Energy That Moves Life

Environmental Impact Assessment

of

132 kV Interconnection Scheme loop in-out from existing Dhabeji- Gharo Circuit up to the interconnection point to Oursun Solar PV Power Project

Final Report

Global Environmental Management Services

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K-Electric Limited

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EXECUTIVE SUMMARY

This report discusses the Environmental and Socio-economic Impact Assessment of the proposed project for electricity power supply infrastructure.

The proposed project comprises of installation of a T-Off Tower at the existing Dhabeji-Gharo Circuit located along the National Highway and 5.7 km Overhead Transmission line connecting to Oursun's solar power plant located along the Sindh Coastal Highway.

The proposed project is expected to fulfill the electricity requirements of Karachi city by importing the power generated from Oursun solar power plants as K-Electric's first renewable energy based source.

NEED OF THE PROJECT

K-Electric is working hard to solve the electricity shortage problem in Karachi City. Oursun is under the process of developing Solar Power Plants. These plants will have the capacity to generate approximately 35 MW of power. Oursun intends to export to the K-Electric System as it understands that there is constant need of power supply to the country and the proposed project area in itself is feasible for installing renewable energy projects. K-Electric, being an environmentally conscious electric utility, has proposed this project for the first time to extend the existing circuit and import renewable energy produced by Oursun's Solar Power Plant to overcome the electricity supply shortages in the city. Since Oursun's Power Plant project is already under implementation stage, it is necessary to develop the transmission line as well to utilize the additional power that will be generated from the plant on an urgent basis.

PROPONENT INTRODUCTION

K-Electric, commonly referred to as KE is a Pakistani vertically integrated electric company involved in generating, transmitting and distributing power to over 2.5 million customers in Karachi and in the nearby towns of Dhabeji and Gharo in Sindh, and Hub, Uthal, Vinder and Bela in Balochistan. It employs over 10,000 people and covers 6,500 square kilometers with industrial, commercial, agricultural and residential areas falling under its network. K-Electric has its own generation capacity of 1,652 MW, predominantly from its major

Thermal Power Plants (BQPS I, BQPS II and KPC) and two Gas Engines Power Plants (SITE & Korangi), inclusive of 450 MW that has been added owing to the initiatives of the new management and the company inaugurated an additional 560 MW project in 2012.

K-Electric being a prestigious and environmentally conscious organization wants to comply with all applicable laws and therefore intends to carry out the environmental impact assessment of its transmission line project.

PROJECT AREA

The proposed project area lies about 60 km southeast of the city of Karachi, at the Sindh Coastal Highway. It is located right at the junction of National Highway (N-5) and Sindh Coastal Highway between the cities of Dhabeji and Gharo.

PROJECT DESCRIPTION

The ESIA study includes the following component of the transmission project which is described below.

Scope and Design:

Oursun has planned to develop Solar Power Plants at Sindh Coastal Highway at Bhambore, District Thatta and sublet electricity to K-Electric; the purpose is to extend the existing Dhabeji-Gharo Circuit and import power from these plants;

- A Double Circuit 132 kV 400mm^2 Copper Overhead transmission line will be erected from a new T-Off Tower at the existing Dhabeji-Gharo Circuit of 5.7 km to connect to the Gantry of Oursun plant which are located at the Sindh Coastal Highway;
- A temporary Overhead transmission line arrangement of 2x2 = 4 km will be installed along the existing Dhabeji-Gharo Circuit and Gharo-RECP Circuit to create a slight diversion and space for the T-Off Tower so that after the commissioning of the Tower and line, the diverted lines can be reconnected and the circuit may carry the supply on normal basis.

LEGISLATIVE REQUIREMENT

The ESIA of the proposed K-Electric Project activity will be subjected to the pertinent legislative and regulatory requirements of the Government of Sindh including State laws. Legislation presents a synopsis of environmental policies, legislation and other guidelines that have relevance to the proposed project.

The proposed project falls under the project category of SCHEDULE II "*Transmission lines (11kV and above) and distribution projects*" as per the guidelines issued by the Environmental Protection Agency - Sindh (SEPA) under the Sindh Environmental Protection Act 2014 (SEPA 2014).

According to these guidelines, projects under this category require an EIA to be conducted. The Sindh Environmental Protection Act, 2014 (SEPA 2014) is the basic legislative tool empowering the provincial government to frame regulations for the protection of the environment. The SEPA 2014 is broadly applicable to air, water, soil, marine and noise pollution. Penalties have been prescribed for those contravening the provisions of the Act.

The two primary deliberations of the Act are the conduct of projects only after approval of environmental assessments from the relevant EPA and adherence with Sindh Environmental Quality Standards (SEQS).

Under section 17 of SEPA 2014, No proponent of a project shall commence construction or operation unless he has filed with the EPA an IEE or EIA, and has obtained from the EPA approval in respect thereof.

PHYSICAL ENVIRONMENT

The proposed project area lies on the main Sindh Coastal Highway where it begins from the National Highway turning. At present, the area is completely barren and is close to the Sindh creek system. Proposed project area is found to be windy and relatively less rainfall is recorded in the region. The area is selected by the Government of Sindh as a viable area for renewable energy projects. The area has both underground and surface water resources where the local people who live in hamlets utilize the water for irrigation, livestock and drinking purposes.

BIOLOGICAL ENVIRONMENT

Data for the ESIA was gathered from both primary and secondary sources. Baseline field survey was conducted in June 2016. No endangered or threatened species were found to be existent within the project areas. Since the areas represent semi-rural environment, minimal floral habitat was found that may need special attention, the project will be carefully executed to eliminate unnecessary damage to vegetation. The proposed project area does not seem to provide favorable conditions for ecosystems to flourish. No trees were found along the proposed transmission line route.

SOCIOECONOMIC ENVIRONMENT

The proposed project area can be considered as suburbs of Gharo city as it lies on the main Sindh Coastal Highway. No major settlements were found along the proposed transmission line route, however sparse hamlets were identified during the survey. The people are mostly illiterate and their lifestyle depends on livestock and agriculture. Locals live a simple lifestyle that lack health and other essential facilities. Thereby they look forward for a safe and a better way of living. An archeological site of Sindh namely, Bhambore Excavations and Heritage site is found near the proposed project area. However, the site is not going to be affected by the proposed project.

IMPACT ASSESSMENT & MITIGATIONS

The transmission line is not an air, water polluting and resource intensive sector. However, there can be considerable environmental impacts during the initial construction phase mainly due to civil works such as site preparation, vehicle movement etc. Construction phase impacts are usually temporary and localized phenomenon, except the permanent changes that may occur in the local landscape and land use patterns along the Right-of–Way. However, these impacts are given due consideration, wherever applicable.

The operational phase may have some environmental impacts including electrical hazards due to meteorological conditions and generation of EMF. These can be mitigated or minimized by proper vigilance. The mitigations for these impacts are summarized in the Environmental Management Plan.

CONCLUSION

The ESIA of the proposed transmission line project has achieved the following goals:

- Identification of national and provincial environmental regulatory requirements that apply to the proposed project activities;
- Identification of the environmental features of the project area including the physical, biological and social disturbance and likely impact of the project on the environment;
- Recommendation of appropriate mitigation measures that K-Electric will incorporate and ensure as per this ESIA into the project to minimize the adverse environmental impacts;
- The study was intended to generate factual information on power transmission lines and their potential applications.

"If the activities are undertaken as proposed and described in this report and the recommended mitigation measures and environmental management plan is adopted, it is concluded that the proposed project will increase the existing K-Electric's capacity to deliver the necessary load without causing any negative impact. The proposed project is favorable in all respects which include system capacity, economics, minimization of losses and environmental impacts."

Aspect	Impact	Mitigation	Monitoring Parameter	Location	Frequency of Monitoring	Responsibility
Air	Chronic health effects Reduced visibility on roads	Sprinkling of water Tuning of construction vehicles & machines Dust masks for laborers Monitoring of vehicular emission Monitoring of Ambient Air	Particulate Matter Smoke CO SOx NOx	All project locations	Monthly	Contractor K-Electric
Noise	Stress Hypertension Hearing loss Headache	Avoid working at night Lubrication of construction vehicles Ear plugs Monitoring of Ambient Noise Monitoring of noise (near construction machinery)	Noise levels	Project location close to residential areas	Monthly	Contractor K-Electric
Land and soil	Soil erosion on barren access routes	Water sprinkling and develop gravel path if required	Surface topography	All project locations	Continuous	Contractor K-Electric
Vegetation	No cutting of trees is involved	In case of cutting of trees, one plant should be replaced by 1:3 for immature plants and 1:6 for mature plants	No of trees cleared or cut Ensure re-plantation by appropriate tree compensation ratio of same species	All project locations	Continuous	K-Electric

Aspect	Impact	Mitigation	Monitoring Parameter	Location	Frequency of Monitoring	Responsibility
Water	Wastage and misuse of water	Avoid un necessary use of water Prevent leakages	Record log of water usage	All project locations	Continuous	Contractor
Social Environment	Disturbance to routine activities Conflicts between laborers and local communities	Specify time scale for construction activities Discussion with local people regarding conflicts if any	Review of complaint register Local Consultations	All project locations	Monthly	K-Electric
Roads and networks	Traffic congestion leading to accidents	Diversion routes must be notified to maintain traffic flow Signs and reflectors must be boarded for driver's visibility at night	Signs and detours are being followed	Intersections of diversions	Monthly	Contractor
Health and Safety	Lack of awareness among general public about safety may lead to accidents Incompetent and untrained workers might cause harm to themselves and others Construction works may include many risks and hazards that may lead to injuries or even death	Safety symbols and instructions will be boarded at work sites Trained personnel will be appointed for the specific work Appropriate PPEs must be used for technical work	Record of Safety Talks Record of safety Incidents (Major & Minor) Record of PPEs Visual Assessments	On all project sites	Monthly	Contractor K-Electric

Aspect	Impact	Mitigation	Monitoring Parameter	Location	Frequency of Monitoring	Responsibility
Operational Phase						
Meteorological conditions **(Heavy rainfalls, strong winds etc.)**	Accidents • Electrocution • Injuries	In case of breakage, ensure emergency shutdown of transmission line Immediately repair the damage and ensure Log-Off-Tag-Off (LOTO) Implement HSE & Emergency Response Plans	HSE Inspection Reports	All project components Grids	Biannually	K-Electric
Electric Magnetic Field (EMF)	Human health impacts such as, neuropsychological disorders or cardiovascular diseases	Appropriate cabling with protective shields to suppress electron flux	EMF Intensity	Neighboring communities near the corridor	Biannually	K-Electric

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

This report discusses the Environmental and Socio-economic Impact Assessment of the proposed project for electricity power supply infrastructure.

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The proposed project is expected to fulfill the electricity requirements of Karachi city by importing the power generated from Oursun solar power plants as K-Electric's first renewable energy based source.

The proposed project falls under the project category of Schedule II "Transmission Lines (11 kV and above) and distribution projects" as per the guidelines issued by the Sindh Environmental Protection Agency (SEPA) under the Sindh Environmental Protection Act 2014 (SEPA 2014). According to these guidelines, projects under this category require an Environmental Impact Assessment (EIA) to be conducted.

1.2 PROPONENT INTRODUCTION

K-Electric, commonly referred to as KE is a Pakistani vertically integrated electric company involved in generating, transmitting and distributing power to over 2.5 million customers in Karachi and in the nearby towns of Dhabeji and Gharo in Sindh, and Hub, Uthal, Vinder and Bela in Balochistan. It employs over 10,000 people and covers 6,500 square kilometers with industrial, commercial, agricultural and residential areas falling under its network. K-Electric has its own generation capacity of 1,652 MW, predominantly from its major Thermal Power Plants (BQPS I, BQPS II and KPC) and two Gas Engines Power Plants (SITE & Korangi), inclusive of 450 MW that has been added owing to the initiatives of the new management and the company inaugurated an additional 560 MW project in 2012.

K - Electric being a prestigious and environmentally conscious organization wants to comply with all applicable laws and therefore intends to carry out the EIA of its transmission line project.

1.3 NEED OF THE PROJECT

K-Electric is working hard to solve the electricity shortage problem in Karachi City. Oursun is under the process of developing Solar Power Plants. These plants will have the capacity to generate approximately 35 MW of power. Oursun intends to export to the K-Electric System as it understands that there is constant need of power supply to the country and the proposed project area in itself is feasible for installing renewable energy projects. K-Electric, being an environmentally conscious electric utility, has proposed this project for the first time to extend the existing circuit and import renewable energy produced by Oursun's Solar Power Plant to overcome the electricity supply shortages in the city. Since Oursun's Power Plant project is already under implementation stage, it is necessary to develop the transmission line as well to utilize the additional power that will be generated from the plant on an urgent basis.

1.4 PURPOSE OF THE STUDY

The purpose of this ESIA study is to evaluate the proposed extension project activities against Pakistan Environmental Protection Agency (PEPA) standards.

The specific objectives of this ESIA are to:

- Assess the existing environmental conditions in the proposed project area, including the identification of environmentally sensitive areas and receptors;
- Assess the various activities to identify their potential impacts on environment, evaluate these impacts, and determine their significance;
- Propose appropriate mitigation measures that can be incorporated into the rehabilitation plans of the proposed project to minimize damaging effects or lasting negative consequences identified by the environmental assessment;
- Assess the proposed activities and determine whether they comply with the relevant environmental regulations in Pakistan;
- Prepare an ESIA report for submission to the SEPA.

1.5 PROJECT AREA

The proposed project area lies about 60 km southeast of the city of Karachi, at the Sindh Coastal Highway. It is located right at the junction of National Highway (N-5) and Sindh Coastal Highway between the cities of Dhabeji and Gharo.

1.6 SCOPE OF THE ESIA

For the ESIA study, the scope of work is as under:

- Description of physical, environmental, socio-economical and cultural conditions in the proposed project area;
- Project impact identification, prediction, and significance based on proposed project activities.
- Identification and assessment of the workability of mitigation measures to offset or minimize negative project impacts on environment.

1.7 APPROACH AND METHODOLOGY

The ESIA was performed in five main phases, which are described below.

1.7.1 Scoping

The key activities of this phase included:

Project Data Compilation: A generic description of the proposed activities, within the proposed project area relevant to environmental assessment, was compiled with the help of PEPA Guidelines.

Literature Review: Secondary data on weather, soil, water resources, and wildlife vegetation was reviewed and compiled.

Legislative Review: Information on relevant legislation, regulations, guidelines, and standards was reviewed and compiled.

Identification of Potential Impacts: The information collected in the previous steps was reviewed, and potential environmental issues were identified.

1.7.2 ESIA Project Team

The following members were the part of the ESIA team for this study.

S. No.	Name	Designation	Qualification
1.	Abdul Basit Khan	Sr. Environmental Officer / ESIA Project Leader	M.Sc. Environmental Sciences
2.	Muhammad Saleem	Sr. Ecologist / Botanist	M.Sc. Botany
3.	Baseer Khan	Environmental and Social survey specialist	M.Sc. Environmental Sciences
4.	Ali Aslam	Environmental monitoring specialist	M.Sc. Chemistry
5.	Kareem Akbar	Jr. Environmentalist	M.Sc. Environmental Sciences

1.7.3 Baseline Studies

Following the scoping exercise, the proposed project area was surveyed to collect primary data. During the field visits, information was collected on ecologically important areas, ambient air quality, surface and groundwater resources, existing infrastructure, local communities, public services, and sites of archaeological or cultural importance. The following specific studies were conducted as part of the ESIA.

Vegetation: A botanist conducted vegetation study, which consisted of a thorough literature review and field data collection. As part of the vegetation study, random sampling was conducted and the area's floral species were documented.

Vegetation communities were identified and vegetation cover determined.

Wildlife Study: A wildlife expert has conducted wildlife study, which consist of a thorough literature review and field data collection. During the fieldwork, the faunal species of the area were documented. The diversity of avian, large and small mammals, and reptile species was determined. Information was collected on the species found in the area.

Physical Environment: Environmental Assessment Specialist conducted physical environmental study including, ambient air, noise, water sampling, surface water resources and the groundwater resources of the areas. Specialists also carried out the impact of proposed project on soil and water resources

Socioeconomic Study: A sociologist conducted socioeconomic and cultural study in the proposed project area.

The study team through participatory technique collected data from the locals of the proposed project area. The profile included livelihood, culture, leadership, gender issues, spiritual and temporal leadership, demographic information based on field data and published sources, the existing use of land resources, community structure, employment, distribution of income, goods and services, public health, local religious and cultural values, and local customs, aspirations, and attitudes.

1.7.4 Impact Assessment

The environmental, socioeconomic and cultural, gender and project information collected in previous phases was used to assess the potential impacts of the proposed activities. The issues studied included potential project impacts on:

- Groundwater and surface water quality;
- Ambient air quality;
- Ecology of the area, including flora and fauna;
- Local communities.

Wherever possible and applicable, the discussion covers the following aspects:

- The present baseline conditions;
- The change in environmental parameters likely to be effected by proposed project related activities;
- Identification of potential impacts;
- Likelihood and significance of potential impacts;
- Mitigation measures to reduce impacts to as low as possible;
- Prediction of impacts, including all long-term and short-term, direct and indirect, and beneficial and adverse impacts;
- Evaluation of the importance or significance of impacts (The significance of each impact has been judged on the basis of available local, national, and international standards. Where such standards were not available, the best practice elsewhere has been referred to);
    - Implementation of mitigation measures (i.e., environmental management);
    - Determination of residual impacts;
    - Identification of controls and monitoring of residual impacts.

1.7.5 Documentation

At the end of the assessment, a report is prepared according to the relevant guidelines of PEPA. This report includes the findings of the assessment, proposed project impacts, and mitigation measures to be implemented during the execution of the proposed activities.

Components of this Report are:

Chapter: 1	Introduction
Chapter: 2	Project Description
Chapter: 3	Institutional, Legislation and policy framework
Chapter: 4	Physical Environment
Chapter: 5	Biological Environment
Chapter: 6	Socio-Economic and Cultural Environment
Chapter: 7	Stakeholder Consultation
Chapter: 8	Alternatives
Chapter: 9	Environmental Impacts Assessment & Environmental Management Plan
Chapter 10	Conclusion

CHAPTER 2

PROJECT DESCRIPTION

Electric power transmission is the bulk transfer of electrical energy between the point of generation and multiple substations near a populated area or load center. Transmission may be via overhead or underground lines, however, most transmission is done with overhead lines because they are less costly to construct and easier to maintain. Underground lines are generally restricted to urban areas.

The ESIA study includes the following components of the transmission project which is described below.

