2	400 KV D/C	3.5	--	5	100		
3	400 KV D/C Ballabhgarh-Maharanibagh	3.7	2.32	5	100	Corporate Technology Deptt. (CTD) PGCIL	
4	400 KV D/C Bhiwadi- Agra	4.8	2.84	5	100	CTD, PGCIL	
5	400 KV D/C Hyderabad-Ramagundam	3.2	5.04	5	100		

From the above, it is evident that values of Electric and Magnetic Field are well within the limits prescribed by ICNIRP for continuous exposure. Since, residential areas are mostly avoided during routing of line, the chances of continuous exposure are remote

Management of SF6 gas is given utmost importance considering its Global Warming Potential. Strict and well defined procedure has been put in place for storage, handling and refilling of SF6 gas cylinders. Every refill is documented and any unusual variation in gas volume is reported to concerned higher officials for review and rectification. Each and every leakage is promptly detected, addressed and documented.

Considering the importance of SF6 management, it is also incorporated in EMP (refer clause - 45)

Poly Chlorinated Biphenyls (PCBs) due to its high heat capacity, low flammability and low electrical conductivity was extensively used as insulating material in capacitors and transformers. But after the finding that these PCBs are non-biodegradable and has carcinogenic tendency, its use in electrical equipments as insulating medium has been banned all over the world long back. However, it has been reported in some studies that chances of contamination of oil with PCB is possible. Keeping that in mind, POWERGRID has taken all possible steps in association with NGC, UK and setup Regional testing laboratories for testing of existing oil for PCB traces and results of this suggests that PCB contamination is not an issue with POWERGRID. The World Bank has also made following comments after a detailed study on Management of PCBs in India:

"Power Grid was the most advanced in testing for PCBs of the organizations visited for this project. They have established a procedure for identification of the presence of PCBs in transformer oil and more detailed analysis for positive identification sample. To date no significant concentrations of PCBs have been detected. Power Grid do not appear to have any significant issues regarding PCB management and have initiated a testing program. The experience & laboratories of Power Grid could be used to provide a national PCB auditing service".

6.5 CRITICAL ENVIRONMENTAL REVIEW CRITERIA

(i) Loss of Irreplaceable Resources

The transmission projects do not involve any large scale excavation. In the proposed transmission lines, land is affected to the extent 278 sq. m below the tower base for which compensation is paid to land owner. In the instant scheme, one line i.e. 400kV Pugalur-Thiruvalam transmission line is passing through approximately 5km (23 ha.) of forest area. However, as per regulations, afforestation on double the diverted area in respect of forest will be undertaken to compensate any loss of natural resources.

(ii) Accelerated use of resources for short-term gains

The subject project will not be making use of any natural resources occurring in the area during construction as well as maintenance phases. The construction materials such as tower members, cement etc. shall come from factories while the excavated soil shall be used for leveling and backfilling to restore the surface. During construction of line, very small quantity of water is required which is met from nearby existing source or through tankers. Hence, it may be seen that the activities associated with implementation of subject project shall not cause any accelerated use of resources for short term gain.

(iii) Endangering of species

As described earlier, no endangered species of flora and fauna exist in the subprojects area is getting affected thus there is no possibility of endangering/ causing extinction of any species.

(iv) Promoting undesirable rural to urban migration

The subject project will not cause any submergence or loss of land holdings that normally trigger migration. It also does not involve acquisition of any private land holdings. Hence, it will not contribute to rural to urban migration.

6.6 CUMULATIVE IMPACTS

The project's contribution to cumulative biophysical and socio-economic impacts that are occurring from the range of activities and developments in a defined geographic area will be insignificant due to the small scale of projects.

SECTION – VII: CONSULTATIONS AND INFORMATION DISCLOSURE

7.1 CONSULTATIONS

Public consultation/information disclosure is an integral part of the POWERGRID project cycle. POWERGRID follows a well defined procedure for conducting public consultation involving different techniques as laid down in its ESPP, which is also approved by The World Bank under the Use of Country System (UCS). These procedures are also in line with AIIB's ESP and ESSs provisions for public consultations and information disclosure.

There are 10 different consultation techniques, which are used either independently or in combination appropriately at different milestones of the project depending on field conditions (for details refer **Annexure-8**). The location for public meeting is usually selected at every 50-100 km involving major villages/habitated area en-route of line. However, in other villages/parts, informal group meetings or other techniques are applied for consultation. The consultation and feedback process is a continuous one and implemented regularly at different milestones of project cycle.