Scope and Design:

Oursun has planned to develop Solar Power Plants at Sindh Coastal Highway at Bhambore, District Thatta and sublet electricity to K-Electric; the purpose is to extend the existing Dhabeji-Gharo Circuit and import power from these plants;

- A Double Circuit 132 kV $400mm^2$ Copper Overhead transmission line will be erected from a new T-Off Tower at the existing Dhabeji-Gharo Circuit of 5.7 km to connect to the Gantry of Oursun plant which is located at the Sindh Coastal Highway

- A temporary Overhead transmission line arrangement of 2x2 = 4 km will be installed along the existing Dhabeji-Gharo Circuit and Gharo-RECP Circuit to create a slight diversion and space for the T-Off Tower so that after the commissioning of the Tower and line, the diverted lines can be reconnected and the circuit may carry the supply on normal basis.

The proposed Transmission line location map and layout map can be seen in **Exhibit 2.1.**

Exhibit 2.1: Transmission Line Location

2.1 PROJECT SCHEDULE

As per bid document, tentatively 10 months' time is allotted for project completion. A project schedule will be available after award of contract and it is expected to be from June, 2016 to April 2017.

2.2 OVERHEAD TRANSMISSION LINE

An overhead power line is an electric power transmission line suspended by towers or utility poles. Since most of the insulation is provided by air, overhead power lines are generally considered the lowest-cost method of transmission for large quantities of electric energy. Towers for support of the lines are made of steel (either lattice structures or tubular poles). The bare wire conductors on the line are made of aluminum (either plain or reinforced with steel or sometimes composite materials) or Copper. In this project, Copper wire will be used.

Installation of an overhead transmission lines generally involves the following sequence of events:

2.2.1 Retaining Walls

Retaining walls are built to hold back earth which would otherwise move downwards. The purpose is to stabilize slopes and provide useful areas at different elevations.

2.2.2 Construction of Foundation Wall

This involves drilling large holes, which are then typically filled with concrete for the steel structure foundation.

2.2.3 Erection of tower

Structures for overhead lines take a variety of shapes depending on the type of line. Tubular steel poles are typically used in urban areas. High-voltage lines are often carried on lattice-type steel towers or pylons.

2.2.4 Conductors

Suspension towers will have brackets (hangers) suitable for the attachment of insulator strings associated with suspension conductor support assemblies and shall be flexible on the direction of the line and rigid transverse to the line. The angle tension and terminal towers shall have brackets suitable for the attachment of insulator strings associated of an overhead earth wire clamp to the tower, holes shall be provided on the earth wire peak.

2.2.5 Grounding Wire

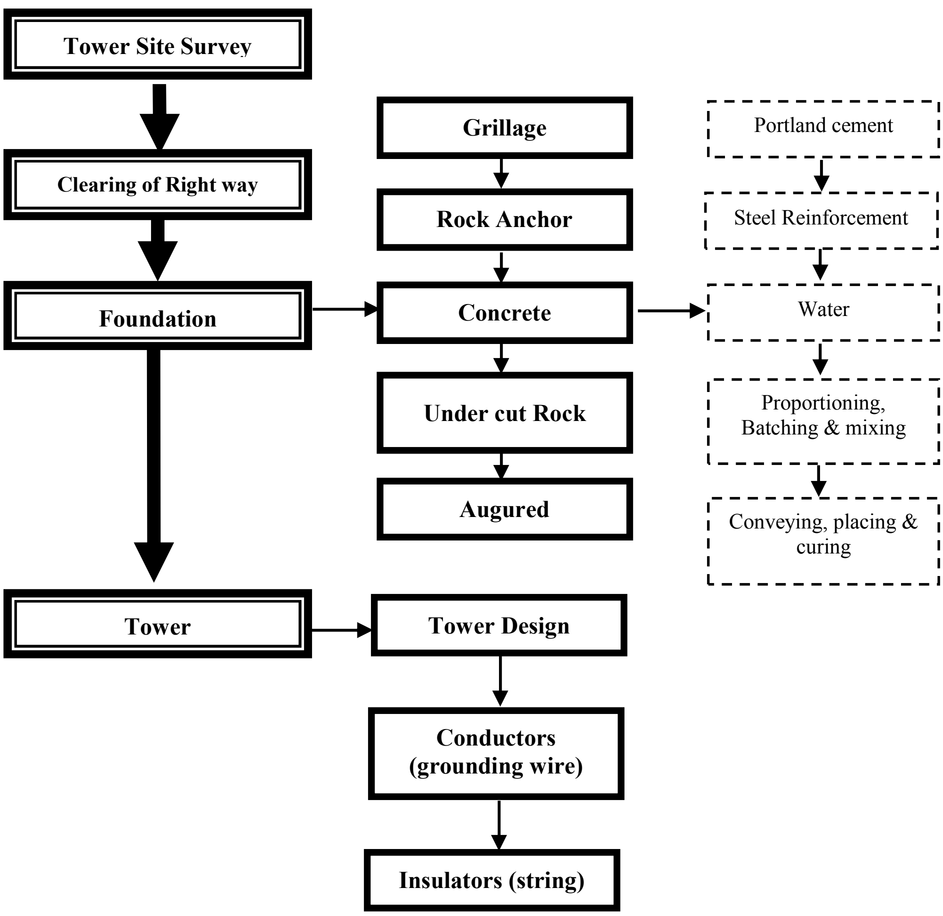
Optical Power Ground Wire (OPGW) is an earthing wire having fiber optic cable inside it. OPGW is primarily used by the electric utility industry, placed in the secure topmost position of the transmission line where it “shields” the all-important conductors from lightning. OPGW is capable of withstanding the mechanical stresses applied to overhead cables by environmental factors such as wind and ice. OPGW is also capable of handling electrical faults on the transmission line by providing a path to ground without damaging the sensitive optical fibers inside the cable.

2.2.6 Insulators

Insulators must support the conductors and withstand both the normal operating voltage and surges due to switching and lightning. Insulators are broadly classified as either pin-type, which support the conductor above the structure, or suspension type, where the conductor hangs below the structure.

A Standard Operating Procedure (S.O.P) is established by K-Electric for “Supervision of Erection, Testing & Commissioning (ETC) of Overhead & Underground Transmission Lines till taking over/ Handing-over & closure of project”. The S.O.P. is attached as **Annexure-1.** Furthermore a complete set of guidelines for installation of Overhead transmission lines is attached as **Annexure-2**.

Overhead Transmission Line process diagram



2.3 ROW CLEARANCES

When designing the Right-of-Way (ROW), K-Electric has complete in-house procedures to consult and obtain clearances from Municipal and District Government bodies, City Traffic Police, National Highway Authority (NHA) and Utilities Service Provider bodies (such as SSGC, PTCL etc.) to avoid any disturbance or disruption of utility services in the city. Furthermore, during commissioning phase of the project, K-Electric's supervisors will maintain their coordination with the relevant bodies to ensure smooth project completion.

2.4 HSEQ POLICY

K-Electric has a comprehensive Health, Safety and Environment policy as well as a protocol developed for third-party contractors and all parties involved in construction works of grid stations and transmission lines.

The 'HSEQ Policy' and 'Contractors and Suppliers HSEQ Management Procedure' are attached as **Annexure -3** and **4** respectively.

CHAPTER

3

INSTITUTIONAL, LEGISLATION AND POLICY FRAMEWORK

The ESIA of the proposed project will be subjected to the pertinent legislative and regulatory requirements of the Government of Pakistan including State laws. This chapter presents a synopsis of environmental policies, legislation and other guidelines that have relevance to the proposed project.

3.1 NATIONAL ENVIRONMENTAL POLICY, LEGISLATION AND GUIDELINES

The enactment of comprehensive legislation on the environment, covering multiple areas of concern, is a relatively new and ongoing phenomenon in Pakistan. Whereas, a basic policy and legislative framework for the protection of the environment and overall biodiversity in the country is now in place, detailed rules, regulations and guidelines required for the implementation of the policies and enforcement of legislation are still in various stages of formulation and discussion. The following section presents a brief overview of the existing national policies, legislation and guidelines.

3.1.1 National Conservation Strategy (NCS)

The NCS is the primary Policy document of the Government of Pakistan on national environmental issues. The Policy was approved by the Federal Cabinet in March 1992. The Strategy also attained recognition by international donor agencies, principally the World Bank. The NCS identifies 14 core areas including conservation of biodiversity, pollution prevention and abatement, soil and water conservation and preservation of cultural heritage and recommends immediate attention to these core areas in order to preserve the country's environment.

A midterm review of the achievements of NCS in 2000 concluded that achievements under NCS have been primarily awareness raising and institutional building rather than actual improvement to environment and natural resources and that NCS was not designed and is not adequately focused as a national sustainable development strategy (GoP, November 2000). The need therefore arose for a more focused National Environmental Action Plan (NEAP) required to bring about actual improvements in the state of the national environment with greater emphasis on poverty reduction and economic development in addition to environmental sustainability.

The NEAP was approved by the Pakistan Environmental Protection Council under the chairmanship of the President/Chief Executive of Pakistan in February 2001. NEAP now constitutes the national environmental agenda and its core objective is to initiate actions that safeguard public health, promote sustainable livelihoods, and enhance the quality of life of the people of Pakistan.

A National Environmental Policy has been approved by the Federal Cabinet in its meeting held during June 2005. This policy has already been endorsed by the Pakistan Environmental Protection Council during 2004. The new policy has total 171 guidelines on sectoral and cross-sectoral issues. The objectives of new policy include assurance of sustainable development and safeguard of the natural wealth of country. The following are the approved Sectoral Guidelines;

- Water Supply and Management;
- Air Quality and Noise;
- Waste Management;
- Forestry;
- Biodiversity and Protected Areas;
- Climate Change and Ozone Depletion;
- Energy Efficiency and Renewable;
- Agriculture and Livestock;
- Multilateral Environmental Agreements.

3.1.2 Sindh Environmental Protection Act 2014

Since the amendments in Constitution in 2008, the federal PEPA is no more applicable to provinces and now they have developed their own laws known as the Sindh Environmental Protection Act, 2014 (SEPA 2014). It is the basic legislative tool empowering the government to frame regulations for the protection of the environment. The SEPA 2014 is broadly applicable to air, water, soil, marine and noise pollution. Penalties have been prescribed for those contravening the provisions of the Act.

The two primary deliberations of the Act are the conduct of projects only after approval of environmental assessments from the SEPA and adherence with Sindh Environmental Quality Standards (SEQS).

3.1.3 Approval from Sindh Environment Protection Agency

As per the 2014 Regulations, Proponent will submit an EIA report for their proposed project activities to SEPA, and seek approval on the same from the agency. Ten (10) hard copies and two (02) soft copies of the EIA report will be submitted to SEPA. It will then grant its decision on the EIA as per the rules and procedures set out in the 2014 Regulations. The following rules will apply:

- A fee is payable to SEPA for review of the EIA;
- The EIA submission is to be accompanied by an application in the format prescribed in Schedule V of the 2014 Regulations;
- SEPA is bound to conduct a preliminary scrutiny and reply within four weeks of the submission of the report a) confirming completeness, or b) asking for additional information, if needed;
- K-Electric will publish a public notice in any English or Urdu national newspaper and in a local newspaper of general circulation in the area affected by the project. The public notice will mention the following:
    - The type of project;
    - The location of the project;
    - The name and address of the proponent;
    - The places at which the EIA can be accessed;
    - The date, time and place for public hearing of any comments on the project or its EIA;
- The date set for public hearing will not be earlier than fifteen (15) days from the date of publication of the public notice
- In the review process SEPA may consult a Committee of Experts, which maybe constituted on the request of the Director General (DG) SEPA;
- On completion of the review process, the decision of SEPA will be communicated to the proponent in the form prescribed in Schedule V;
- Where an EIA is approved, SEPA can impose additional controls as part of the conditions of approval;
- SEPA is required to make every effort to complete the EIA review process within four months;
- The approval will remain valid for the project duration mentioned in the EIA but on the condition that the project commences within a period of three years from the date of approval. If the project is initiated after three years from approval date, the proponent will have to apply for an extension in the validity period. The SEPA on receiving such request grant extension (not exceeding 3 years at a time) or require the proponent to submit a fresh EIA if in the opinion of SEPA changes in baseline conditions or the project so warrant;
- After receiving approval from SEPA the proponent will acknowledge acceptance of the conditions of approval by executing an undertaking in the form prescribed in Schedule VI of the 2014 Regulations;
- The 2014 Regulations also require proponents to obtain from SEPA, after completion of the project, a confirmation that the requirements of the EIA and the conditions of approval have been duly complied with;

- The SEPA in granting the confirmation of compliance may impose any additional control regarding the environmental management of the project or the operation, as it deems necessary.

3.1.4 Sindh Environmental Protection Agency Review of IEE and EIA Regulations, 2014

The Sindh Environmental Protection Agency Review of IEE and EIA Regulations, 2014 (The 2014 Regulations) promulgated under SEPA 2014 were enforced on December 2014. The 2014 Regulations define the applicability and procedures for preparation, submission and review of IEEs and EIAs. These Regulations also give legal status to the Pakistan Environmental Assessment Procedures prepared by the SEPA in 2014.

The Regulation classifies projects based on expected degree of adverse environmental impacts and lists them in three separate schedules. Schedule I lists projects that may not have significant environmental impacts and therefore require an IEE. Schedule II lists projects of potentially significant environmental impacts requiring preparation of an EIA. The Regulations also require that all projects located in environmentally sensitive areas require preparation of an EIA.

This project falls under the following category:

Schedule II (EIA):

Energy

- Transmission lines (11 KV and above) and distribution projects

3.1.5 The Sindh Environmental Quality Standards, 2016

During the construction and post development phase of the project SEQS will apply to all effluents, gaseous emissions and Noise generation. SEQS for municipal and industrial effluents, selected gaseous pollutants from industrial sources and motor vehicle exhaust and noise are provided in **Exhibits 3.1**, **3.2**, **3.3 & 3.4**.

3.1.6 Land Acquisition Act, 1894

The Land Acquisition Act (LAA) of 1894 amended from time to time has been the defacto policy governing land acquisition, resettlement and compensation in the country. The LAA is the most commonly used law for acquisition of land and other properties for development projects. It comprises of 55 sections pertaining to area notifications and surveys, acquisition, compensation and apportionment awards and disputes resolution, penalties and exemptions.

3.1.7 Pakistan Penal Code (1860)

The Pakistan Penal Code (1860) authorizes fines, imprisonment or both for voluntary corruption or fouling of public springs or reservoirs so as to make them less fit for ordinary use.

3.1.8 The Antiquities Act, 1975

The Antiquities Act of 1975 ensures the protection of cultural resources of Pakistan. The Act is designed to protect 'antiquities' from destruction, theft, negligence, unlawful excavation, trade, and export. Antiquities have been defined in the Act as ancient products of human activity, historical sites, or sites of anthropological or cultural interest, national monuments, etc. The law prohibits new construction in the proximity of a protected antiquity and empowers the Government of Pakistan to prohibit excavation in any area that may contain articles of archaeological significance.

Under the Act, the project proponents are obligated to:

- Ensure that no activity is undertaken in the proximity of a protected antiquity;
- Report to the Department of Archeology, Government of Pakistan, any archeological discovery made during the course of a project.

3.1.9 Electricity Act, 1910

The Act provides a legal base for power distribution. A licensee under this Act is enabled to operate supply of electricity. This Act obligate licensee to pay compensation for any damages caused during the constructions and maintenance of any power distribution facilities

3.1.10 Hazardous Waste

The Sindh Hazardous Substances Rules, 2014 are a set of rules derived from the Sindh Environmental Act, 2014 and are first of the very specific hazardous substances regulations brought into force in 2014 after the initial draft set of rules devised in 2003. They represent specific regulations with aspect of handling, storage and disposal of hazardous substances and issuing an approving license to the user or facility. The Schedule-I of the Rules enlists the hazardous substances that are under the scrutiny of the SEPA.

Under its licensing terms, the Rules highlight particular components as follows:

- Employment of Qualified technical personnel;
- Packing and labelling;

- Conditions of Premises;
- Safety precautions;
- Trainings;
- A comprehensive safety plan;
- Waste management Plan and
- Transporting of hazardous substances.

3.1.11 Sindh Wildlife Protection Ordinance 1972

The Sindh Wildlife Ordinance 1972 empowers the government to declare certain areas reserved for the protection of wildlife and to control activities within these areas. It also provides protection to endangered species of wildlife. The Project area does not lie with in or near any protected area; hence no provision of this law is applicable.

3.1.12 Cutting of Trees (Prohibition) Act, 1975

This Act prohibits cutting or chopping of trees without permission of the Forest Department.

3.1.13 Highways Safety Ordinance, 2000

This ordinance includes provisions for the licensing and registration of vehicles and construction equipment; maintenance of road vehicles; traffic control, offences, penalties and procedures; and the establishment of a police force for motorways and national highways charged with regulating and controlling traffic on the national highways, and keeping the highways clear of encroachments.

3.2 NATIONAL AND INTERNATIONAL GUIDELINES OR STANDARDS

3.2.1 The Pakistan Environmental Assessment Procedures, 1997

The Pakistan Environmental Protection Agency prepared the Pakistan Environmental Assessment Procedures in 1997. They are based on much of the existing work done by international donor agencies and Non-Governmental Organizations (NGO's). The package of regulations prepared by PEPA includes:

- Policy and Procedures for Filing, Review and Approval of Environmental Assessments;
- Guidelines for the Preparation and Review of Environmental Reports;
- Guidelines for Public Consultation;

- Guidelines for Sensitive and Critical Areas; and
- Sectoral Guidelines for various types of projects.

3.2.2 World Bank Guidelines on Environment

The principal World Bank publications that contain environmental guidelines are listed below.

- Environmental Assessment-Operational Policy 4.01. Washington, DC, USA. World Bank 1999.
- Environmental Assessment Sourcebook, Volume I: Policies, Procedures, and Cross-Sectoral Issues. World Bank Technical Paper Number 139, Environment Department, the World Bank, 1991,

The above two publications provide general guidelines to conduct EIA, and address the EIA practitioners themselves as well as project designers. While the Sourcebook in particular has been designed with Bank projects in mind, and is especially relevant for the impact assessment of large-scale infrastructure projects, it contains a wealth of useful information, for environmentalists and project proponents.

The Sourcebook identifies a number of areas of concern, which should be addressed during impact assessment. It sets out guidelines for the determination of impacts, provides a checklist of tools to identify possible biodiversity issues and suggests possible mitigation measures. Possible development project impacts on wild lands, wetlands, forests etc. are also identified and mitigation measures suggested.

3.2.3 OSHA Standards Health Safety

The Occupational Safety and Health Administration (OSHA) are issuing safety and health program management guidelines for use by employers to prevent occupational injuries and illnesses. The Occupational Safety and Health Act of 1970 (OSHA) representatives have noted a strong correlation between the application of sound management practices in the operation of safety and health programs and a low incidence of occupational injuries and illnesses. Where effective safety and health management is practiced, injury and illness rates are significantly less than rates at comparable worksites where safety and health management is weak or non-existent.

The Occupational Safety and Health Administration (OSHA) have concluded that effective management of worker safety and health protection is a decisive factor in reducing the extent and the severity of work-related injuries and illnesses. Effective management addresses all work-related hazards, including those potential hazards which could result from a change in worksite conditions or practices. It addresses hazards whether or not they are regulated by government standards.

Exhibit: 3.1 SEQS for Municipal and Industrial Effluents[a]

Parameters	***Into Inland Water(mg/l)***	***Into Sewage Treatment(mg/l)***
Temperature or temperature increase[c]	≤3°C	≤3°C
pH	6-9	6-9
Biochemical Oxygen Demand (BOD5) at 20°C[d]	80	250
Chemical Oxygen Demand (COD)[d]	150	400
Total Suspended Solids (TSS)	200	400
Total Dissolved Solids (TDS)	3,500	3,500
Grease and oil	10	10
Phenolic compounds (as phenol)	0.1	0.3
Chloride (as Cl^-)	1,000	1,000
Fluoride (as F)	10	10
Total cyanide (as CN-)	1.0	1.0
An-ionic detergents (as MBAS)[e]	20	20
Sulphate (SO_4)	600	1000
Sulphide (S-)	1.0	1.0
Ammonia (NH_3)	40	40
Pesticides[f]	0.15	0.15
Cadmium[g]	0.1	0.1
Chromium (trivalent & hexavalent)[g]	1.0	1.0
Copper[g]	1.0	1.0
Lead[g]	0.5	0.5
Mercury[g]	0.01	0.01
Selenium[g]	0.5	0.5

Parameters	***Into Inland Water(mg/l)***	***Into Sewage Treatment(mg/l)***
Nickel[g]	1.0	1.0
Silver[g]	1.0	1.0
Total Toxic metals	2.0	2.0
Zinc	5.0	5.0
Arsenic[g]	1.0	1.0
Barium[g]	1.5	1.5
Iron	8.0	8.0
Manganese	1.5	1.5
Boron[g]	6.0	6.0
Chlorine	1.0	1.0

Notes

[a]All values are in mg/l, unless otherwise defined

[b]Applicable only when and where sewage treatment is operational and BOD5=80 mg/L is achieved by the sewage treatment system

[c]The effluent should not result in temperature increase of more than 3°C at the edge of zone where initial mixing and dilution take place in the receiving body. In case zone is defined, use 100 meters from the point of discharge

[d]Assuming minimum dilution 1:10 on discharge, lower ratio would attract progressively stringent standards to be determined by the Sindh Environmental Protection Agency. By 1:10 dilution means, for example that for each one cubic meter of treated effluent, the recipient water body should have 10 cubic meter of water for dilution of this effluent

[e]Modified Benzene Alkyl Sulphate; assuming surfactant as biodegradable

[f]Pesticides include herbicide, fungicides and insecticides

[g] Subject to the total toxic metals discharge should not exceed level of total toxic metals

Exhibit 3.2: SEQS for Selected Gaseous Pollutants from Industrial Sources [a]

Parameter	Source of emission	Standard(mg/Nm^3)
Smoke	Any	40% or 2 Ringlemann scale or equivalent smoke number
Particulate matter[b]	Boilers and furnaces:	
	Oil fired	300
	Coal fired	500
	Cement kilns	300
	Grinding, crushing, clinker coolers and related processes, metallurgical processes, converter blast furnaces and cupolas	500
Hydrogen chloride	Any	400
Chlorine	Any	150
Hydrogen fluoride	Any	150
Hydrogen sulfide	Any	10
Sulfur oxides[c]	Sulfuric acid/Sulfonic acid plants	5,000
	Other plants except power plants operating on oil and coal	1,700
Carbon monoxide	Any	800
Lead	Any	50
Mercury	Any	10
Cadmium	Any	20
Arsenic	Any	20
Copper	Any	50

Parameter	Source of emission	Standard(mg/Nm³)
Antimony	Any	20
Zinc	Any	200
Oxides of nitrogen[d]	Nitric acid manufacturing unit	3,000
	Other plants except power plants operating on oil or coal:	
	Oil Fired	400
	Coal fired	600
	Cement kilns	1,200

Notes:

a All values are in mg/Nm^3, unless otherwise defined

b Based on the assumption that the size of the particulates is 10 micron or more

c Based on 1% sulphur content in fuel oil. Higher content of sulphur will cause standards to be pro-rated

d In respect of the emissions of the sulfur dioxide and nitrogen oxides, the power plants operating on oil or coal as fuel shall, in addition to NEQS specified above, comply with the following standards

Exhibit 3.3: SEQS for Motor Vehicle Exhaust and Noise

Parameter	Standard	Measuring Method
Smoke	40% or 2 on the Ringlemann scale during engine acceleration mode	To be compared with Ringlemann Chart at a distance of 6 meters or more
Carbon Monoxide	6%	Under idling conditions, non-dispersive infrared detection through gas analyzer
Noise	85 dB (A)	Sound-meter at 7.5 meters from the source

Exhibit 3.4: SEQS for Noise

S. no	Category of Area/Zone	Effective from 1st Jan, 2016	
		Limits in dB	
		Day Time	Night Time
1	Residential Area	65	50
2	Commercial Area	70	60
3	Industrial Area	80	75
4	Silence Area	55	45

Note:

1. Day Time hours: 6.00am to 10.00pm
2. Night Time hours: 10.00pm to 6.00am
3. Silence Zone: zones which are declared as such by the competent authority. An area comprising not less than 100 meters around hospitals, educational institutions and courts.
4. Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.

dB: Time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.

CHAPTER 4 ENVIRONMENTAL BASELINE: PHYSICAL ENVIRONMENT

The existing physical environmental conditions of the project area are described in this section. Much of the information on topography and land use, geophysical, climate and water resources was gained from published literature and previously conducted studies. The information given in the sections on air, sound and water quality is the result of detailed field surveys conducted specifically for this ESIA.

4.1 TOPOGRAPHY AND LAND USE OF THE PROJECT AREA

The project area is located in the district in the tehsil of Mirpur Sakro of Sindh along the Indus Basin, which is briefly described below.

Thatta is one of the oldest town and the district headquarter of Thatta, it is situated at about 60 mile from east of Karachi on the National Highway. According to the Thatta District Census Report 1998, the district is situated at 23º 43' to 25º 26' north latitudes and 67º 05' to 68º 45' east longitudes. The total area of the district is 17,355 kilometers which constitutes 12.3% of the total geographical area of Sindh.

The district of Thatta is bounded by district Badin and Tando Muhammad Khan on the east; district Jamshoro on the north, district Hyderabad on the northeast, district Karachi on the northwest and the Arabian Sea and Rann of Kach on the south.

The district is further divided into nine Tehsils which includes

i. Thatta
ii. Mirpur Sakro
iii. Mirpur Bathoro
iv. Ghorabari
v. Jati
vi. Sujawal
vii. Keti Bunder
viii. Shah Bunder
ix. Kharochan

Four Tehsils of district are on the right bank of Indus River and four lie on the left bank while one tehsil lies on both sides of the river.

The current project area lies in the tehsil of Mirour Sakro of Thatta district with an area of 2,958 km^2 (USAID September 14).

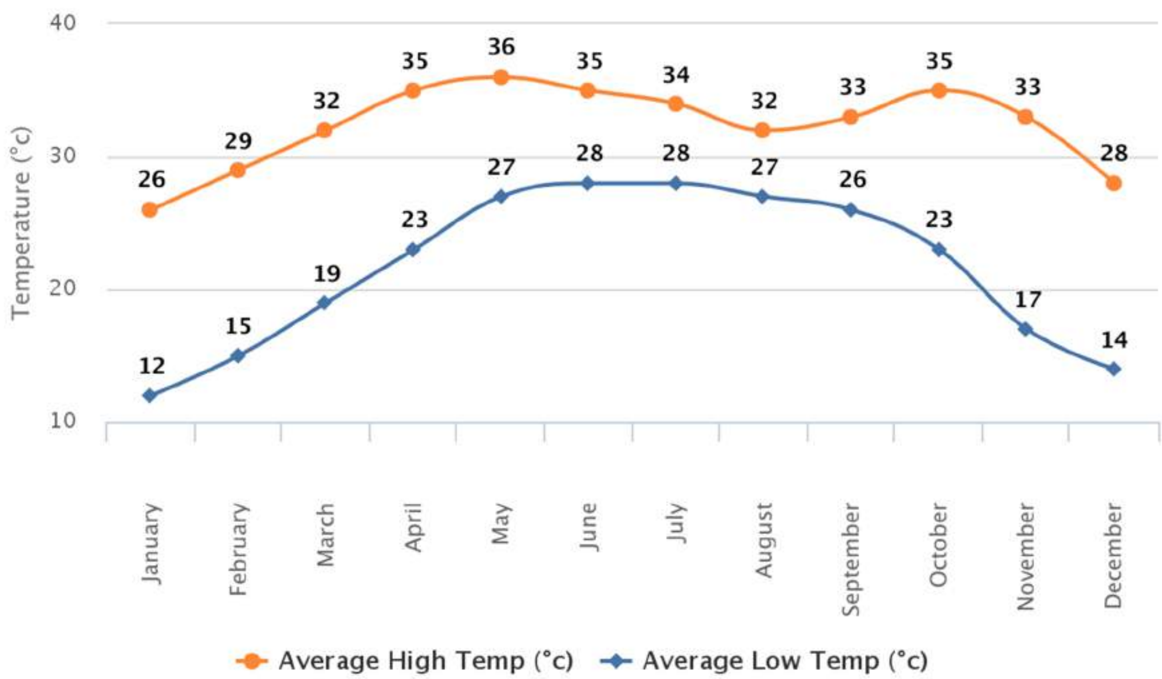
4.2 METEOROLOGY

The climatic condition of Sindh coastal area varies with seasons it can be characterized as dry, hot and humid, typical of sub-tropical coastal zones lying in monsoon region. The summer period is very long as compared to winter it started from March and extends to October while the winter season is very short. There is a minor seasonal intervention of a mild winter from mid-December to mid-February.

4.2.1 Temperatures

The temperature of the coastal area varies in range between 6 to 40°C near the project area the mean maximum temperature during summer is 35°C whereas the mean minimum temperature during winter is 10 °C. The climate in Mīrpur Sakro is called a desert climate. During the year, there is virtually no rainfall in Mīrpur Sakro. The Köppen-Geiger climate classification is BWh. The average annual temperature in Mīrpur Sakro is 26.4 °C and the average precipitation is 206 mm. The average annual temperature of Mirpur Sakro is presented in the form of Graph in **Exhibit 4.1.**

Exhibit 4.1: Average Annual Temperature of Mirpur Sakro, Thatta



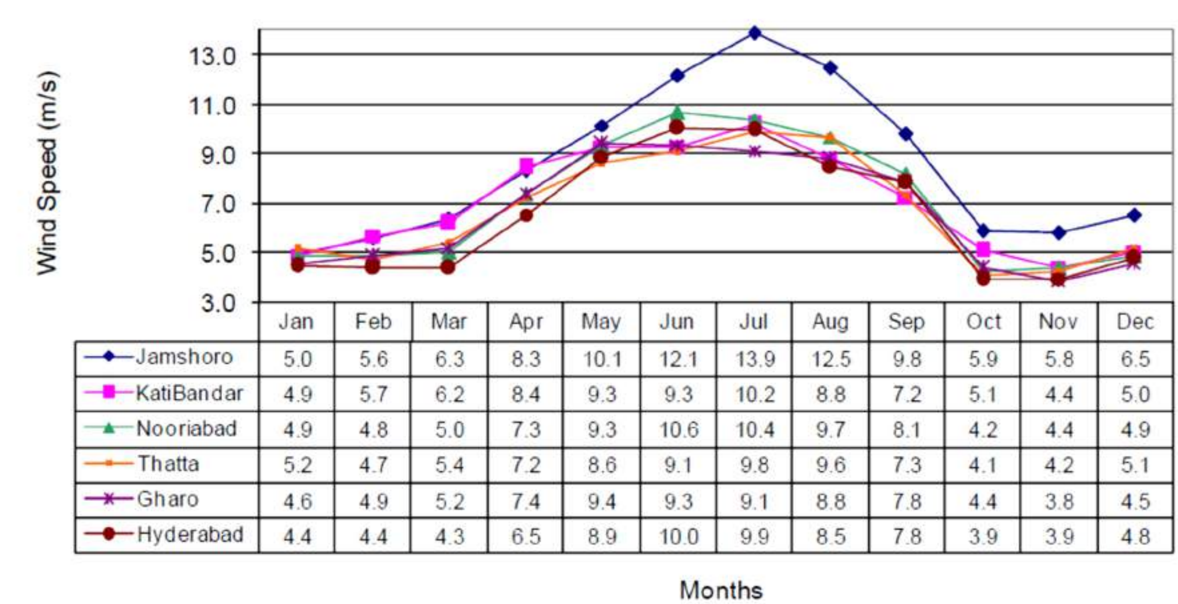
The data for the above charts are taken from year 2000 to 2012, Source: (WWO, .2012)

4.2.2 Wind

In the coastal areas of Sindh, Karachi and its adjoining deltaic areas, the wind blows throughout the year with high velocities during the monsoon season the wind speeds reaches its peak speed. The direction of the wind varies throughout the season but it is mostly observed that during the summer season the direction is west-southwest and during the winter season its direction is mostly from east-northeast.

Exhibit 4.2 represents the monthly average estimated wind speed at 50m heights at six most windy stations of district Thatta. The graph clearly shows that from the month of April to September the wind speed is very high in these coastal areas of Sindh. Moreover the areas closer to the project areas such as Kati Bandar, Nooriabad, Thatta, Gharo, Hyderabad, Sajawal, Jati, Golarchi, Baghan, Talhar, and Chuhar Jamali are also suitable sites for power generation.

Exhibit 4.2: Average Monthly Wind Speed near Project Area



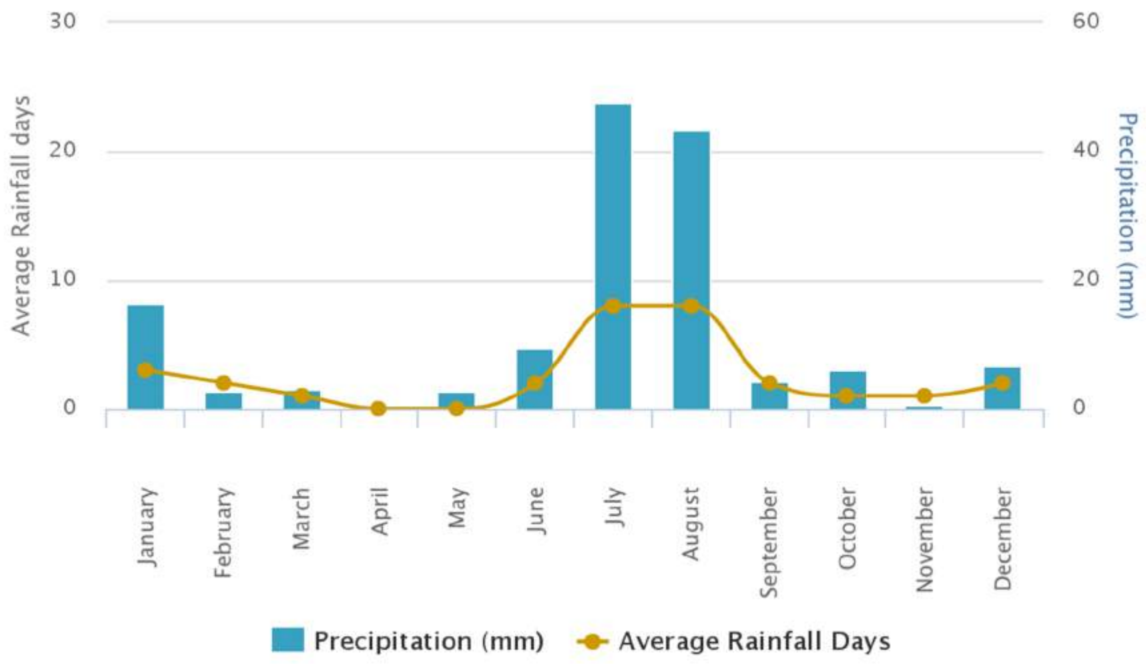
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Jamshoro	5.0	5.6	6.3	8.3	10.1	12.1	13.9	12.5	9.8	5.9	5.8	6.5
KatiBandar	4.9	5.7	6.2	8.4	9.3	9.3	10.2	8.8	7.2	5.1	4.4	5.0
Nooriabad	4.9	4.8	5.0	7.3	9.3	10.6	10.4	9.7	8.1	4.2	4.4	4.9
Thatta	5.2	4.7	5.4	7.2	8.6	9.1	9.8	9.6	7.3	4.1	4.2	5.1
Gharo	4.6	4.9	5.2	7.4	9.4	9.3	9.1	8.8	7.8	4.4	3.8	4.5
Hyderabad	4.4	4.4	4.3	6.5	8.9	10.0	9.9	8.5	7.8	3.9	3.9	4.8

Source: An Investigation on Wind Power Potential of Sindh, Pakistan metrological department

4.2.3 Rainfall

The rainfall pattern of the proposed project side is low and the same trend of rain fall has been observed in the coastal belt as well as the deltaic regions of Sindh. The average rainfall pattern for Mirup Sakro is exhibited in **Exhibit 4.3**.

Exhibit 4.3: Average rainfall pattern for Mirupur Sakro District Thatta



The data for charts above are taken from year 2000 to 2012, Source: (WWO, .2012)

4.2.4 Climate:

According to Koppen‟s classification the climate of Pakistan falls under 7 types. Based on this classification the project area falls in the tropical semi-arid with dry winter climate zone.

Tropical Semi-arid with Dry Winter: the region of Karachi, Hyderabad and southern khairpur falls in this category and the average annual temperature is below 19 °C.

Tropical Arid: Most of the areas of southern Khalat and Indus plains lies inthis area with a characterized average annual temperature of about 18 °C.

Cold Semi-arid With Dry Summer: Most of the regions of central Kashmir, Peshawar, D. I. Khan, Quetta and Kalat Division falls in this category qith cold winter.