The process of consultation and information dissemination begins even before the start of work as POWERGRID informs the general public by publishing in 2 (Two) local newspapers in vernacular language on implementation of project indicating the route of final alignment with name of the town /villages its passing. During survey also POWERGRID site officials meet people and inform them about the routing of transmission lines. During construction, every individual, on whose land line is constructed and people affected by RoW, are consulted. Apart from this, Public consultation using different technique like Public Meeting, Small Group Meeting, Informal Meeting shall also be carried out during different activities of project cycle. During such consultation the public are informed about the project in general and in particular about the following:

- Complete project plan (i.e. its route and terminating point and substations, if any, in between);
- Design standards in relation to approved international standards;
- 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 approach to minimizing and solving them;
- Trees and crop compensation process.

Additionally, questions, doubts and apprehensions of members of public are heard and answered to the extent possible. Queries raised by participants are mostly concentrated on improvement in power availability to their village, safety and RoW compensation. Some of the queries raised are presented below:

- ✓ Whether this line will improve the power supplies in our village and remove frequent interruption/outage;
- ✓ Whether these lines are safe for the nearby dwellers without any problems of electrocution while working in the fields;
- ✓ What is compensation policy for the standing crops damaged and compensation for the land occupied by the tower footings;
- ✓ What about employment for local people and procedure for same;
- ✓ What is the width of RoW for cutting trees. How much compensation for the trees will be given and when.

In the project area also, many group meetings were organized (informally and formally) in all villages where the interventions are likely to happen. Such consultation culminated in public meetings organized at different locations as provided in **Table 7.1**. These meetings were

attended by Gram Panchayat leaders/members, Village heads, interested villagers/general public and representatives from POWERGRID. Village women folk also actively participated in consultation. To ensure maximum participation, prior intimation in local language was given and such notices were also displayed at prominent places/panchayat office etc. During the public consultation details of line and its importance were explained to the villagers by the officials of POWERGRID. The consultation was arranged in interactive manner in local language and queries like crop/land compensation, engagement employment opportunities, health & safety, improvement of power scenario & infrastructure in region etc. were addressed. The initiative was appreciated by the villagers and they assured their cooperation for construction of the said lines. The process of such consultation shall continue during different stage of project implementation and even during O& M stage. Details of above public consultation meetings including public notice, list of participants, photographs and public queries & answers are enclosed as **Annexure-9**.

Table 7.1: Public Consultation en-route of Transmission Lines

Sl. No.	Date & time of Consultation	Venue	Persons Attended
1.	31st May 2016, 11.00 AM	At- Community Hall Village-Ammapalyam District- Thiruvanamalai State- Tamil Nadu	Total 25 persons including Panchayat members, interested villagers/ general public attended
2.	1st June 2016, 11.00 AM	At- Village Primary School Village- Poosimalaikuppam District- Arani, State- Tamil Nadu	Total 77 persons including Panchayat head & member, interested villagers/ general public attended
3.	2nd June 2016, 11.00 AM	At- Gram Panchayat Village-Satur District- Arcot State- Tamil Nadu	Total 29 persons including Panchayat head & members, interested villagers/ general public attended
4	12th Dec. 2015, 10.00 AM	At- Village Primary School Village- Muthalipalayam District- Tiruppur State- Tamil Nadu	Total 50 persons including Panchayat President & members, Panchayat Council Members and interested villagers/ general public attended
5	16th Dec. 2015, 3.00 PM	At- Grampanchayat Community Hall, Village- Arasampalayam District- Coimbatore, State- Tamil Nadu	Total 25 persons including Village heads, interested villagers/ general public attended

7.2 INFORMATION DISCLOSURE

IThe policy requirements of POWERGRID, as well as the ESP of the AIIB, provide that the environmental and social assessment reports are made available/accessible to the general public. Information disclosure will follow the procedure for AIIB ESP environmental and social category B projects.

All environmental and social safeguards documents are subject to public disclosure, and therefore, will be made available to the public. This IEER will be disclosed on websites of POWERGRID and AIIB. This IEER will be made available for review at POWERGRID HQ in India as well as POWERGRID Regional Offices and at other locations accessible to stakeholders (to be determined by the POWERGRID). POWERGRID through its regional office will ensure that meaningful public consultations, particularly with project affected persons'are undertaken through the entire project cycle, the design, installation and operation phases.

SECTION – VIII: IMPLEMENTATION ARRANGEMENT, MITIGATION & MONITORING

8.1 ENVIRONMENTAL MONITORING PROGRAM IN POWERGRID

Monitoring is a continuous process for POWERGRID projects at all the stages be it the site selection, construction or maintenance.