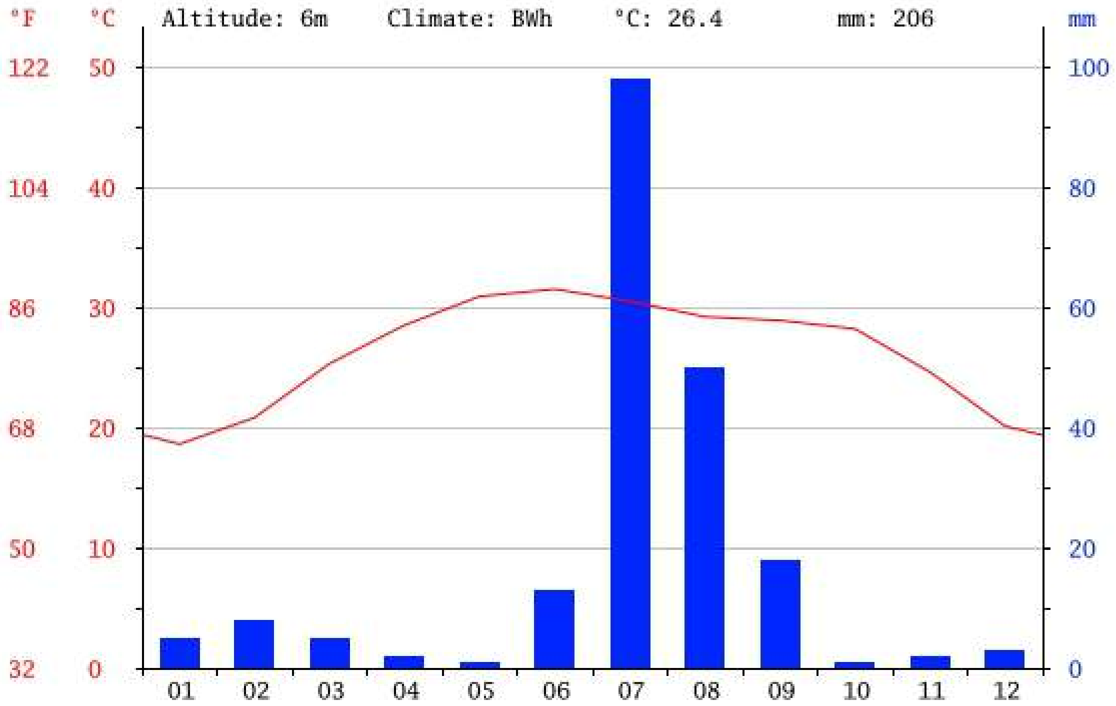
Snow Forest Climate: the mean temperature varies between 0 to 22 °C. The winters are cold while in summer the average mean temperature increases up to 22 °C. Most of the parts of Gilgit Baltistan and upper parts of Kashmir.

Extreme Cold: in this category most of the parts of northern Kashmir, Chitral, Gilgit and Laddakh falls. This climate type is characterized by average temperature of the warmest months between 10 and 0 C.

Climate Graph of Mirpur Sakro

The driest month is May. There is 1 mm of precipitation in May. The greatest amount of precipitation occurs in July, with an average of 98 mm. the climatic graph for the tehsil Mirpur Sakro can be seen in **Exhibit 4.4.**

Exhibit 4.4: Average climate graph of Mirupur Sakro District Thatta



Source: climate Data.org

Another climatic classification made by Shamshad (1956) has classified the climate of Pakistan based on topography, proximity to the sea, rainfall, temperature, and winds, he has divided Pakistan into eleven climatic zones. Under his scheme, the climate of the project area is classified as 'subtropical double season hot land.' The characteristic features of this climatic zone are low rainfall (less than 250 mm per annum), the absence of a well-defined rainy season, and high temperatures that increase from east to west.

4.3 WATER RESOURCES

This section details the water resources of the proposed project area. Both, surface and ground water resources have been summarized in this section of the report. Data was obtained from secondary sources and through field observation and data collection (ESIA field survey).

4.3.1 Surface water Sources:

Plenty of surface water sources are available in the project area and in the district of Thatta in the form of rivers, streams, tributaries and canals. Gharo creek system is among the main fresh water artery which is used for agriculture purpose while a scanty amount of water is used for domestic purpose. Some of the major surface water sources are listed below.

- Indus River
- Gharo Creek
- Haleji Lake
- Kinjhar Lake
- Dhand Yimini
- Makarvari Lake
- Reen Lake

Exhibit 4.5: Chemical Analysis of Surface Water: Goth Mohammad Hassan Khaskhali (SW-1)

S.No	Parameters	Units	SEQS	Concentration	Method
1.	pH value		6-9	7.05	pH meter
2.	Chloride	mg/l	<250	21.97	APHA 4500 Cl B
3.	Residual chloride	mg/l	0.5	0.03	Hach Method 8167
4.	Salinity	mg/l	------	408	Conductivity meter
5.	Calcium	mg/l	<500	52.21	APHA 3500 D
6.	Phosphate	mg/l	------	1.94	Hach Method 8048
7.	Total Dissolved Solid	mg/l	<1000	232	APHA 2540 C
8.	Turbidity	NTU	5	8	Merck Method (077)

Exhibit 4.6: Chemical Analysis of Surface Water: Goth Jangi Khan (SW-2)

S.No	Parameters	Units	SEQS	Concentration	Method
1.	pH value	-----	6-9	7.58	pH meter
2.	Chloride	mg/l	<250	47.86	APHA 4500 Cl B
3.	Residual chloride	mg/l	0.5	0.02	Hach Method 8167
4.	Salinity	mg/l	------	611	Conductivity meter
5.	Calcium	mg/l	<500	46.75	APHA 3500 D
6.	Phosphate	mg/l	------	0.07	Hach Method 8048
7.	Total Dissolved Solid	mg/l	<1000	348	APHA 2540 C
8.	Turbidity	NTU	5	<1	Merck Method (077)

Exhibit 4.7: Surface Water Monitoring

Surface Water sample collection

Fresh water Canal near project site

4.3.2 Ground Water Resources:

Ground water extraction is one of the expensive process in the project area most of the ground water in the project area is brackish while at some points palatable clean groundwater can be found, as the project area lies in the coastal belt therefore the case of seawater intrusion is common in most of the area. Meanwhile two main sources of groundwater were found in the project area at Jangi Khan and Goth Mohamad Hassan Khaskheli. Samples from both the sources were taken using the standard procedure and analyzed the results are incorporated in **Exhibit 4.8 and 4.9.**

Exhibit 4.8: Chemical Analysis of Ground Water: Goth Mohammad Hassan Khaskhali (UG-1)

S. No	Parameters	Units	SEQS	Concentration	Method	Remarks
1.	pH value		6-9	7.22	pH meter	OK
2.	Chloride	mg/l	<250	150.41	APHA 4500 Cl B	OK
3.	Residual chloride	mg/l	0.5	0.02	Hach Method 8167	OK
4.	Salinity	mg/l	------	1197	Conductivity meter	
5.	Calcium	mg/l	<500	82.98	APHA 3500 D	OK
6.	Phosphate	mg/l	------	0.13	Hach Method 8048	OK
7.	Total Dissolved Solid	mg/l	<1000	672	APHA 2540 C	OK
8.	Turbidity	NTU	5	5	Merck Method (077)	OK

Exhibit 4.9: Chemical Analysis of Ground Water: Goth Jangi Khan (UG-2)

S. No	Parameters	Units	SEQS	Concentration	Method	Remarks
1.	pH value		6-9	5.71	pH meter	OK
2.	Chloride	mg/l	<250	524.48	APHA 4500 Cl B	
3.	Residual chloride	mg/l	0.5	0.03	Hach Method 8167	OK
4.	Salinity	mg/l	------	2219	Conductivity meter	
5.	Calcium	mg/l	<500	134.02	APHA 3500 D	OK
6.	Phosphate	mg/l	------	0.24	Hach Method 8048	OK
7.	Total Dissolved Solid	mg/l	<1000	1248	APHA 2540 C	
8.	Turbidity	NTU	5	7	Merck Method (077)	

Irrigation system of the project area:

Within the project area four main flood drainage exist namely Ghaggar, lath, Jhulay and Dhabeji wala Dora which are seasonally used for irrigation but most of the areas are dependent on Koteri barrage, K.B fed canals and Pinyari canal for irrigation and also the water in the forms of streams are used for domestic and livestock purpose.

Ground water sample collection

Ground water pumps for filling local supply tankers

4.4 GEOLOGY

The district of Thatta is a part of Indus delta and has been formed primarily by deposition of Late Holocene (7000-10,000 years BP) sediments carried by Indus River from Himalaya which host aquifers in the area. The deltaic soil constitutes fine grained sediments, rich in organic matter containing high amount of arsenic, which is supposed to become part of aquifers by various geochemical processes. Indus River has changed its course throughout the ages the abandoned organic matter rich courses of Indus River have been silted up and are under cultivation. This region includes alluvial plains trenched with river channels and river terraces these channels are traceable from Qambar, Dadu and Hala to Tando Allayar and beyond, which are hot spots of arsenic contamination.

Geology of the local area is underlain a lower Indus basin described as Indus river alluvial early Eoicene early deposition of sediments includes silt, sand stone, conglomerate, limestone with low compact and cementing materials. Surface feature describe as syncline delta and valley region and anticline ridges exposed. As stratigraphic description, there are two formations Gazij and Manchar formation dip gently northeast to southeast in offshore (HEC).The coastal region is found to be of tertiary and post-tertiary origin. Blatter et al (1929) dates it as recent as Eocene. The region has been formed by the upheaval of land from the Tethys Sea, which once extended up to the northern border of Pakistan but, gradually withdrew with the rising of the Himalayas. The underlying rocks are mostly of marine origin, highly folded, faulted and fissured everywhere. (Sidra *et al*, 2010 Situation Analysis of Sindh Coast Issues and Options)

4.5 CHARACTERISTICS OF SOIL:

The soil was studied in depth the soil is yellowish brown in color which is silty, clay and fine coarse.

4.6 PROJECT SITE LOCATIONS

SR. No.	Description	View of Location
I	Mohammad Hassan Khaskhali	

SR. No.	Description	View of Location
II	Jangi Khan Goth	
III	Bhambore Bridge	

4.7 AMBIENT AIR & NOISE QUALITY

As the project site is located in a rural area of the district Thatta and it is less populated major of the land area is barren only a few area of the tehsil Sakro is used for agriculture purpose. Keeping in view the SEQS for noise level different sampling sites were selected for sampling air and noise level and it was found that all the results were underlying the SEQS. Air and Noise sampling plan is presented below in **Exhibit 4.10** respectively.

Exhibit 4.10: Air and Noise Quality Monitoring Results

Sampling Location	Parameters	Units	SEQS Limits	Concentrations	Method
1	*Suspended particulate matter (SPM)*	mg/m^3	**10**	11	EVM-7
	Particulate Matter (PM_{10})	$\mu g/m^3$	**150**	6	EVM-7
	Noise	dB(A)	**85**	67	Noise Meter
2	*Suspended particulate matter (SPM)*	mg/m^3	**10**	12	EVM-7
	Particulate Matter (PM_{10})	$\mu g/m^3$	**150**	6	EVM-7
	Noise	dB(A)	**85**	70	Noise Meter
3	*Suspended particulate matter (SPM)*	mg/m^3	**10**	22	EVM-7
	Particulate Matter (PM_{10})	$\mu g/m^3$	**150**	10	EVM-7
	Noise	dB(A)	**85**	84	Noise Meter

4.8 EARTHQUAKES

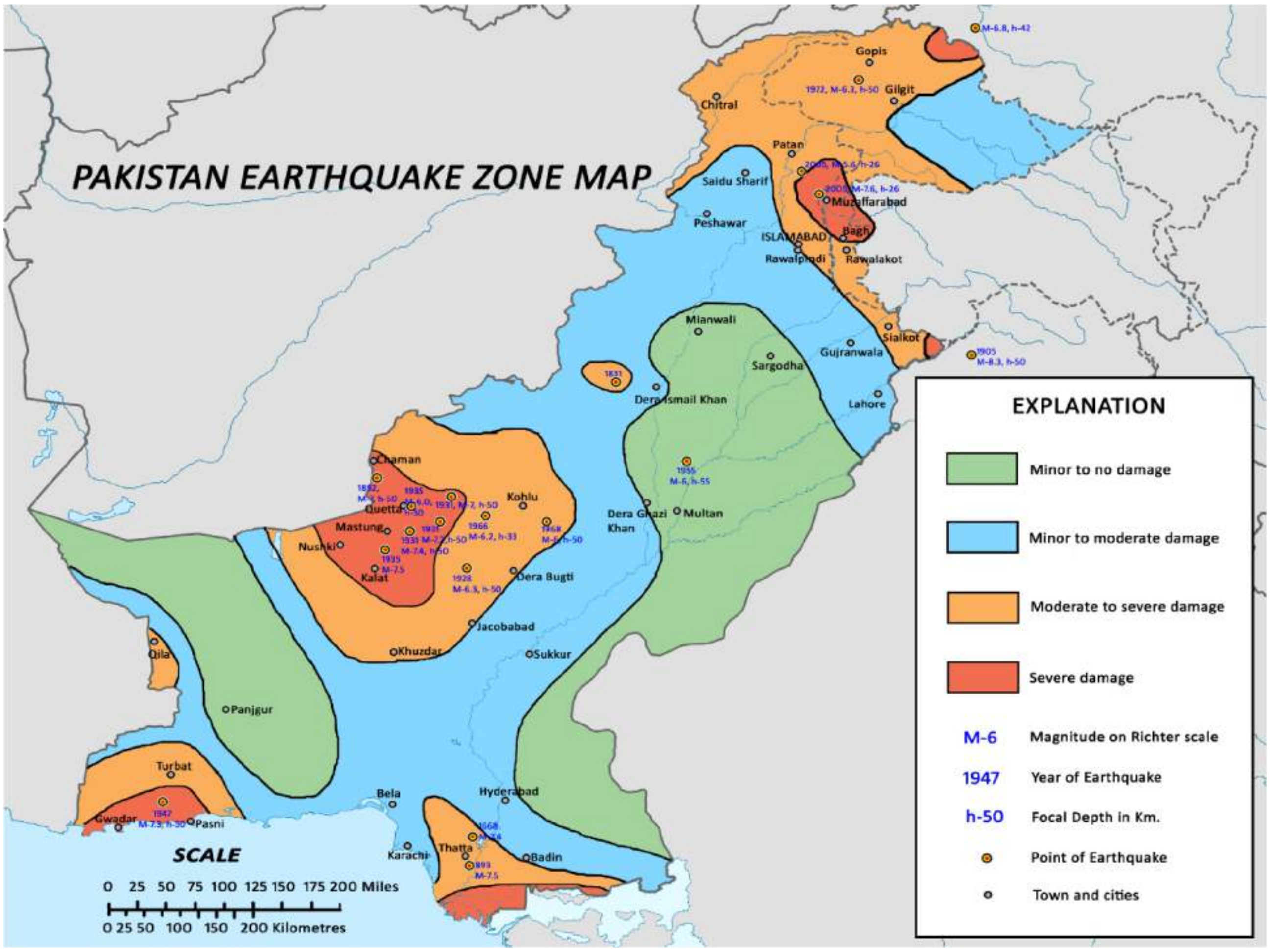
The Indo-Australian plate upon which Pakistan, India and Nepal lie, is continuously moving northward, colliding with and sub-ducting under the Eurasian plate, thus forming the Himalayan mountains, and triggering earthquakes in the process. The history reveals that:

The areas comprising Pakistan have suffered four major earthquakes in the 20th century including the great Quetta earthquake of 1935, the 1945 earthquake off the coast of Makran, the 1976 earthquake in the Northern areas, and the October 2005 Kashmir earthquake. In between these major events, the Northern areas and Kashmir have experienced many small quakes with localized impact. No appreciable earthquakes have been recorded in Karachi during the recent past. However, on September 24, 2013, a tremendous earthquake struck the Awaran District in the western Balochistan Province of Pakistan. The quake's epicenter was near the Awaran District, but others districts of Balochistan Turbat, Panjgur, Chaghai, Khuzdar and Gwadar were also affected. According to the reports, tremors from the earthquake, which registered 7.8 on the Richter scale, were also felt in Quetta, Hub, Kharan, JhalMagsi, Qalat, Sibi, Mastung, Jafferabad and Karachi Pakistan and as far away as UAE.

The recently developed (post October 2005 earthquake) seismic zone map of Pakistan has divided the country into four seismic zones ranging in term of major, moderate, minor and negligible zones with respect to ground acceleration values. Under this zoning Thatta Division has been identified on the edge of moderate to high hazard zone.

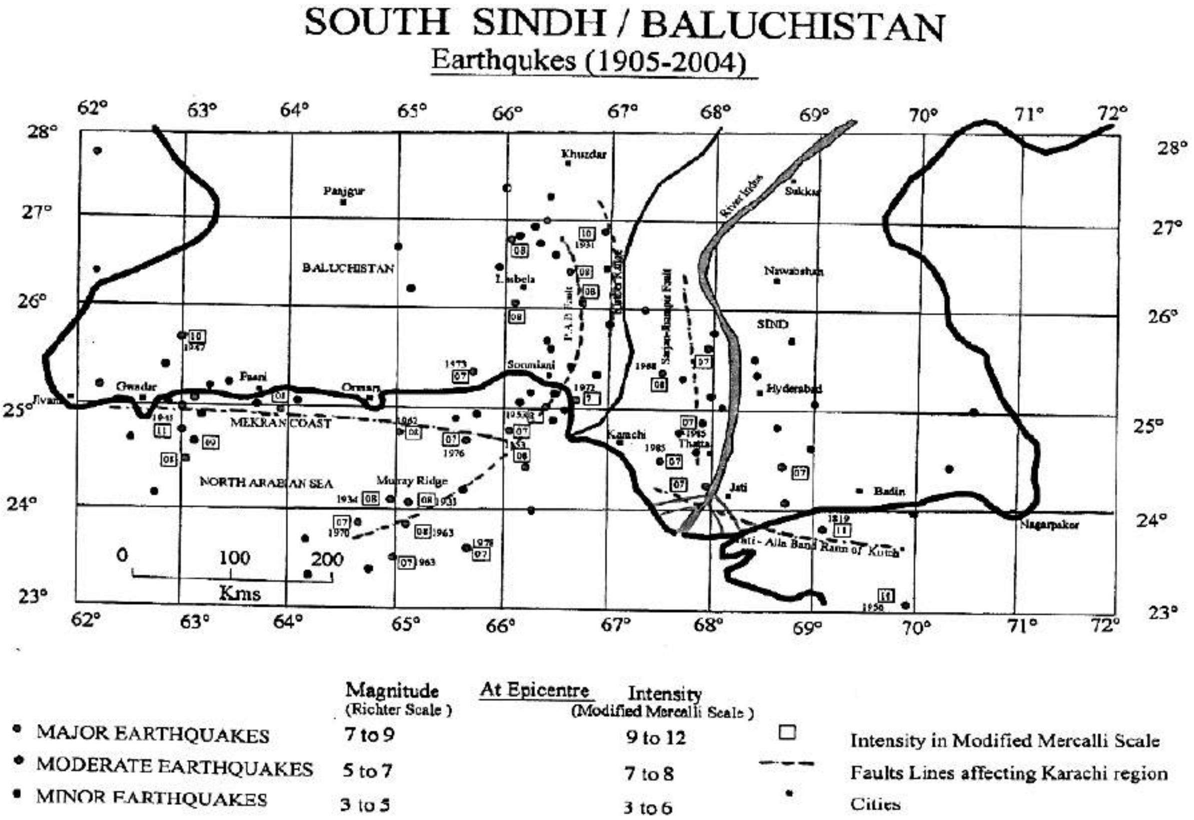
The proposed project is located in the low seismic zone, where a moderate level of seismic activity is believed to exist, but large magnitude earthquakes are very rare. Tectonic Plates/Seismic Zoning Map of Pakistan can be seen in **Exhibit 4.11**.

Exhibit 4.11: Seismic Zone of Pakistan



Source: Geological Survey of Pakistan

Exhibit 4.12: Fault line impacts in South Sindh and Balochistan region



4.8.1 Tsunamis

The coastal areas of Thatta might experience the effect of Tsunamis as the coast line of Pakistan has had this natural hazard in the recent past. An earthquake of magnitude 8.3 generated a destructive tsunami wave in the Northern Arabian Sea and the Indian Ocean on 28th November, 1945, producing 12 m to15 m high sea waves that killed at least 4,000 people in Pasni and adjoining areas. The tsunami hit as far as Mumbai in India. Karachi, about 450 km from the epicenter, experienced 2 m high sea waves which affected harbor facilities. Hence, the occurrence of another tsunami in the future cannot be ruled out.

The fact that cities like Karachi lie close to potential epicenters for large submarine earthquakes, demands attention for enhancement of local capacities for disaster risk reduction, early warning and response in order to reduce losses from tsunami events.

Recent studies show that Subduction of Oman oceanic lithosphere northward beneath the Iranian micro-plate and a tri-junction of tectonic plates at Somiani Bay can be a potential source of future tsunami that can be a major threat to the coastal cities of Pakistan such as Karachi, Gawadar, Pasni, Ormara etc.

4.8.2 Tropical Storms and Cyclones

Tropical cyclones also occur periodically in the coastal areas. Coastal belt of Pakistan (especially in Sindh) is highly vulnerable to cyclones and associated storm surges. Fourteen cyclones were recorded between 1971 and 2001 (NDRMFP, 2007). Seldom have these cyclones had high intensities. The cyclone of 1999 in Thatta and Badin districts wiped out 73 settlements and killed 168 people and 11,000 cattle. Nearly 0.6 million people were affected. It destroyed 1800 small and big boats and partially damaged 642 boats, causing a loss of Rs. 380 million. Losses to infrastructure were estimated at Rs. 750 million. Climate change may increase the frequency and intensity of storms and could cause changes in their tracks. Although the frequency of cyclones along Pakistani coast is low, yet they cause considerable damage, when they occur. Hence the possible occurrence of a future cyclone with severe consequences is quite rare but cannot be ruled out (NDRMFP, 2007).

CHAPTER 5

ENVIRONMENTAL BASELINE: BIOLOGICAL ENVIRONMENT

The Environmental baseline and biological environment of the project area was evaluated by both primary and secondary means. Surveys were conducted in June 2016. Sampling locations for the identification of floral and faunal assemblages were carefully selected so that the maximum number of species could be observed and significant ecological baseline was generated for the project area. The summary of biodiversity found during the site visit is as under, however detailed sampling methodologies and findings are also incorporated as an essential component of this chapter.

5.1 HABITATION

In general, Sindh Coastal Highway has environmental conditions like a semi-arid desert. The natural faunal and floral species and ecosystems are less significant and less in number because of extreme environmental stressors out of which significant source of stress on natural ecosystems includes high temperatures and less rainfall associated with anthropogenic activities thus underscoring floral and faunal ecosystems. During surveys and assessments it was observed that biodiversity of the project area was insignificant due to the dry land texture of the area. Neither species of flora and fauna was threatened, vulnerable, critically endangered or near to extinction according to IUCN red list or protected under CITES and or SIND WILDLIFE ORDINANCE etc.

5.2 FLORA OF THE PROJECT AREA

The project area sustains an arid environment. The harsh climate, minimum rainfall, and poor soil conditions limits the growth of floral species. In addition to that, it is important to note that the population of the area is dependent on livestock and agricultural activities for their livelihood. Therefore over grazing is another issue limiting the frequency of floral species within the project area. The detailed description, list of identified species and methodology adopted for sampling are discussed in details below.

5.2.1 List of identified floral species

5.2.1.1 Trees of the project area

S. No	Family	Plant Name	Quantity
1	*Meliaceae*	*Azadirichta indica*	03
2	*Mimosaceae*	*Prosopis juliflora*	30
3	*Mimosaceae*	*Prosopis cineraria*	12
4	*Mimosaceae*	*Parkinsonia aculata*	03
5	*Salvadoraceae*	*Salvadora oleides*	14

5.2.1.2 Shrubs of the project area

S. No	Family	Plant Name	Quantity
1	*Asclepidiaceae*	*Calotropis procera*	06
2	*Rhamanaceae*	*Ziziphus nummularia*	02

5.2.1.3 Herbs of the project area

S. No	Family	Plant Name	Quantity
1	Amranthaceae	*Aerva javanica*	06
2	*Tamaracaceae*	*Tamarix ramosissima*	03

5.2.2 Sampling Methodology

In order to study the dominant vegetation/ floral species of the project area standard line-transact sampling method was used in which different sized quadrats by means of measuring tape were made, the quadrat size ranged between 2-10 meter.

Large shrubs & trees	**5 m x 10 m**
Small shrubs & Herbs	2 m x 2 m

5.2.2.1 Dominant Vegetation

The dominant floral species of the project area is ***Prosopis juliflora*** which is one of the wild species in Sindh, rest of the species contributed less in vegetation cover of the project area.

5.2.2.2 Pictorial presentation of the floral species

Tamarix ramosissima	***Prosopis juliflora***

5.3 FAUNA

Proposed project site is located in semi-arid environment, however the faunal species observed during the survey were mainly of desert origin. Moreover, it is important to note that the proposed project site sustains few nocturnal species as well. Detailed sampling protocol and method is presented below after brief description of the species and list of identified avifauna, mammals and reptile species of the proposed project area.

5.3.1 Avifauna

The area was found to be too windy and dry where it was safe to conclude that birds avoid being in such environments therefore very few species could be spotted or reported. The species identified in the proposed project area are of less ecological importance. The detailed sampling methodology and list of identified species during the ecological/ baseline survey is presented below.

5.3.2 Sampling methodology

In order to study the avifaunal diversity of the project area individual count technique was used during field surveys and the identified species were immediately recorded and reported accordingly. The detailed list of identified avifaunal species is presented below in **Exhibit 5.1** and pictorial profile in **5.2** respectively.

Exhibit 5.1: Avifauna (Birds) of the project area

S. No	English Name and Scientific Name		Occurrence					Protection Status	Population Total Count
			Resident	Migratory	Common	Less Common	Scarce	Protected under SWPO	
1	House Crow	*Corvus splendens)*	X		X				21
2	House Sparrow	(*Passer domesticus)*	X		X				18
3	Common Myna	(*Acridotheres tristis)*	X		X				12
4	Desert Lark	*Ammomanes deserti*	X		X				9
5	Little green bee eater	*Merops orientalis*	X		X				11
6	Lapwing	*Hoplopterus indicus*	X		X				10
7	Indian Roller	*Coracias benghalensis*	X		X				05

Exhibit 5.2: Pictorial Profile of Avifauna of the project area

Green bee eater

Lapwing

Indian Roller

Desert lark

5.3.3 Mammals

No major mammalian habitats were identified except those of Hedgehog and mongoose habitats but not spotted nor reported. None of the species recorded is protected, threatened or included in the CITES appendices. List of Mammals recorded in the project area is incorporated after the sampling methodology.

5.3.4 Sampling Methodology

Direct count method was adopted to identify total number of identified species during the ecological/baseline surveys. The list of identified mammals is presented below in **Exhibit 5.3.**

Exhibit 5.3: List of Identified Mammals of the Project Area

S. No	English Name	Scientific Name	Occurrence		
			Common	Lass Common	Scarce
1	Roof Rat	Rattus Rattus	x		
2	Small Indian Mongoose	Herpestes javanicus	x		

5.3.5 Herpito fauna of the Project area

The site has slightly higher populations of reptiles as the environment favors their existence. Lizards and snakes were observed and reported by locals. None of the species is protected or threatened.

Exhibit 5.4: Reptiles of the project area

S. No.	English Name	Scientific Name	Occurrence		
			Common	Less Common	Scarce
1	Spiny tailed lizard	*Uromastyx*	X		
2	Monitor lizard	Varanus	X		
3	Desert cobra	Naja naja	X		


Indian garden lizard	Desert cobra

Conclusion:

As mentioned earlier, the proposed project site is naturally dry and windy which does not provide favourable habitat for floral and faunal species. The species observed are of less ecological importance. No major trees were found however if need be, in case of cutting of trees, one plant should be replaced by 1:3 for immature plants and 1:6 for mature plants. Since the area is already under constant movement of heavy vehicles, animals do not approach the area rather they have migrated more into safe areas where anthropogenic activities do not persist the area has no biological importance.

CHAPTER 6

SOCIO-ECONOMIC CULTURAL ENVIRONMENT

6.1 SCOPE AND METHODOLOGY

This chapter presents the assessment of the socio-economic baseline of the entire surroundings of the project area based on social surveys. The assessment includes the administrative, demographic and social structures, amenities, health, education, livelihood, security and economics of the project area. The assessment also includes a focus on the gender aspects.

A brief socio-economic profile of the project area, based mainly on secondary data, is also provided following the needs and requirements of an Environmental Impact Assessment (EIA), incorporating the Pakistan Environmental Assessment Procedures 2000.

6.1.1 Tools for Data Collection

The socio-economic assessment is focused on evaluation of population, languages, literacy rate, education facilities, health facilities, private medical facilities, diseases, number of houses, available utilities, access to social amenities, road access, availability and medium of transport, occupational statistics, livestock, water resources and pressing needs of the people living in the area.

Interviews, focus group discussions and consultative meetings were conducted at community level and with different private and government departments and organizations to gather additional relevant primary data. A brief profile was designed very carefully and administrated to sample the target population of the area.

The information gained helped in the measurement and determination of the impacts (positive and negative) on social services, livelihood and cultural pattern of the population under study.

Exhibit: 6.1 shows the socioeconomic features of the project area.

6.2 LOCATION AND ADMINISTRATIVE SETUP

The proposed transmission line of K-electric lies in the newly formed union council of Bhanbor of Mirpur Sakro tehsil of Thatta district. Thatta is one of the oldest town and the district headquarter of Thatta, it is situated at about 60 mile from east of Karachi on the National Highway. According to the Thatta District Census Report

1998, the district is situated at 23º 43' to 25º 26' north latitudes and 67º 05' to 68º 45' east longitudes. The total area of the district is 17,355 kilometers which constitutes 12.3% of the total geographical area of Sindh.

The district of Thatta is bounded by district Badin and Tando Muhammad Khan on the east; district Jamshoro on the north, district Hyderabad on the northeast, district Karachi on the northwest and the Arabian Sea and Rann of Kach on the south.

The district is further divided into nine Tehsils which includes

1. Thatta
2. Mirpur Sakro
3. Mirpur Bathoro
4. Ghorabari
5. Jati
6. Sujawal
7. Keti Bunder
8. Shah Bunder
9. Kharochan

Four Tehsils of district are on the right bank of Indus River and four lie on the left bank while one tehsil lies on both sides of the river.

6.2.1 Entry and Exit Point

The proposed project area lies along the coastal highway which is originated from National Highway (N5) near union council Dhabeji. One can easily get access to the project area through National Highway.

6.3 DEMOGRAPHICS OF THE AREA

According to the 1998 census the population of district Thatta was 1,113,194 with an estimated growth rate of 2.26% per annum, the major percentage of population 43.85 percent is of the age below 15 years and 2.94 percent is 65 years or above. The estimated population for 2014 is 1,593,88718, showing almost 43% increase in 16 years from 1998 (USAID September. 2014).Out of the estimated population of 2014 53 percent are males and 47 percent are females.

The Mirpur Sakro Taluka covers an area of about 2,982 square kilometers (736,541 acres). The taluka is distributed in 10 unions. The total population according to the 1998 census was 198,852 individuals.

6.4 MAIN SOURCES OF LIVELIHOOD/INCOME

According to ADB (Asian Development Bank) 79% of the population is poor and the district is the poorest district of Sindh, most of the people of the district are dependent on agriculture and fisheries and a major population of the district are landless and they depend on landlords and own livestock for living. 59% of the males are engaged in agriculture and the female population also works with men side by side. Wheat and rice is the major crops of the district along with sugarcane and maize.

Wood is used as fuel for cooking in all villages. It is mostly collected from the nearby villages of Kacha area. The animals (Buffalos, Cows, and Goats) usually graze in surrounding areas of the village within a 3 km area. Mostly children herd them.

Other sources of income includes fish farming and also poultry farming in many villages. Non-skilled labor work in the nearby cities and some villagers are also employed in the surrounding industries of Gharo and Dhabeji. A few villagers also work in salt works near Arjina bridge of Gharo Creek.

Agricultural land in project area

Livestock available in villages

6.5 NETWORKING AND COMMUNICATION

During the field visit, many villages were visited. People residing in these villages regularly visit Dhabeji and Gharo cities for shopping, business, documentation, availing health facilities. Small shops are also available in some of the targeted villages. A very few link roads are available in some villages of the project area; all of these villages have easy access to nearby towns and cities.

There is no public transportation available in the targeted villages such as buses, Suzukis, Ching chi (rickshaw) and Tanga. A reasonable number of motorcycles were seen in the project area because this is the cheapest personal transportation for villagers. Cow and donkey carts are also used for transportation by poor villagers.

The use of mobile phones was visible in almost all the villages visited. Village people mutually share cell phones. This trend has developed recently.

6.6 LEADERSHIP DYNAMICS

There are different hierarchy of leadership in the project area i.e. village leader, community leader, political leaders and spiritual leaders. The village leader is normally the most influential person of the village in terms of land. Minor conflicts are resolved at village level. However, if the conflict is big and complex, the community leader resolves the conflict through listening to both the parties' point of view. The community approaches to the police in rare cases for resolving their problems. Mostly conflicts occur due to tribal disputes, disputes on land, theft of animals, arrangements of marriage etc.

Spiritual leadership is also believed in some villagers of the area and a Mazaar (grave of saint) was also found in the route of proposed transmission line near Jangi Khan Goth at safe distance from transmission line. People also consult the Moulana of the Masjid to resolve any religious issues.

A Masjid and Madarsah in a Village

6.7 ROUTINE ACTIVITY OF FEMALES

The women of this area are very hard working and more practical than men. They play a major role as counterpart to carry out household and field activities with their men. Generally the women remain very busy in the project area; women are responsible for cooking food, dish-washing, washing of clothes, and sewing of clothes, making Rillhies, and look after their children. In addition to all above activities, women were also seen working in the agriculture field mostly in harvesting of crop, and feeding and milking the livestock. Almost all the women of the project area are illiterate and have no authority to interfere in domestic decision making; they usually sleep early and wake-up early in the morning to start routine activities.

6.8 HOUSING AND LIVING PATTERN

The area has totally poor rural outlook. There is a presence of separate Otaks system for serving the guests. The living is very simple and is manifested in their eating habits and social ceremonies. People of the project area are very hospitable and caring. Most of the houses in the project area had katcha houses and poor villagers live in huts. No concreted houses were found in the nearby villager of proposed transmission line.

Housing Pattern of the villagers

6.9 DRINKING WATER

The source of drinking water in most of the villages is underground water drawn through motor and hand pumps. Water supply system through pipelines was not available in any village of the project area but people prefer to use the water of hand pump instead of water supply, because hand pumps were reported to have sweet water as compare to the water supply. In some small villages no hand pumps are available and people use irrigation water from open channels for drinking purpose.

6.10 EDUCATION

The state of education in the area is poorest. Only one government primary school found in the route of proposed transmission area route and another primary school was found which is run by an NGO. Shortage of teachers was observed in government school. Most of the school-age going children were not attending any school due to shortage of schools and lack of interest of their parents in education. Also the schools are available at long distances and due to lack of public transportation, children avoid to go to school regularly. The literacy rate is below 5 % in almost all villages. On the other side in few Masjids of the villages religious education is given to the children by the Imam of the Masjid.

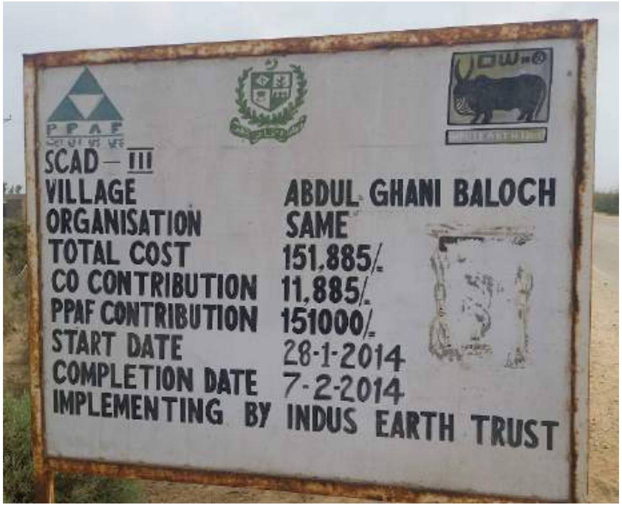
A primary school near the route of proposed transmission line

6.11 HEALTH

There is total shortage of health facilities in the project area. People of these areas suffer huge problems when someone gets sick. The health facilities are only available in Dhabeji and Gharo cities. Major health problems of the area are Malaria, Skin Diseases, Fever Diarrhea, Gastro, Malnutrition in children and mothers, Hepatitis and Diabetes. Few incidents of snake bites were also reported in flood season in villages. The problem is more serious for females especially, in case of pregnancy and delivery due to non-availability of trained female staff/lady Doctor. People travel to Karachi city in case of some serious problem/emergency.