The success of POWERGRID lies in its strong monitoring systems. Apart from the site managers reviewing the progress on daily basis regular project review meetings are held at least on monthly basis which, is chaired by 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 exceptional issues identified in these meetings are submitted to the Directors and Chairman & Managing Director of the Corporation for guidance. The progress of various on-going projects is also informed to the Board of Directors. A flow chart showing institutional arrangements for implementation of ESPP is shown in **Figure 8** (on next page). A three-tier support structure has also been developed at corporate, regional and site level with following functions for effective implementation of environment and social safeguard measures.

8.1.1 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 & Social Management Department (ESMD) by incorporating social aspect of project. Briefly, the ESMD's responsibilities are as follows:

- Advising and coordinating RHQs and Site Offices to carry out environmental and social surveys for new projects;
- Assisting RHQs and Site Offices to finalize routes of entire power transmission line considering environmental and social factors that could arise en-route;
- Help RHQs and Site Offices 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 MoEFCC 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.

8.1.2 Regional Level

At its Regional Office 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 envisaged for ESMC are:

- 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 transmission lines 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.

8.1.3 Site Office

At the Divisional Headquarters level, POWERGRID has made the head of the division responsible for implementing the environmental and social aspect of project and are termed as 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 & Interact with Revenue Authorities for land acquisition;
- Interact with the Forest Departments to make the forest proposal and follow it up for MoEFCC clearance;
- Implementation of Environment Management Plan (EMP);
- Monitoring of EMP & producing periodic reports on the same.

From above, it may be noted that POWERGRID is well equipped to implement and monitor its environment and social management plans.

As regards monitoring of impacts on ecological resources particularly in Forest and Protected areas like Wildlife Sanctuaries or National Parks, it is generally done by the concerned Divisional Forest Officer, Chief Wildlife Warden and their staff as a part of their normal duties.

8.2 ENVIRONMENTAL MANAGEMENT PLAN

A detailed Environment Management Plan (EMP), based on the provisions of POWERGRID's ESPP and including a monitoring plan for potential environmental and social impacts and their proper management, has been prepared (Table 8.1) and will be implemented during various stages of project execution. Since many provisions of EMP are to be implemented by contractors, the proper monitoring of the provisions of the EMP has been included in their contract documents.

Figure 4: Institutional Arrangement for Implementation ESPP

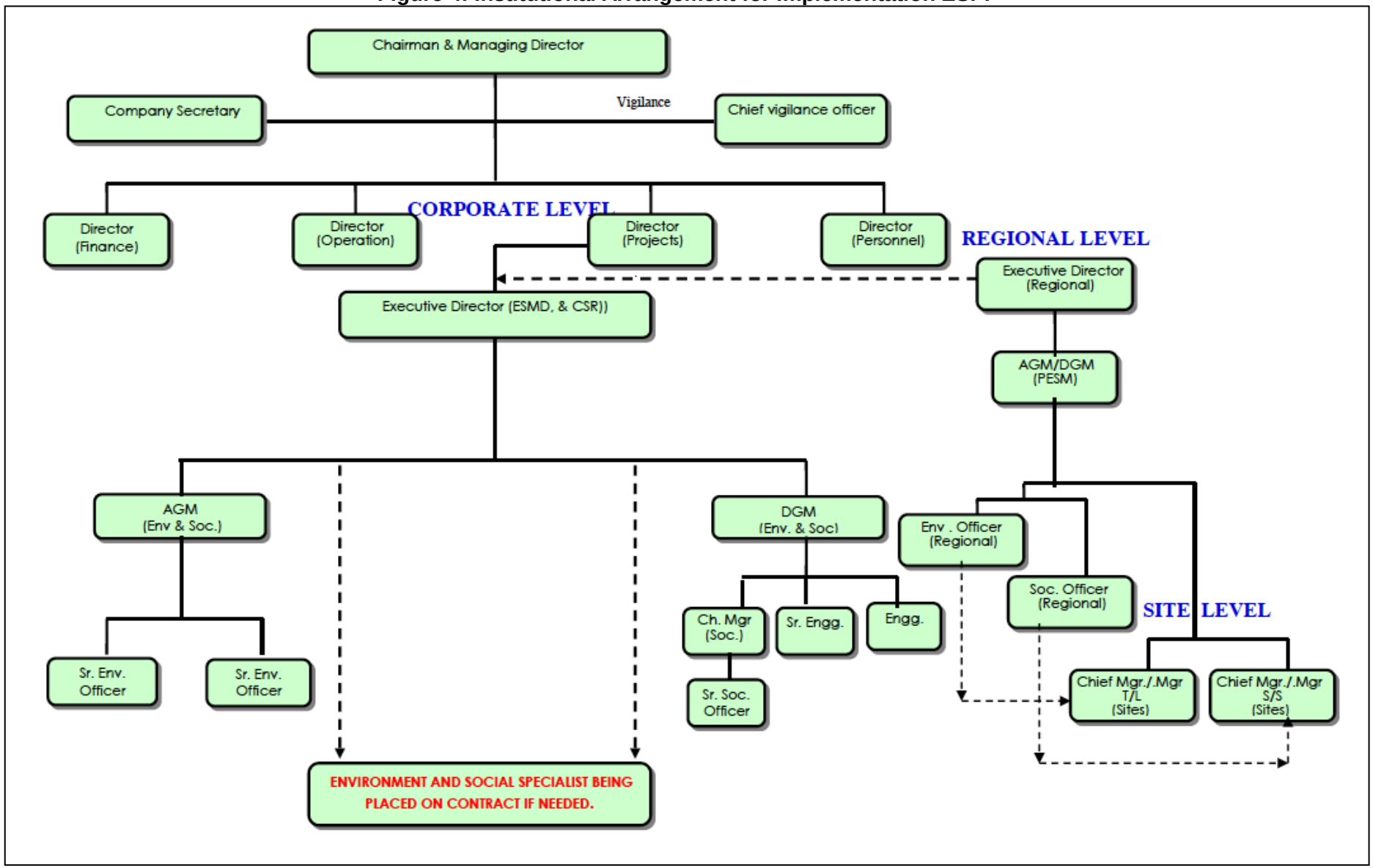

Table 8.1: ENVIRONMENT MANAGEMENT PLAN

Clause No.	Project activity/ stage	Potential Impact	Proposed mitigation measures	Parameter to be monitored	Measurement & frequency	Institutional responsibility	Implementation schedule
Pre-construction							
1	Location of line towers and line alignment and design	Exposure to safety related risks	Setback of dwellings to line route designed in accordance with permitted level of power frequency and the regulation of supervision at sites.	Tower location and alignment selection with respect to nearest dwellings	Setback distances to nearest houses – once	POWERGRID	Part of tower sitting survey and detailed alignment survey and design
2	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 Phase out schedule to be prepared in case still in use – once	POWERGRID	Part of tender specifications for the equipment Part of equipment and process design
3	Transmission line design	Exposure to electromagnetic interference	Line design to comply with the limits of electromagnetic interference from power lines	Electromagnetic field strength for proposed line design	Line design compliance with relevant standards – once	POWERGRID	Part of design parameters
4	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
		Social inequities	Careful selection of site to avoid encroachment of socially, culturally and archaeological sensitive areas (i.e., sacred groves, graveyard, religious worship place, monuments, etc.). If any treasure, or archaeological artifacts are found, the same shall be	Selection of substation location (distance to sensitive area).	Consultation with local authorities – once Consultation with ASI and/or religious authorities if chance finds of an archaeological or sacred nature are encountered.	POWERGRID	Part of detailed siting survey and design Archaeological chance find procedures used as necessary

Clause No.	Project activity/ stage	Potential Impact	Proposed mitigation measures	Parameter to be monitored	Measurement & frequency	Institutional responsibility	Implementation schedule
			intimated in writing to Collector/Archaeology department as per the provisions of Section-4 of "Indian Treasure Trove Act, 1878 as amended in 1949". The Collector shall initiate further action for its safe custody or its shifting to Treasury/ Secure place. The construction activity may be suspended temporarily during this process.				
5	Location of line towers & line alignment and design	Impact on water bodies	Avoidance of such water bodies to the extent possible. Avoidance of placement of tower inside water bodies to the extent of possible	Tower location and line alignment selection (distance to water bodies)	Consultation with local authorities– once	POWERGRID	Part of tower siting survey and detailed alignment survey and design
		Social inequities	Careful route selection to avoid existing settlements and sensitive locations	Tower location and line alignment selection (distance to nearest dwellings or social institutions)	Consultation with local authorities and land owners – once	POWERGRID	Part of tower siting survey and detailed alignment survey and design Archaeological chance find procedures used as necessary
			Minimise impact on agricultural land	Tower location and line alignment selection (distance to agricultural land)	Consultation with local authorities and land owners – once		