6.12 NON GOVERNMENT ORGANIZATION (NGOS)

The expanding advocacy role of NGOs has been recognized by the State. As intermediaries, NGOs have established channels of communication and cooperation between communities, on one hand, and governments, development institutions and funding agencies, on the other. The NGOs operating in the few villages of the project area are Indus Earth and National Rural Support Programme (NRSP) majorly with collaboration of Pakistan Poverty Alleviation Fund (PPAF). The NGOs work for physical infrastructures and social welfare. Through local community we got information regarding social welfare activities in villages of project area.



A board of NGO is displayed in area

6.13 CULTURE AND ETHNICITY

Major castes / tribes in the project area are Kalmati, Rind, Khaskheli, Kohli, All these tribes speak Sindhi as their mutual languages and Balochi is the second biggest language of the project area.

Marriages in most families are arranged by parents preferably in their own caste. The ritual of wedding/ marriage ceremonies usually lasts for two to three days. Usually the people of project area borrow the money to celebrate the marriages/circumcision ceremonies due to poor economic situation of the area.

People of the area have much respect and belief for saints. They usually visit shrines at the time of trouble, misfortune, and pay for birth of sons, and when their wishes come true, this reflects their faith upon them. Depending on which sect one belongs to is determined by the fact that whether or not they visit the shrines or how much they revere the saints. Dressing pattern of the villagers represents common rural Sindhi culture and women of Hindu community also wear Saari as additional dress besides shalwar kamiz.

6.14 ARCHEOLOGICAL AND HISTORICAL SIGNIFICANCE OF THE AREA

There exist a large number of sites of archeological, cultural, historical and religious significance in Thatta district. The major ones include the archeological remains of Makli Hills graveyard, Shah Jahan Mosque and excavations of Debal Fort (Bhamhor) which are at 3 Km distance of proposed transmission line.

Famous archeological site of Bhambhor near the project area

6.15 MAJOR PROBLEMS/NEEDS

Following are the main problems/needs of the public of the project area:

- Unemployment;
- Shortage of health facilities;
- Shortage of schools and teachers;
- Lack of sewerage facilities;
- Non-availability of Sui Gas for domestic use;
- Load shedding of electricity/Lack of Electricity
- Lack of Public Transportation

CHAPTER 7

STAKEHOLDER CONSULTATIONS

7.1 INTRODUCTION

Stakeholder consultation is a fundamental principle of the EIA process. Beside the statutory requirement of Sindh EPA act of 2014 and part of EIA/IEE regulations 2014, it is a valuable source of information on key impacts, potential mitigation measures and the identification and selection of alternatives for any proposed developmental project. It is a two way flow of information between public and developers, with opportunities for public to express its views. It also ensures the EIA process is open, transparent and healthy, characterized by defensible analysis. The range of stakeholders involved in an EIA typically includes:

- the people (individuals, groups and communities) who are affected by the project;
- the proponent and other project beneficiaries;
- government agencies;
- others, such as the private sector, academics etc.

7.2 PURPOSE AND OBJECTIVES OF STAKEHOLDER CONSULTATION

The purpose of stakeholder consultation is to:

- inform the stakeholders about the proposed project and its likely impacts, (either positive or negative) on biophysical and socioeconomic environment;
- canvass their inputs, views and concerns; and
- take account of the information and views of the public in the EIA and decision making.

The key objectives of stakeholder consultation are to:

- obtain local and traditional knowledge that may be useful for decision-making;
- facilitate consideration of alternatives, mitigation measures and tradeoffs;
- ensure that important impacts are not overlooked and benefits are maximized;
- reduce conflict through the early identification of contentious issues;

- provide an opportunity for the public to influence project design in a positive manner (thereby creating a sense of ownership of the proposal);
- improve transparency and accountability of decision-making; and
- increase public confidence in the EIA process.

7.3 PROCESS

A team of environmental consultants organized meetings with the primary and secondary stockholders of the proposed project, including local communities of the area, civil servants and representatives of other institutions. The team visited various prominent places in the project area to meet the targeted audience. During these visits a simple, non-technical description and location map of the project were shared, along with an overview of the project's likely environmental and socioeconomic impacts. Following the project description, a discussion was held so that the participants could voice their concerns and opinions. These concerns and suggestions were recorded in field notes and questionnaires. All the stakeholders were encouraged to ask questions and share their concerns and suggestions related to the project.

7.3.1 Community Views

- Generally all the participants were found agreed with the proposed project and positive opinions were found about the project. The participants had the opinion that the proposed project is a developmental project and it will help in fulfilling their future energy requirements.

- Some of participants raised concerns related to temporary roads and streets disturbance due to construction works of transmission line and they demanded to complete the project as soon as possible;

- The participants emphasized to take measure and action in order to avoid environmental pollution, specially solid waste should not be left and cleared immediately after reinforcement activity;

- The villagers of the area also asked for any job opportunity in the proposed project and emphasized that non skilled workers should be employed from the local community in the project to get financial benefits and to ensure the security of the project staff.

- All the participants wished that such projects will bring change in the area and their lifestyle will be enhanced and infrastructures of the area will be improved.

- The participants also emphasized on the point that during operation, the transmission line should be monitored and complains of consumers should be considered and the problems should be withdrawn immediately by K-electric.


7.3.2 Bhanbhore Museum and Archeological Site

Official Name: Mr. Arshad Ali
Designation: Curator, Archeological Site Bhanbhore

Comments:

- The project site is at safe distance from this archeological site and no adverse impacts are anticipated with this project of K-Electric.
- NOC has to be taken from the Archeology department; before this proposed project, Sindh Coastal Highway project was initiated and they designed it near Bhambore excavations but the Archeology department refused and made it develop further away from the site. Government of Sindh is serious about the safety of the archeological sites.
- Electricity was provided to the museum in 2012. Electricity shortage is too common and administration has no choice but to exhibit the museum under natural light.
- The Bhanbhore excavation site is often a host for archeological researchers and students and facilitates them to the best of their ability. Impacts on air, water and soil quality are less significant in case of the proposed project; however green belt will be affected at some parts of the project.
- The working site should be barricaded and safety signs should be installed for the safety of general public.
- We expect that all other occupational Health and Safety measures will be taken by K-Electric for the proposed project.

7.3.3 Union Council Dhabeji

Official Name: Mr. Anwar Ali
Designation: Clerk, Union Council Dhabeji

Comments:

- The Bhanbhore area has been currently announced as new union council and formerly it was under Dhabeji union council.
- The project area is growing popular for renewable energy projects and many wind and solar power projects are proposed in the area.
- K- Electric will be getting more energy in future from these projects to fulfill the growing requirement of electricity in Karachi city and its surroundings.
- K-Electric should certainly consult with all relevant stakeholders including municipalities and other offices of Thatta before the commencement of their projects.
- We appreciate and support the efforts of K-Electric to bring prosperity in the area through fulfilling the basic need of the people that is electricity.

7.3.4 Indus Earth Trust (NGO)

Official Name: Dr. Abdullah Rajpar
Designation: Senior General Manager, Indus Earth Trust

Comments:

- Indus Earth Trust has been working for many years for the welfare of the poor people in the project area specially in the sectors of livelihood support and community physical infrastructures like hand pumps, link roads and irrigation canals etc.
- The people of the project area are facing problems in drinking water and hence diseases are spread in the area. The groundwater available in the area is temporary and depends on rain. Otherwise villagers have to consume the

irrigation water for drinking purpose which is not safe for human consumption.

- The proposed project of K-Electric will exhibit positive impacts in the area if local people are given importance in the project.
- Current needs of the people in the project area are electricity, safe drinking water, and proper irrigation system to conserve limited irrigation water.
- Currently a welfare programme is being run in the area by the name of "Sindh Coastal Area Development Programme" which is initiated international donor agencies and NGOs like IET, NRSP, HANDS and SAFWCO are active partners in the implementation of this progromme.

CHAPTER 8

ALTERNATIVES

Analysis of alternatives is part of the ESIA process to select the best among all possible project options. The assessments and recommendations made by the ESIA team are presented below:

8.1 NO PROJECT ALTERNATIVES

While not developing the Power line would avert negative impacts commonly associated with power lines such as visual intrusion, impact on road, street infrastructure, utilities services and land take. It will not balance the need of development in the city for fulfilling the electricity demands. Moreover, the power generated by the Solar Power Plant willing to sublet electricity to K-Electric will not be available for provision if it is not developed.

Since there is increasing demand of electricity at local and national scale, the "No-Development" Alternative is not considered as a feasible option.

8.2 ALTERNATIVE ROUTES

The proposed project route was finalized from many alternate routes. The final route was planned considering primary factors:

In selecting the corridor route and shortest possible path was identified after considering the factors which include:

- clustered settlements;
- common access routes and pathways;
- private land (by avoiding it to extent possible).

Technically the route identified for transmission line is as follows:

- While selecting the route, due weightage was given to the accessibility of the line for construction as well as for maintenance for its total life span;
- The line is sited in areas which are accessible by slight deviations and marginal increase in the route length;
- In most part of the route it is possible to transport materials and tools quickly in case of breakdowns;

- Wherever roads are existing the line and stations are approachable from such roads (in this case, the highway); proper planned system is designed
- It would be possible for the personnel patrolling the line to be able to reach every location, careful inspection of the towers, insulators and the accessories without any obstruction from the land owners;
- Prior consultations were held with the concerned departments.

8.3 ALTERNATIVE TECHNOLOGIES

Trenching is carried out generally with machinery like excavator and jack hammer for rocky soil but in streets/narrow paths where machineries are unable to reach the project area trench is made manually by using a spade or shovel and not a fork or pick-axe, in areas where utility services exist.

CHAPTER 9

ENVIRONMENTAL IMPACT ASSESSMENT & ENVIRONMENTAL MANAGEMENT PLAN

After a thorough assessment of the existing environmental and socio-economic conditions and review of technical data, a team of environmental professionals analyzed the environmental impacts and suggested the necessary measures of mitigation for significant impacts. This Chapter presents the environmental impact assessment of the proposed project.

The transmission line project is not an air, water polluting and resource intensive project. However, there may be considerable environmental impacts during the initial construction phase of proposed transmission lines. Construction phase impacts are usually temporary and localized phenomenon, except the permanent changes that might be introduced in the local landscape and land use patterns along the Right-of–Way. However, these impacts are given due consideration, wherever applicable.

9.1 ENVIRONMENTAL IMPACTS ASSESSMENT

9.1.1 Environmental Impacts associated with construction phase

The construction works would require foundation works for tower erection, resulting in disturbance from excavation and associated activities, such as heavy equipment use and soil storage. Ecological impacts could be increased by the greater soil disturbance, as could impacts to archeological and cultural resources.

The impacts on the environment from various activities of the project can be categorized as follows:

- Impact on Physical Resources
  - Impact on Topography
- Impact on Environmental Resources
  - Impact on Air Quality
  - Impact on Noise Levels
  - Impact on Surface Water Quality
  - Impact on Ground Water Quality
  - Impact on Soils and Geology

- Impact on Ecological Resources
  - Terrestrial Ecology
  - Wild Life
- Impact on Human Environment
  - Health and Safety
  - Socio-economics
  - Traffic and Transport
  - Interference with other utilities
- Waste Disposal
  - Solid waste disposal
  - Liquid waste disposal.

9.1.1.1 Impact on Physical Resources

Impact on Topography

During the construction of the transmission line, the topographic profile at the sites of tower construction might be disturbed temporarily. However, the nominal impact may be due to excavation and erection of tower, fill and cut for leveling the tower erection place.

Mitigation Measures:

Slight and temporary changes are envisaged during the construction phase of the transmission line. The existing access routes will be utilized during the operation and maintenance of the transmission line.

Areas other than the tower sites will not be disturbed and pits will be stone pitched to avoid loosening of soil.

9.1.1.2 Impact on Environmental Resources

Impact on Air Quality

During the construction phase, the major sources of air pollution are movement of vehicles transporting the construction material and equipment to the site. Most of the access roads along the alignment are feasible for motor vehicles as it is the main highway. The major work of the construction is expected to be carried out during the day time.

The area is naturally windy therefore care must be taken to avoid excessive emissions which may travel at great lengths towards eastern parts of the proposed project area.

Mitigation Measures:

All these activities would give rise to emission of dust particles thereby affecting air quality marginally at the site which will be transitory in nature. Sprinkling of water during excavation and construction will control dust emission to a great extent.

The intensity of dust generating activities like excavations, piling of raw materials will be kept low and steady movements of vehicles will be maintained.

Impact on Noise Levels

During the construction phase, the major sources of noise pollution include movement of vehicles, transportation of construction material and equipment to the site and operation of heavy machineries. The major work of the construction is expected to be carried out during the day time. The area is generally observed to have low levels of noise as there is no major industry or settlements.

Mitigation Measures:

Following measures will help to keep noise and vibration in acceptable level during construction phase:

- The most likely people to be affected of nearby settlements shall be fairly warned about the severity of the works.
- Contractor shall equip their heavy construction equipment and plants with exhaust silencers to limit the engine noise so as not to exceed 75 db (A) (compacters, loaders, vibrators and cranes) and regularly maintain all construction vehicles and machinery in accordance with the SEQS.
- PPEs must be made mandatory to be worn by workers.
- Contractor shall limit working time for activities that create noise only from 7.00 am to 8.00 pm. Construction related activities closer to sensitive receptors have to be scheduled in coordination with the relevant authorities.
- To control corona, proper dampers should be used to permit any unnecessary noise.

Impact on Surface Water Quality

The construction of the transmission lines might have impact on the surface water quality in the area as one of the main creek system lies in the route of the proposed transmission lines. Sediment runoff at tower pit sites near the canals and water bodies is expected.

Contractors shall use silt traps and erosion control measures where the construction is carried out in close proximity to the water channels to avoid entering of cement particles, rock, rubbles and waste water to the surrounding water bodies or channels.

Mitigation Measures:

Care shall be taken to locate the temporary construction worker sheds away from the water bodies. Adequate drinking water facilities, sanitary facilities, and soakage pits in the temporary sheds of the construction workers should be provided to avoid surface water pollution.

Impact on Ground Water Quality

Ground water pollution can take place, if chemical substances and oily waste get leached by precipitation of water and percolate to the ground water table. For transmission line construction activity, no chemical substance or oil is used hence there is no impact on ground water quality.

Mitigation Measures:

Despite the fact that no activities will impact ground water quality, the possibility of water getting stagnant at the proposed site must be checked and controlled by the contractor so no water may get contaminated and percolate in the ground.

Impact on Soil and Geology

The impact on soils will be due to the soil erosion at the tower construction site and along the access routes. Excavation activity and land clearance in the erosion prone areas have to be minimized while conducting site selection for towers. Leveling and stabilization of tower construction sites will be done after completion of construction activity which will avoid surface runoff and damage to the topsoil.

Mitigation Measures:

The impact associated with landslides due to excessive erosion and other civil works can be avoided or minimized by following mitigation measures:

- Minimize obstruction or destruction to natural drainage pattern of the surrounding area

- Proper treatment of clearing and filling areas against flow acceleration

- Turfing work should be taken prior to rainy season around the tower sites and Gantry.

- Contractors shall restrict cut and fill operation around sharp/deep slope areas

- Top soil (2-3 cm from the top of the soil), which is removed during construction from the cultivated lands must be stored separately for future utilization of cultivated lands near tower leg locations

9.1.1.3 Impact on Ecological Resources

There is no national wildlife park, bird sanctuary, wetland in the route alignment of the proposed transmission line. The study area for route alignment has sparse plantations area. The ecological impacts are briefly described in the following sections

Effect on Flora and Fauna

No major floral or faunal species were found in the immediate proposed transmission line route. Reptiles and avian species like snakes, lizards and sparrows are wary of human activities and hide when the areas are approached.

Mitigation Measures:

- Strict attention on worker force regarding disturbance to surrounding habitats, flora and fauna including hunting of animals and unnecessary cutting of plants

- Construction activities must begin with low intensity which may serve as an early warning system for the fauna to leave the area and go to safer areas

- Ensure habitat conservation by avoiding dumping of construction and sanitary waste like debris, bricks, gravel, litter, food leftovers in open areas and seek a place with the municipal office to extricate a place to release them

Impact on Terrestrial Ecology

There is no sensitive ecological area / protected forest area such as national wildlife park, or bird sanctuary crossing the proposed route alignment. The removal of herbaceous vegetation from the soil and loosening of the top soil generally causes soil erosion. However, such impacts would be primarily confined to the project site during initial periods of the construction phase.

Mitigation Measures:

These would be minimized through adoption of mitigation measures like paving and surface treatment and water sprinkling.

Removal of Trees

No trees were found along the route of the proposed transmission line route, therefore no tree will be cut during the project activities.

Mitigation Measures:

Care has been taken to avoid the thick plantations/vegetation as far as possible and tower locations are selected at plain paddy fields where the vegetation is thin. This will minimize the tree loss.

Replanting of similar species with the ratio of 6 against 1 for mature plants and 3 against 1 for immature plants will be implemented in case any cutting of tree is necessary.

9.1.1.4 Impact on Human Environment

Health and Safety

Health and safety impacts will be in terms of risk of accidents and exposure to electromagnetic fields along the alignment. The accidents may be caused due to electrocution, lightening, fires and explosions. Necessary training on safety aspects to the personnel working at the line will be provided by the contractor. Personal protective equipment like safety gloves, helmet, shoes etc. will be provided during Construction period. First aid facilities will be made available with the labor groups and doctors called in from nearby locations when necessary.

Mitigation Measures:

Project activities may create accidental damage to public as well as the construction workers. Therefore, contractors should take necessary action to enhance personal safety during Construction works through following measures:

- Organize awareness programs relevant to personal safety of the workers in particular and public in the area in general.
- Installation of warning signs at particular locations such as transverse points of local road network.
- Provide protective safety belts, footwear, helmets, goggles, eye-shields, and clothes to workers depending on their job specification.
- Arrangement of proper first aid unit and emergency vehicle to take affected personnel to the nearest medical facility.
- The ‘HSEQ Policy’ and ‘Contractors and Suppliers HSEQ Management Procedure’ are attached as **Annexures 3** and **4** respectively.

Socio-Economics

Skilled workers will be employed for these works; local people will be engaged for communication of project activities.