Clause No.	Project activity/ stage	Potential Impact	Proposed mitigation measures	Parameter to be monitored	Measurement & frequency	Institutional responsibility	Implementation schedule
			Careful selection of site and route alignment to avoid encroachment of socially, culturally and archaeological sensitive areas (i. g. sacred groves, graveyard, religious worship place, monuments etc.) If any treasure, or archaeological artifacts are found, the same shall be intimated in writing to Collector/Archaeology department as per the provisions of Section-4 of "Indian Treasure Trove Act, 1878 as amended in 1949". The Collector shall initiate further action for its safe custody or its shifting to Treasury/ Secure place. The construction activity may be suspended temporarily during this process	Tower location and line alignment selection (distance to sensitive area)	Consultation with local authorities –once Consultation with ASI and/or religious authorities if chance finds of an archaeological or sacred nature are encountered		
6	Securing lands for substations**	Loss of land/ income change in social status etc.	In the case of Involuntary Acquisitions, Compensation and R&R measures are extended as per provision of RFCTLARRA, 2013[5]	Compensation and monetary R&R amounts/ facilities extended before possession of land.	As per provisions laid out in the act	POWERGRID	Prior to award/start of substation construction.
7	Line through protected area/ precious ecological area	Loss of precious ecological values/ damage to precious species	Avoid siting of lines through such areas by careful site and alignment selection (National Parks, Wildlife Sanctuary, Biosphere Reserves/ Biodiversity Hotspots)	Tower location and line alignment selection (distance to nearest designated ecological protected/ sensitive areas)	Consultation with local forest authorities - once	POWERGRID	Part of tower siting survey and detailed alignment survey and design

[5] In the instant case, no involuntary acquisition of land is involved. Hence this clause shall not be applicable.

Clause No.	Project activity/ stage	Potential Impact	Proposed mitigation measures	Parameter to be monitored	Measurement & frequency	Institutional responsibility	Implementation schedule
			Minimize the need by using RoW wherever possible	Tower location and line alignment selection	Consultation with local authorities and design engineers - once	POWERGRID	Part of tower siting survey and detailed alignment survey and design
8	Line through identified Elephant corridor / Migratory bird	Damage to the Wildlife/ Birds and also to line	Study of earmarked elephant corridors to avoid such corridors, Adequate ground clearance, Fault clearing by Circuit Breaker, Barbed wire wrapping on towers, reduced spans etc., if applicable	Tower location and line alignment selection. Minimum/maximum ground clearance	Consultation with local forest authorities – once. Monitoring – quarterly basis	POWERGRID	Part of tower sitting and detailed alignment survey & design and Operation
			Avoidance of established/ identified migration path (Birds & Bats). Provision of flight diverter/ reflectors, bird guard, elevated perches, insulating jumper loops, obstructive perch deterrents, raptor hoods etc[6]., if applicable	Tower location and line alignment selection	Consultation with local forest authorities - once	POWERGRID	Part of tower siting survey and detailed alignment survey and design
9	Line through forestland	Deforestation and loss of biodiversity edge effect	Avoid locating lines in forest land 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 tower siting survey and detailed alignment survey and design
			Minimise the need by using existing towers, tall towers and RoW, wherever possible		Consultation with local authorities and design engineers – once		
			Measures to avoid invasion of alien species	Intrusion of invasive species	Consultation with local forest authorities - once		
			Obtain statutory clearances from the Government	Statutory approvals from Government	Compliance with regulations – once for each subproject		
10	Lines through farmland	Loss of agricultural production/ change in	Use existing tower or footings wherever possible.	Tower location and line alignment selection	Consultation with local authorities and design engineers – once	POWERGRID	Part of detailed alignment survey and design

[6] As per International/National best practices and in consultation with concerned forest/wildlife Authority.

Clause No.	Project activity/ stage	Potential Impact	Proposed mitigation measures	Parameter to be monitored	Measurement & frequency	Institutional responsibility	Implementation schedule
		cropping pattern	Avoid sitting new towers on farmland wherever feasible	Tower location and line alignment selection	Consultation with local authorities and design engineers – once		Part of detailed sitting and alignment survey /design
			Compensation for tower base: 85% of land value as determined by competent authority Compensation for diminution of land value in the width of RoW Corridor due to laying of transmission line: 15% of land value as determined by competent authority	Tower location and line RoW corridor	Consultation with local authorities and design engineers – periodic		Part of detailed siting and alignment survey /design
11	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
12	Interference with drainage patterns/ irrigation channels	Flooding hazards/ loss of agricultural production	Appropriate sitting 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
13	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 clean up equipment.	Equipment specifications with respect to potential pollutants	Tender document to mention specifications – once	POWERGRID	Part of detailed equipment design /drawings
			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
14	Equipments submerged under flood	Contamination of receptors	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	Part of detailed substation layout and design/drawings

Clause No.	Project activity/ stage	Potential Impact	Proposed mitigation measures	Parameter to be monitored	Measurement & frequency	Institutional responsibility	Implementation schedule
15	Explosions /Fire	Hazards to life	Design of substations to include modern fire fighting equipment 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							
16	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
17	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 crop – once per site	POWERGRID (Contractor through contract provisions)	Construction period
18	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
19	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 carriage –way width within RoW – every 2 weeks	POWERGRID (Contractor through contract provisions)	Construction period

Clause No.	Project activity/ stage	Potential Impact	Proposed mitigation measures	Parameter to be monitored	Measurement & frequency	Institutional responsibility	Implementation schedule
20	Construction activities	Safety of local villagers	Coordination with local communities for construction schedules, Barricading the construction area and spreading awareness among locals	Periodic and regular reporting /supervision of safety arrangement	No. of incidents- once every week	POWERGRID (Contractor through contract provisions)	Construction period
		Local traffic obstruction	Coordination with local authority/ requisite permission for smooth flow of traffic	Traffic flow (Interruption of traffic)	Frequency (time span)- on daily basis	POWERGRID (Contractor through contract provisions)	Construction period
21	Temporary blockage of utilities	Overflows, reduced discharge	Measure in place to avoid dumping of fill materials in sensitive drainage area	Temporary fill placement (m^3)	Absence of fill in sensitive drainage areas – every 4 weeks	POWERGRID (Contractor through contract provisions)	Construction period
22	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
			No use of herbicides and pesticides				
23	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 max. 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
24	Wood/ vegetation	Loss of vegetation and	Construction workers prohibited from harvesting	Illegal wood /vegetation harvesting (area in m^2,	Complaints by local people or other evidence	POWERGRID (Contractor	Construction period

Clause No.	Project activity/ stage	Potential Impact	Proposed mitigation measures	Parameter to be monitored	Measurement & frequency	Institutional responsibility	Implementation schedule
	harvesting	deforestation	wood in the project area during their employment, (apart from locally employed staff continuing current legal activities)	number of incidents reported)	of illegal harvesting – every 2 weeks	through contract provisions)	
25	Surplus earthwork/soil	Runoff to cause water pollution, solid waste disposal	Soil excavated from tower footings/ substation foundation disposed of by placement along roadsides, or at nearby house blocks if requested by landowners	Soil disposal locations and volume (m^3)	Acceptable soil disposal sites – every 2 weeks	POWERGRID (Contractor through contract provisions)	Construction period
26	Substation construction**	Loss of soil	Loss of soil is not a major issue as excavated soil will be mostly reused for leveling and re-filling. However, in case of requirement of excess soil the same will be met from existing quarry or through deep excavation of existing pond or other nearby barren land with agreement of local communities	Borrow area sitting (area of site in m^2 and estimated volume in m^3)	Acceptable soil borrow areas that provide a benefit - every 2 weeks	POWERGRID (Contractor through contract provisions)	Construction period
		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(P^H, BOD /COD, Suspended solids, others)	Timing of major disturbance activities – prior to start of construction activities	POWERGRID (Contractor through contract provisions))	Construction period
27	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		
28	Tower erection Substation foundation-disposal of surplus earthwork/fill	Waste disposal	Excess fill from substation/tower foundation excavation disposed of next to roads or around houses, in agreement with the local community or landowner.	Location and amount (m^3)of fill disposal	Appropriate fill disposal locations – every 2 weeks	POWERGRID (Contractor through contract provisions)	Construction period

Clause No.	Project activity/ stage	Potential Impact	Proposed mitigation measures	Parameter to be monitored	Measurement & frequency	Institutional responsibility	Implementation schedule
29	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
30	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
31	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
32	Influx of migratory workers	Conflict with local population to share local resources	Using local workers for appropriate asks	Avoidance/reduction of conflict through enhancement/ augmentation of resource requirements	Observation & supervision–on weekly basis	POWERGRID (Contractor through contract provisions)	Construction period
33	Lines through farmland	Loss of agricultural productivity	Use existing access roads wherever possible	Usage of existing utilities	Complaints received by local people /authorities - every 4 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)			
			Repair /reinstate damaged bunds etc after construction completed	Status of facilities (earthwork in m^3)			
		Loss of income.	Land owners/ farmers compensated for any temporary loss of productive land as per existing regulation.	Process of Crop/tree compensation in consultation with forest dept.(for timber yielding tree) and Horticulture deptt.(for fruit bearing tree)	Consultation with affected land owner prior to implementation and during execution.	POWERGRID	During construction