Temporary Outage of the Electricity

Temporary disconnection of power supply will occur during the construction activities. Thus public and industrial places, which are provided supply from the existing circuit, will face inconvenience for short periods.

Mitigation Measures:

The following measures will have to be taken:

- Advance notice to the public about the time and the duration of utility disruption, and
- Restoration of the utilities as early as possible to overcome public inconvenience.

9.1.1.5 Cultural Sites

There are no archaeological, historical, or cultural important sites within the immediate vicinity of the proposed transmission route alignment; and hence, the impacts on these sites are not envisaged.

Although Bhambore Excavation site is quite near to the project site, there will be no direct or residual impact on the site.

9.1.1.6 Traffic and Transport

Transformers, tower material, iron bars, concrete materials, equipment etc. will be transported through the provincial and local road network to the project site. Heavy transportation vehicles might disturb the local traffic specially during day hours. Visibility is usually minimum during night time where there are less street lights, this will pose as a hazard for the local traffic travelling in night time.

During surveys, very less traffic was observed on the Sindh Coastal Highway but it was also found to be narrow for heavy vehicles to move continuously.

Mitigation Measures:

- Diversion routes for construction vehicular traffic must be allocated to maintain normal traffic flow by forming a temporary pathway made up of gravel and sand along the proposed transmission line route.

- Emergency routes must be kept clear and ensure that they are easily accessible.
- The area has very low traffic count and does not need an extensive traffic management plan to be implemented. However, local traffic police and coastal guards must be consulted during works for supervision.

9.1.1.7 Waste Disposal

Almost all the activities from excavation to erection will generate waste, however the waste will be of inert nature, in addition the waste will mainly comprise of cement and concrete waste, the concrete material resulting from batching and mixing will harden the ground surface resulting in growth inhibition of plant growth. This would also result in unaesthetic environment of the site.

Furthermore, solid wastes will be generated and will be categorized according to their nature. For instance, packaging materials, wood left-overs, plastics of various categories etc.

Mitigation Measures:

Thus following measures are needed to protect and enhance the quality of environment during the construction stage:

- It is strongly recommended that waste should be reduced at source and by reusing the residual waste
- It will be ensured that waste will be segregated and collected, however recyclable waste will be sent to the recycling industry to generate revenue
- The waste which cannot be reused or recycled will be dumped to the proper and allocated containment facility

A comprehensive Waste Management Plan is provided in **Annexure – 5**.

Sanitary Waste Disposal at Construction Sites and Labor Camps

The temporary labor camps generating the human excreta will not be significant to cause contamination of ground water. Mostly, labors will be staying near hamlets, which shall use the community services for solid waste, water and sanitation.

Unacceptable solid waste disposal practices such as open dumping of solid waste and poor sanitation facilities will lead to pollution of surrounding environment, contamination of water bodies and increase adverse impact to the aquatic; terrestrial lives and general public inhabited in the area. Surrounding of labor camps, garbage disposal sites and material storage yards provide favorable habitats for vectors of diseases such as mosquitoes, rats and flies.

Mitigation Measures:

Provision of adequate washing and toilet facilities shall be made obligatory. This should form an integral component in the planning stage before commencement of construction activity.

There should be proper solid waste disposal procedure to enhance sanitation of workers who stay in camps. Thus, possibilities of infecting water borne diseases or vector borne diseases (parasitic infections) will be eliminated by adopting proper solid waste disposal procedure.

Following measures are needed to protect and enhance the quality of environment during the construction stage:

- A better way to overcome garbage disposal as mentioned previously is by reducing or avoiding the construction of labor camps, thus the selection of majority of skilled and unskilled workers from the project influence area will be a proper measure in this regard.

- Provision of solid waste disposal, sanitation, and sewage facilities at all sites of the construction/labor camps to avoid or minimize health hazards and environmental pollution.

- Contractor shall handle and manage waste generated from the construction /labor camps without contamination to natural environment thus reducing risk to neighboring community.

- Adequate supply of water shall be provided in the temporary urinals, toilets, and washrooms of the workers' accommodation.

- Contractor shall provide garbage bins near workers' accommodation and construction sites, for dumping wastes regularly in a hygienic manner.

9.1.2 Environmental impacts associated with operational stage

During the operation phase, most of the construction phase impacts will get stabilized and the impacts will be restricted only to the operation and maintenance of the project.

9.1.2.1 Electric shock

This may lead to death or injury to the workers and public in the area.

Mitigation Measures:

This can be minimized or avoided by:

- Cordon off possible hazard-zones for example, range of conductor wire falling if breakage occurs.
- Display of warning signs.
- Careful design using appropriate technologies such as earthing wire clamps or electrical shock absorbers etc. to minimize hazards.

9.1.2.2 Electric & Magnetic Field

Electric and magnetic fields are produced by any wiring or equipment carrying electric current. This includes overhead and underground power lines carrying electricity, wiring in buildings, and electrical appliances. The strengths of the fields decrease rapidly with increasing distance from the source. Electric and magnetic fields are fundamentally different, in their physical nature and in the way they interact with the body, from true electromagnetic radiation such as radio waves and microwaves. Typical magnetic field levels found in various locations are presented in table.

S/no	Source	Electric Field (kV/m)	Magnetic Field	
			µT	mG
1	High Voltage Transmission line (Direct beneath line)	0.3–3	0.5–5	5-50
2	High Voltage Transmission line (40 metres from line)	0.01–0.1	0.1–1	1-10
3	Near street distribution lines	0.01–0.1	0.05–2	0.5-20
4	Substations Electric fields: generally less than 0.1 kV/m	Generally less than 0.1 kV/m except (Where overhead supply lines enter or leave the station.)	Generally decrease to around 0.1 Within 5 metres of equipment except near where supply lines enter or leave the station.	Generally decrease to around 1 Within 5 metres of equipment except near where supply lines enter or leave the station.

Generally, magnetic fields decrease to around 0.1 µT (1 mG) within 50–100 metres of the line.

Mitigation Measures:

Basic Restriction and reference level of occupational and public exposure to 50 Hz ELF electric and Magnetic field

<table>
<tr><th rowspan="3">Exposure characteristics</th><th>Basic restriction</th><th colspan="3">WHO Reference levels</th></tr>
<tr><th rowspan="2">Induced current density (mA/m²)</th><th rowspan="2">Electric field strength (kV/m)</th><th colspan="2">Magnetic flux density</th></tr>
<tr><th>μT</th><th>mG</th></tr>
<tr><td>Occupational</td><td>10</td><td>10</td><td>500</td><td>5000</td></tr>
<tr><td>General public</td><td>2</td><td>5</td><td>100</td><td>1000</td></tr>
</table>

Note: All values are rms (root-mean-square, a kind of average)

Ref. National Radiation laboratory Manatu Haura
(http://www.who.int/peh-emf/project/mapnatreps/nznrl_emfbooklet2008.pdf

K-Electric has SOPs established to regularly monitor EMF levels for its High Voltage Transmission Lines and they are found to be within safe limits defined by International Standards Guidelines such as ICNIRP Guidelines for EMF Public and Occupational Exposure. These practices should be continued in existing and future networks.

9.2 ENVIRONMENTAL MANAGEMENT PLAN

An Environmental Management Plan (EMP) is a framework for the implementation and execution of mitigation measures and alternatives. It usually covers all phases of the project, right from pre-construction to the operation and maintenance phases of the transmission line project. The plan outlines mitigation measures that will be undertaken to ensure compliance with environmental laws and regulations and to eliminate or reduce adverse impacts. The objectives of an EMP, thus, are:

- To ensure that mitigation measures are implemented;
- To establish systems and procedures for this purpose;
- To monitor the effectiveness of mitigation measures;
- To ensure compliance with environmental laws and regulations;
- To take any necessary action when unforeseen impacts occur;

Exhibit 9.1: Environmental Impact Mitigation Plan

S/No	Aspect	Impacts
Construction phase		
1	**Land Disturbance**	
	Construction works will require heavy vehicles to use off-road lands as the transmission line towers will lie adjacent to the main road.	• Land disturbance may occur in form of top soil degradation by movement of vehicles on off-road lands.
	Mitigation Measures	• Issue "Notices of intent" to all concerned authorities at least four weeks prior to commencement of the work, such as the NHA, Municipality, Telecommunication Department, Traffic police, etc. • Temporary platform must be located exactly within the approved reservation • Minimum traffic access routes are preferred for works, put up signs to refer ongoing activity. • Develop gravel paths on barren lands if feasible to prevent land degradation.

S/No	Aspect	Impacts
2	**Ambient air quality**	
	Vehicular movement at the Construction transmission sites.	• Vehicular movement at sites might cause gaseous emissions, whereas the areas where barren lands are present dust emissions may generate.
	Mitigation Measure	• Use dust abatement techniques on unpaved, non-vegetated surfaces to minimize airborne dust. • Sprinkling of water frequently in the area where barren land access routes are present. • Post and enforce speed limits to reduce airborne fugitive dust caused by vehicular traffic.
3	**Noise Pollution**	
	Noise from construction equipment/vehicles.	• While construction noise is unwelcome during night time in residential areas when people are trying to sleep, sometimes it may be too loud, impulsive, and interrupting in people's activities.
	Mitigation Measure	• Noise pollution due to construction works should be controlled by completing the task in a short period of time and also by confining it to day time hours (8:00 am to 7:00 pm). • Use of noise barriers or noise canceling acoustic devices should be considered if necessary. • PPEs will be made mandatory to be worn by workers where noise generating activities are taking place.

S/No	Aspect	Impacts
4	**Ground Water contamination**	
	Oil leakages from construction vehicles.	Breakdown of construction vehicles may cause oil leakages, leading into the ground and ultimately contaminating nearby ground water reservoirs.
	Mitigation Measure	• Vehicles and equipment must be placed away from water sources. • Incase of spill, immediate action must be taken to prevent leaching. • Contractors must quickly alert spill response team. • Ensure no water remains stagnant at any proposed project area.
5	**Soil and land contamination**	
	Oil, lubricant chemical spillage, construction and debris may cause land contamination.	Spillage of Oil and lubricants may cause soil contamination, slippery surface and oil sludge formation.
	Mitigation Measure	• The secondary containment facility should be available to avoid any spillage or fire hazard and material should be stocked according to the inventory requirement. • Vehicles and equipment must be maintained properly, and checked before allowing to work. • Construction debris should be collected and disposed of properly.

S/No	Aspect	Impacts
6	**Solid Waste**	
	lubricants and chemicals, construction debris and other waste installation material (metal, wooden, plastic & cable pieces or tower assembling defective articles), and packaging material	• Waste may cause land contamination, slippery site surface and harm natural environment, excavated material with trench may slide on workers, choking of drains, etc.
	Mitigation Measure	• Use waste minimization techniques to reduce, reuse & recycle waste material. • Non-hazardous solid waste must be segregated and sent to municipal contractors for disposal. • Raw material inventory records should be maintained and excessive stocks should be avoided. • Integrated waste management plan should be prepared to minimize waste generation. • Hazardous waste should be temporarily stored with proper labels in air tight lid container. • Hazardous waste should be disposed of through EPA certified contractors.

S/No	Aspect	Impacts
7	**Ecological Impact**	
	Ecological disturbance from project activities.	• No major vegetation clearing will be carried out during transmission line installation phase except for common vegetation in negligible quantities for access route maintenance. • The plants species within the vicinity of the proposed site are of minor ecological importance. • Animals of the area are urbanized species i.e. adapted to city developments and will not be disturbed by the project.
	Mitigation Measure	• Construction techniques shall be environment friendly to minimize local vegetation clearance of the project site. • Workers must be warned not to clear vegetation unnecessarily. • Avoiding night construction whenever possible to minimize fauna disturbance. • Small animals or birds of the area should not be harmed from project activities

S/No	Aspect	Impacts
8	**Health and Safety**	
	Incident may occur in case of improper management and work practices	Active live line Construction works pose major issues with regard to health and safety; these may involve electrocution, falling from height, injuries and fractures.
	Mitigation Measure	• Establish and maintain a safety and health program for the worksite. Provide adequate systematic policies, procedures, practices • Surface encumbrances that create hazards must be removed/supported • Only Trained Employees must be allowed to operate heavy equipments • Use barricades, hand or mechanical signals, stop logs to keep operators safe. • Appropriate PPEs should be provided to workers. • Implementation of a fall protection program must be done that will include inspection, maintenance, and replacement of fall protection equipment; and rescue of fall-arrested workers, among others. • All workers and contractors will be properly trained for the task. • Fitness test of all workers is deemed necessary. • Evacuation plan must be designed according to the project activities on site.

S/No	Aspect	Impacts
	Lock-Out-Tag-Out (LOTO)	• Before approaching Live line LOTO procedures must be followed to prevent live voltage in wires. • Prior to commencement of works, proper grounding shall be ensured wherever applicable. • Provide complete line charts to contractors and communicate all in-house procedures for live line works.
	Mobile Elevated Platforms	• The Mobile vehicle should be positioned at appropriate distance, adjacent to the tower. • Number of Workers will be restricted according to the loading capacity of the platform. • Workers must use safety harness, gloves and boots and work within the platform. • Supervisors must keep constant communication with workers on platform.

S/No	Aspect	Impacts
	Scaffolding	• Wherever railways, road tracks, or water bodies are located, scaffolding must be used. • Scaffolding should be at regular height intervals for safe access. • Tower heights must be first analyzed and infrastructure durability must be ensured prior to scaffolding
	Insulator Hanging	• Insulators must be first aligned at solid ground and checked for any defects. • Insulators must be thoroughly cleaned and bolted before hanging. • Hanging must be done through mechanical pulley and all personnel must remain clear of the area.
	Stringing of Conductors	• All sites under Construction works must remain clear from people and only mechanical staff must have controlled access. • No person will be allowed under the route and the sites must be marked or labeled mentioning work in progress. • Area should be cleared from people to maintain safe distances. • No traffic or public will be allowed to pass through. • Conductors must be carefully pulled such that they do not touch the ground or hang loose from the tower.

S/No	Aspect	Impacts
9	**Traffic**	
	Vehicle movement disturbance on main road of project site	• Proposed Construction activities would temporarily affect transportation facilities within the project area. It is likely to cause temporary traffic delays.
	Mitigation Measure	• Develop temporary pathway preferably of sand and gravel along the route off the main road for heavy vehicles to work easily. • Mark the transmission line route with reflecting cones or tape, to warn incoming traffic of active project site.
10	**Social Impacts**	
	Blocking of Right of Ways in streets, Electricity supply shut down	• visual and auditory disturbance due to the presence of machinery, construction workers, transmission towers, and associated equipment • Shut down of electricity will affect the daily routine of consumers.
	Mitigation Measure	• Local People to be informed about the construction activities and surveys. • Construction vehicles should be placed at designated areas to avoid any incident. • Electricity shut down must be planned and communicated to the affected general public.

S/No	Aspect	Impacts
11	**Geo hazards –Earthquake**	
	Could cause towers to fall.	• Limited potential for harm unless people were very close to tower or line.
	Mitigation Measure	• Foundation should be inspected periodically.
12	**Meteorological impacts**	
	Damages of towers, equipment and structure caused by heavy rainfall, flooding & wind storms.	• Damage lines may fall on people passing by or charge stagnant or surface water below that may cause severe electrical hazards or even death. • Rainfall may affect the Construction work. Heavy rain have tendency to collapse foundation or trench structure.
	Mitigation Measure	• Proper HSE Plan and Emergency Response Plan will be prepared and implemented to deal with natural hazards. • Construction work during heavy rainfall, flooding and windstorms will be prohibited.

S/No	Aspect	Impacts
Post Development Phase		
1	**Meteorological impacts**	
	Damages of towers, equipment's and construction structure caused by heavy rainfall, flooding & wind storms.	• Damage lines may fall on the residents which may cause serious incident. • Heavy rain have tendency to collapse foundation or trench structure. • These hazards may work as a medium between ground objects and energized conductors. This may cause any serious incident. • Dust or water drops can affect a conductor's electrical surface gradient and its corona & induced current performance (Corona is the physical manifestation of energy loss, and can transform discharge energy into very small amounts of sound, radio noise, heat, and chemical reactions of the air components).
	Mitigation Measure	• Safety measures should be sufficient in case of any natural hazards such as tightening insulator clamps and proper earthing. • Prohibit the maintenance work during heavy rainfall, flooding and windstorms.

S/No	Aspect	Impacts
2	**Electric and Magnetic field**	
	There is public and scientific concern over the potential health effects associated with exposure to EMF	• There is no empirical data demonstrating adverse health effects from exposure to typical EMF levels from power transmissions lines and equipment. However, while the evidence of adverse health risks is weak, it is still sufficient to warrant limited concern.
	Mitigation Measure	• Identification of potential exposure areas in the workplace, including surveys of exposure levels in new projects and EMF measurement will be carried out in accordance with Corporate EMF Management Procedure • Establishment and identification of safety zones to differentiate between work areas with expected elevated EMF levels compared to those acceptable for public exposure. • Heights of transmission towers to be increased at least in residential areas. • Since Sindh does not have SEQS for EMF levels, it is suggested to follow international guidelines of IFC's Environmental, Health and Safety Guidelines "Electrical Power Transmission and Distribution" as well as WHO and ICNIRP's standards. Refer to Section 9.
3	**Health and Safety**	
	Incident may occur in case of improper management and work practices	• Overhead transmission line may interfere with industry's infrastructures that pose electrocution hazards and Structure collapse during Construction of transmission line.

S/No	Aspect	Impacts
	Mitigation Measure	• Establish and maintain a safety and health program for the worksite. • Provide adequate systematic policies, procedures, practices. • Health and safety Impact assessment should be prepared before starting project activity to prevent any incident to workers or nearby community. • Contractor should be aware of health hazards from project activities. • Employees must be trained before working • Use barricades, hand or mechanical signals, illuminants painted towers for traffic safety in night hours, stop logs to keep operators safe. • Appropriate PPEs should be provided to workers during maintenance work. • Implementation of a fall protection program that includes use of fall protection measures; inspection, maintenance, and replacement of fall protection equipment; and rescue of fall-arrested workers. • Understand the minimum approach distances outlined for specific live line voltages. • Ensure proper use of special safety equipment and procedures when working near or on exposed energized parts of an electrical system. • The worker is properly isolated and insulated from any other conductive object (live-line work).

S/No	Aspect	Impacts
4	**Noise (Corona)**	
	High voltage often creates aberrations in conductors at splicing points or insulators mostly due to high electricity charge and atmospheric moisture which creates a buzzing or humming noise (corona)	The corona often produces loud noises and especially at joints or splicing points where there are open edges. These noises although do not have any serious effect but constant exposure to these noises may develop noise-inflicted diseases.
	Mitigation Measure	• Maintain a sag distance to ensure minimum exposure areas. • Use appropriate material and installation techniques such that loose edges or aberrations do not form.