Clause No.	Project activity/ stage	Potential Impact	Proposed mitigation measures	Parameter to be monitored	Measurement & frequency	Institutional responsibility	Implementation schedule
34	Uncontrolled erosion/silt runoff	Soil loss, downstream siltation	Need for access tracks minimised, 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				
35	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
			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
36	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 on-going construction activities	Contract clauses (e.g. suspended solids and BOD/COD in receiving water)	Incorporating good construction management practices- once for each site	POWERGRID (Contractor through contract provisions)	Construction period

Clause No.	Project activity/ stage	Potential Impact	Proposed mitigation measures	Parameter to be monitored	Measurement & frequency	Institutional responsibility	Implementation schedule
37	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
38	Inadequate siting of borrow areas (quarry areas)	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 site	POWERGRID (Contractor through contract provisions))	Construction period
39	Health and safety	Injury and sickness of workers and members of the public	Safety equipment's (PPEs) for construction workers	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
			Contract provisions specifying minimum requirements for construction camps				
			Contractor to prepare and implement a health and safety plan.				
			Contractor to arrange for health and safety training sessions				
40	Inadequate construction stage monitoring	Likely to maximise damages	Training of environmental monitoring personnel	Training schedules	No. of programs attended by each person – once a year	POWERGRID	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							
41	Location of line towers and line alignment & 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.	Compliance with setback distances ("as-built" diagrams)	Setback distances to nearest houses – once in quarter	POWERGRID	During operations
42	Line through	Injury/	Avoidance of established/	Regular monitoring for any	No. of incidents- once	POWERGRID	Part of detailed

Clause No.	Project activity/ stage	Potential Impact	Proposed mitigation measures	Parameter to be monitored	Measurement & frequency	Institutional responsibility	Implementation schedule
	identified bird flyways, migratory path	mortality to birds, bats etc due to collision and electrocution	identified migration path (Birds & Bats). Provision of flight diverter/reflectors, elevated perches, insulating jumper loops, obstructive perch deterrents, raptor hoods etc., if applicable	incident of injury/mortality	every month		siting and alignment survey /design and Operation
43	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
44	Oil spillage	Contamination of land/nearby water bodies	Substation transformers located within secure and impervious sump areas with a storage capacity of at least 100% of the capacity of oil in transformers and associated reserve tanks.	Substation bunding (Oil sump) ("as-built" diagrams)	Bunding (Oil sump) capacity and permeability - once	POWERGRID	During operations
45	SF_6 management	Emission of most potent GHG causing climate change	Reduction of SF6 emission through awareness, replacement of old seals, proper handling & storage by controlled inventory and use, enhance recovery and applying new technologies to reduce leakage	Leakage and gas density/level	Continuous monitoring	POWERGRID	During Operations
46	Inadequate provision of staff/workers health and safety during operations	Injury and sickness of staff /workers	Careful design using appropriate technologies to minimise 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	Design and operation
			Safety awareness raising for staff.	Training/awareness programs and mock drills	Number of programs and percent 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		

Clause No.	Project activity/ stage	Potential Impact	Proposed mitigation measures	Parameter to be monitored	Measurement & frequency	Institutional responsibility	Implementation schedule
47	Electric Shock Hazards	Injury/ mortality to staff and public	Careful design using appropriate technologies to minimise hazards	Usage of appropriate technologies (no. of injury incidents, lost work days)	Preparedness level for using these technology 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 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 percent of total persons covered –once each year		
48	Operations and maintenance staff skills less than acceptable	Unnecessary environmental losses of various types	Adequate training in O&M to all relevant staff of substations & line maintenance crews.	Training/awareness 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				
49	Inadequate periodic environmental monitoring.	Diminished ecological and social values.	Staff to receive training in environmental monitoring of project operations and maintenance activities.	Training/awareness programs and mock drills for all relevant staff	Number of programs and percent of staff covered – once each year	POWERGRID	Operation
50	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 Govt.	Process, equipment and system design	Phase out schedule to be prepared in case still in use – once in a quarter	POWERGRID	Operations
51	Transmission line maintenance	Exposure to electromagneti c interference	Transmission line design to comply with the limits of electromagnetic interference from overhead power lines	Required ground clearance (meters)	Ground clearance -once	POWERGRID	Operations
52	Uncontrolled growth of vegetation	Fire hazard due to growth of tree/shrub /bamboo along	Periodic pruning of vegetation to maintain requisite electrical clearance. No use of herbicides/	Requisite clearance (meters)	Assessment in consultation with forest authorities - once a year(pre-monsoon/post-	POWERGRID	Operations

Clause No.	Project activity/ stage	Potential Impact	Proposed mitigation measures	Parameter to be monitored	Measurement & frequency	Institutional responsibility	Implementation schedule
		RoW	pesticides		monsoon		
53	Noise related	Nuisance to neighbouring properties	Substations sited and designed to ensure noise will not be a nuisance.	Noise levels {dB(A)}	Noise levels at boundary nearest to properties and consultation with affected parties if any - once	POWERGRID	Operations

***** These measures will not be applicable in the instant case since no new substation is covered under the present scope of works.***

8.3 EMP COST ESTIMATE

A budget estimate towards tree/crop compensation and EMP implementation is prepared and is placed at **Annexure-10**. A summary of the same is presented in Table 8.2. The preliminary estimated cost of the environmental and social management for Scheme 2 components including implementation and monitoring is INR 2810.15 million.

Table 8.2: Summary of EMP Cost Estimate

S. N.	Budgetary Head	Amount (Rs. Lakhs)
1	Forest compensation	460.00
2	Tree & Crop Compensation	3050.00
3	Land Compensation for Tower Base and RoW Corridor	24520.00
4	Implementation Monitoring & Audit	71.50
Total		**28101.50**

Any other measures like provision of bird guards, spike guards, barbed wire fencing or any other arrangement for addressing the issues like bird hit/animal/elephant scratching etc. shall be finalized only after detailed/ check survey and finalization of route alignment. Since the detailed/ check survey is part of main package requirement of such measures, its extent and estimated cost shall be incorporated in the revised cost estimate proposal which is normally prepared for all projects as there is a considerable time gap between planning and actual implementation. However, as per the preliminary assessment such additional measures may not be required in the instant scheme as no such impact are envisaged due to routing of lines far away from such sensitive areas.

8.4 GRIEVANCE REDRESSAL MECHANISM

Grievance Redress Mechanism (GRM) is an integral and important mechanism for addressing/resolving the concern and grievances in a transparent and swift manner. Many minor concerns of peoples are addressed during public consultation process initiated at the beginning of the project. For handling grievance, Grievance Redress Committee (GRC) will be established at two places, one at the project/scheme level and another at Corporate/HQ level. The GRCs shall include members from POWERGRID, Local Administration, Panchayat Members, Affected Persons representative and reputed persons from the society on nomination basis under the chairmanship of project head. The composition of GRC shall be disclosed in Panchayat/Village council offices and concerned district headquarter for wider coverage.

The complainant will also be allowed to submit its complaint to local project official who will pass it to GRC immediately but not more than 5 days of receiving such complaint. The first meeting of GRC will be organized within 15 days of its constitution/disclosure to formulate procedure and frequency of meeting. However, GRC meeting shall be convened within 15 days of receiving a grievance for its solution. GRC endeavor will be to pronounce its decision/ may also refer it to corporate GRC for solution within 30-45 days of receiving grievances. In case complainant/appellant is not satisfied with the decision of GRC they can approach POWERGRID Corporate Level Committee/District Collector or Court of law for solution.

The corporate level GRC shall function under the chairmanship of Director (Project) who will nominate other members of GRC including one representative from corporate ESMC who is conversant with the environment & social issues. The meeting of Corporate GRC shall be convened within 7-10 days of receiving the reference from project GRC or complainant directly and pronounce its decision within next 15 days.

8.5 ENVIRONMENTAL REVIEW

Periodic review by corporate ESMD and higher management including review by POWERGRID CMD of all environmental and social issues is under taken to ensure that EMP and other measures are implemented at site. Besides it annual review by Independent Auditor under ISO: 14001 shall also be undertaken for compliance of agreed policy and management plan.

SECTION – IX: CONCLUSIONS

It is clear from the above assessment/studies that none of the proposed Scheme 2 components are in environmentally sensitive areas. Also the project area has limited natural forest resources. Through careful route selection the lines have completely avoided protected areas; however, in the case of the 400kV Pugalur-Thiruvalam line 23 ha of reserve forest would be affected due to geographical constraints and location of substations/load centers. However, route is so aligned that it involves minimum forest area and there will be minimum vegetation loss and other environment impacts. Moreover, with implementation of various management measures as listed in EMP, it is envisaged that intensity of possible impacts shall be nullified to the extent possible. The infrastructural constraints are very real and pose a limiting factor on the development of the area.

Best available technology and best management practices are built-in to the project design. All project components will be implemented and monitored in line with the Environmental and Social Policy and Procedures of Power Grid Corporation of India Limited, which is broadly in line with AIIB's Environmental and Social Policy and Environmental and Social Standards. A semi-annual environmental monitoring report will be submitted to AIIB and will be disclosed publicly at POWERGRID and AIIB websites.