Exhibit 9.2: Environmental Management Plan

Aspect	Impact	Mitigation	Monitoring Parameter	Location	Frequency of Monitoring	Responsibility
Air	Chronic health affects Reduced visibility on roads	Sprinkling of water Tuning of construction vehicles & machines Dust masks for laborers Monitoring of vehicular emission Monitoring of Ambient Air	Particulate Matter Smoke	All project locations	Monthly	Contractor K-Electric
Noise	Stress Hypertension Hearing loss Headache	Avoid working at night Lubrication of construction vehicles Ear plugs Monitoring of Ambient Noise Monitoring of noise (near construction machinery)	Noise levels	Project location close to residential areas	Monthly	Contractor K-Electric

Aspect	Impact	Mitigation	Monitoring Parameter	Location	Frequency of Monitoring	Responsibility
Land and soil	Soil erosion on barren access routes	Water sprinkling and develop gravel path if required	Surface topography	All project locations	Continuous	Contractor K-Electric
Vegetation	No cutting of trees is involved	In case of cutting of trees, one plant should be replaced by 1:3 for immature plants and 1:6 for mature plants	No. of trees cleared or cut Ensure re-plantation by appropriate tree compensation ratio of same species	All project locations	Continuous	K-Electric
Water	Wastage and misuse of water	Avoid un necessary use of water Prevent leakages	Record log of water usage	All project locations	Continuous	Contractor
Social Environment	Disturbance to routine activities Conflicts between laborers and local communities	Specify time scale for construction activities Discussion with local people regarding conflicts if any	Review of complaint register Local Consultations	All project locations	Monthly	K-Electric

Aspect	Impact	Mitigation	Monitoring Parameter	Location	Frequency of Monitoring	Responsibility
Roads and networks	Traffic congestion leading to accidents	Diversion routes must be notified to maintain traffic flow Signs and reflectors must be boarded for driver's visibility at night	Signs and detours are being followed	Intersections of diversions	Monthly	Contractor
Health and Safety	Lack of awareness amonggeneral public about safety may lead to accidents Incompetent and untrained workers might cause harm to themselves and others Construction works may include many risks and hazards that may lead to injuries or even death	Safety symbols and instructions will be boarded at work sites Trained personnel will be appointed for the specific work Appropriate PPEs must be used for technical work	Record of Safety Talks Record of safety Incidents (Major & Minor) Record of PPEs Visual Assessments	On all project sites	Monthly	Contractor K-Electric

Aspect	Impact	Mitigation	Monitoring Parameter	Location	Frequency of Monitoring	Responsibility
Operational Phase						
Meteorological conditions **(Heavy rainfalls, strong winds etc.)**	Accidents • Electrocution • Injuries	In case of breakage, ensure emergency shutdown of transmission line Immediately repair the damage and ensure Log-Off-Tag-Off (LOTO) Implement HSE & Emergency Response Plans	HSE Inspection Reports	All project components Grids	Biannually	K-Electric
Electric Magnetic Field (EMF)	Human health impacts such as, neuropsychological disorders or cardiovascular diseases	Appropriate cabling with protective shields to suppress electron flux	EMF Intensity	Neighboring communities near the corridor	Biannually	K-Electric

CHAPTER 10

CONCLUSION

The ESIA of the proposed transmission lines project has achieved the following goals:

- Identification of national and provincial environmental regulatory requirements that apply to the proposed project activities;
- Identification of the environmental features of the project area including the physical ,biological and social disturbance and likely impact of the project on the environment;
- Recommendation of appropriate mitigation measures that K-Electric will incorporate and ensure as per this ESIA into the project to minimize the adverse environmental impacts;
- The study was intended to generate factual information on power transmission lines and their potential applications.

Baseline physical, biological, socio-economic and cultural data and information was collected from a variety of primary and secondary sources, including field surveys, review of relevant literature and online publications. The collected data was used to organize profiles of the physical, biological and socio-economic environments, likely to be affected by the proposed project.

Further an ESIA Report has been made to highlight the potential impacts of the described project on the area's physical, biological, socio-economic and cultural environments.

It is concluded that the potential impacts of the proposed K-Electric's transmission lines project will be insignificant on most of the environmental receptors, provided that the EMP and the mitigation measures proposed in this report are implemented in true spirit. K-Electric must be constituted to ensure minimum impacts.

After assessing the proposed project activities and investigating the project area, the environmental consultants, GEMS have concluded that:

"If the activities are undertaken as proposed and described in this report and the recommended mitigation measures and environmental management plan is adopted, it is concluded that the proposed project will increase the existing K-Electric's capacity to deliver the necessary load without causing any negative impact. The proposed project is favorable in all respects which include system capacity, economics, minimization of losses and environmental impacts."

ANNEXURE-1

S.O.P of Supervision of Erection, Testing & Commissioning (ETC)

S.O.P

(Standard Operating Procedure)

Supervision of Erection, Testing & Commissioning (ETC) of Overhead & Underground Transmission Lines till Taking over/Handing-over & closure of project

RECORD OF REVISIONS

Edition Number	Revision Number	Issue Date	Effective Date	Released By & Date
1st Edition	00	31.03.2015	5.5.15	

1. Purpose:

1.1. The purpose of this SOP is to:

1.1.1. Define the procedure for safety during the site activity and identify the control of safety process.

1.1.2. Define the procedure for supervision of Erection, Testing & Commission (ETC) of OH/UG Transmission lines work and identify the control process for the supervision of ETC activity.

1.1.3. Define the procedure for Taking Over/Handing-over the project and identify the controls for taking over/handing over process.

1.1.4. Define the procedure for project closure.

2. Scope:

2.1. This SOP is applicable to the employees of Transmission Section of PID.

3. Safety:

3.1. Procedure:

3.1.1. The Contractor shall ensure compliance to the SOPs developed for Contractor Management (e.g. document no. SP-022 Contractor HSEQ Management Procedure). Other SOPs may be applied depending upon the scale and scope of the project.

3.1.2. Contractor shall submit the emergency exit plan on the request of KE via MOM/Letter/email if required in the project.

3.1.3. Tool Box Talk (TBT) including headcount will be performed to ensure that all the present staff at the site shall be equipped with healthy PPE/SPE. It may highlight the probable hazards that can occur during the course of work and their mitigation plan.

3.1.4. In case of work in existing grid station, DM/AM/AE shall inform to grid in-charge present at site or LDC about the activity.

3.1.5. Excavated/drilled area shall be properly barricaded. All excavations shall be back filled by the contractor (and refinished as per existing) before the removal of warning sign / barricade.

3.2. Monitoring & Control:

3.2.1. Dully filled and signed SP-22 document is submitted by the contractor before start of the project. (e.g. Ref. No. DTS/KE/Project/XXX/Date)

3.2.2. Emergency Exit Plan shall be available at site by contractor. The work shall be started after discussing of emergency exit plan. (e.g. Ref. No. DTS/KE/Project/XXX/Date)

3.2.3. Dully filled Toolbox talk (TBT) form No. KESC-SP-10-F01 including headcount should be available at site and copy received by DM/AM/AE of PID.

3.2.4. Entry in grid log book shall be made for both starting / finishing the work, where applicable.

3.2.5. Safety coordinator will perform real time delivery of the work once a week using criteria mentioned in SP-22 (e.g. document no. SP-022 Contractor HSEQ Management Procedure), if safety coordinator finds any discrepancy during real time delivery verification like poor workmanship or non-conformance, he/she will perform the analysis of discrepancy and then will make a decision to either continue the work or stop the work with the consultation of GM.

3.3. Responsibility & Authority:

3.3.1. Contractor is responsible for compliance of the submitted SOP. However, Safety Coordinator of PID is responsible to check the compliance of the SOP at site.

3.3.2. Contractor’s HSEQ personnel shall discuss the emergency exit plan with the all present staff. DM/AM/AE of PID should witness. Contactor’s HSEQ personnel or PM of contractor shall email or send the record of emergency exit plan to safety coordinator of PID-KE. (e.g. Ref. No. DTS/KE/Project/XXX/Date)

3.3.3. Contractor’s engineer/supervisor or HSEQ personnel shall perform the Toolbox talk (TBT). DM/AM/AE of PID should witness. DM/AM/AE of PID shall maintain the record of TBT and shall submit the record to safety coordinator of PID. ref. email of Transmission (PID). Record of all safety documents should be maintained by Safety Coordinator.

3.3.4. DM/AM/AE shall be responsible to enter the work in grid log book for both start/finish the work.

3.3.5. Contractor HSEQ personnel shall be responsible to ensure the barricade of excavated/drilled area. Placement of safety sign board is also the responsibility of the contractor.

4. Supervision of Erection/laying of OH/UG Transmission Line:

4.1. Procedure:

4.1.1. Work should be conducted according to approved project schedule, drawings, specifications and layouts.

4.1.2. All heavy equipment should be unloaded by means of a crane or lifter. The operator of crane/lifter must have certificate with valid operating license.

4.1.3. When equipment is transported at site, inspection should be conducted for any apparent damage.

4.1.4. When all the relevant materials/equipment have reached at site, erection and installation works for both overhead transmission line and underground cables shall be started. If required, shutdown will be arranged prior to start the work.

4.1.5. During and after erection and installation of all the towers, conductor, hardware and laying of cable with terminations, all works should be inspected properly.

4.1.6. Customer Feedback will be taken from TMOH/TMUG during execution of the project.

4.2. Monitoring & Control:

4.2.1. Approved project schedule, drawings, specifications and layouts shall be made available at site. **(ref. letter GM (PID) /XXX/Date).** If any deviation is found (e.g. wrong revision of drawing, layout), the work will immediately stopped.

4.2.1.1. DM/AM/AE Transmission Line will remain on site during all working duration and can stay late if required for supervision of the site activities.

4.2.1.2. Manager Transmission Line will perform real time delivery of the work once a week using SOP **(PID/TL/SC/03).** Schedule will be the part of criteria, if Manager finds any discrepancy during real time delivery verification like poor workmanship or non conformance to project schedule or quality standard. He/she will perform the analysis of discrepancy and then will make a decision to either continue the work or stop the work with the consultation of DGM / GM Transmission Line.

4.2.1.3. DGM Transmission Line will perform real time delivery of the work twice a month using SOP **(PID/TL/SC/03)**. Schedule will be the part of criteria. Upon finding any deviation from the project plan or drawing or discrepancy reported by manager or AM, he/she will perform the RCA and forward the case to concerned GM. He/she is authorized to stop or continue the work based on evidence.

4.2.1.4. GM implementation will perform real time delivery once a month using SOP **(PID/TL/SC/03)**. Schedule will be the part of criteria. Upon finding any deviation from the project plan or drawing or discrepancy reported by DGM, he/she will send the RCA to contractor. GM implementation will ensure that the contractor should remove discrepancy as soon as possible, if required Liquidity Damage (LD) will be imposed on delay of work. GM will issue LD to the contractor.

4.2.2. Checklist of Crane and lifter should properly be filled. (**Ref No. PID/TL/CL/04**)

4.2.3. Checklist of Equipment Inspection should be properly filled. **(Ref Doc. PID/TL/EI/XX)**.

4.2.4. Shutdown is taken well in advance by submitting the LDC shutdown form. SBO (switch board operator) shall ensure proper grounding of all phases of line under shutdown at both ends of transmission line before start of the work. **(Ref. Doc. PID/TL/CL/S/04)**

4.2.5. Checklist of inspection after installation should properly be filled**. (Ref No. PID/TL/CL/XX).**

4.2.6. Customer feedback should be taken on the form **PID/TL/CFF/04** and recorded properly.

4.3. Responsibility & Authority:

4.3.1. Contractor is responsible to provide approved project schedule, drawings, specifications and layouts at site. DM/AM/AE Transmission Line shall be responsible for supervising the site works as per project schedule and ensure the work to be done according to approved documents.

4.3.1.1. DM/AM/AE Transmission Line is authorized to stop the work if deviation is found and will inform to the concerned manager/DGM for further actions.

4.3.1.2. Manager Transmission Line shall ensure the work done by the team at site is according to approved design and project schedule. Any deviation intimated by DM/AM/AE, manager shall communicate to respective DGM accordingly if required. DGM shall further communicate to the GM accordingly if required.

4.3.1.3. GM will notify the reported deviation to contractor if required via email or letter.

4.3.1.4. Manager Transmission Line is responsible to perform real time delivery once a week or as per plan.

4.3.1.5. DGM Transmission Line has a responsibility to perform real time delivery twice a month or as per plan.

4.3.1.6. GM Transmission Line has a responsibility to perform real time delivery once a month or as per plan.

4.3.1.7. Record of dully filled and signed checklist of erection/laying work will be kept by MR-PID.

4.3.1.8. Certificate of works / Measurement sheet / Invoices shall be verified by respective Managers/DM/AM/AE; however, the same shall be vet and approved by DGM and GM Transmission Line respectively.

4.3.2. DM/AM/AE is responsible to fill the checklist of crane and lifter. DM/AM/AE can stop the work, if any required certificate is not present or not valid and inform to Manager/DGM.

4.3.3. DM/AM/AE Transmission Line is responsible to inspect all incoming Goods and its verification. He/She is authorized to reject the goods if abnormality found. DM/AM/AE has the responsibility to sign documents received with Goods and send to Manager or DGM.

4.3.4. DGM or Manager Transmission Line shall be responsible to arrange shutdown where required as per LDC shutdown procedure.

4.3.5. DM/AM/AE is responsible to fill the checklist of inspection after installation. DM/AM/AE are authorized to find shortcomings in the project and inform to Manager/DGM

4.3.6. Customer Feedback will be taken from TMOH/TMUG department as an end user, feedback will be taken by respective Manager. Records are maintained by MR for future actions.

5. Testing & Commissioning:

5.1. Procedure:

5.1.1. Once the Installation is completed, the next phase is the testing and commissioning of the equipment.

5.1.2. SAT (Site Acceptance Test) protocol submitted by contractor **(e.g. Ref. No. DTS/KE/XXX/Date)** will be reviewed and commented/approved by the GM before testing & commissioning. **ref. letter GM (PID)/XXX/Date**. All test and commissioning activities are to be witnessed by KE site engineer.

5.1.3. At all stages, the approved SAT protocol must be filed by DM/AM/AE and any deviation from the approved values may be discussed and notified.

5.1.4. Any type of deviation need to be rectified by contractor immediately and verified by KE site engineer.

5.1.5. Following tests will be performed, in the presence of KE site engineer, by the contractor for Underground Transmission Line project;

5.1.5.1. 10kV DC Sheath Test
5.1.5.2. Meggar test for outer sheath
5.1.5.3. Earth Resistance test for joint bays
5.1.5.4. 24 hour soak test on no load

5.1.6. Following tests will be performed, in the presence of KE site engineer, by the contractor for Overhead Transmission Line project;

5.1.6.1. Soak test
5.1.6.2. Positive Sequence Test
5.1.6.3. Zero Sequence Test
5.1.6.4. Earth Resistance Test
5.1.6.5. Painting Test
5.1.6.6. Tower Tightening Test

5.1.7. Feedback will be taken from TMOH/TMUG department after completion of testing activity.

5.2. Monitoring & Control:

5.2.1. Approved SAT protocol shall be available at site by contractor. Testing & Commissioning shall be done as per approved project schedule. **Ref. no. ProjectName/Schedule/XXX/XXX**

5.2.2. DM/AM/AE of transmission line shall be responsible to fill and sign the SAT protocols in coordination with maintenance department representative.

5.3. Responsibility & Authority:

5.3.1. Work shall be assigned by Manager to DM or AM.

5.3.2. DM/AM/AE of Transmission line shall be responsible for supervising the testing & commissioning as per project schedule and ensure the activity to be done according to SAT protocol and approved drawings.

6. Taking over / Handing Over

6.1. Procedure:

6.1.1. "Taking over Certificate" TOC request submitted by contractor (e.g. Ref. No. DTS/KE/XXX/Date) will be reviewed and commented/approved. By the GM ref. letter GM (PID)/XXX/Date

6.1.2. "Handing over Certificate" HOC of commissioned project/work shall be issued to user/maintenance department by GM PID.

6.1.3. Customer Feedback will be taken from TMOH/TMUG and LDC department as an end user by concerned Manager.

6.2. Monitoring & Control:

6.2.1. The Taking Over (from Contractor) of the project should be done after receiving the following documents from the contractor;

- 6.2.1.1. Energization of Grid/Transmission line or underground cable.
- 6.2.1.2. Completion of Works declaration.
- 6.2.1.3. Confirmation Letter for the completion of List of Open Points (LOPs).
- 6.2.1.4. Complete End Documentation.
- 6.2.1.5. Complete Tests (Factory & Site) Reports.
- 6.2.1.6. As-Built Drawings.
- 6.2.1.7. O&M Manuals.

6.2.2. The Handing Over to End User of the project should be considered as Completed, with the handing over of following documents to the End User;

- 6.2.2.1. Complete Tests (Factory & Site) Reports.
- 6.2.2.2. As-Built Drawings.
- 6.2.2.3. O&M Manuals.
- 6.2.2.4. End Documentation

6.3. *Responsibility& Authority:*

6.3.1. GM of project shall be responsible to issue TOC and HOC of the project.

7. Procedure for Close out the Project

7.1. The project shall be finally Closed Out after;

7.1.1. Material Reconciliation
7.1.2. Successful completion of Defects Liability Period (DLP) and Issuance of DLP Certificate.
7.1.3. Commercial / Financial close out of the project.

8. Abbreviations

8.1. Following abbreviations are used in the document;

8.1.1. ETC (Erection, Testing and Commissioning)
8.1.2. SOP (Standard Operating Procedure)
8.1.3. OH (Over Head)
8.1.4. UG (Underground)
8.1.5. TBT (Tool Box Talk)
8.1.6. LDC (Load Dispatch Center)
8.1.7. PPE (Personal Protective Equipment)
8.1.8. SPE (Special Protective Equipment)
8.1.9. GM (General Manager)
8.1.10. DGM (Deputy General Manager)
8.1.11. DM (Deputy manager)
8.1.12. AM (Assistant Manager)
8.1.13. AE (Assistant Engineer)
8.1.14. PM (Project Manager)
8.1.15. DD (Deputy Director)
8.1.16. HOD (Head of Department)
8.1.17. HSEQ (Health Safety Environment Quality)
8.1.18. PID (Project Implementation Department)
8.1.19. KE (K-Electric)
8.1.20. RCA (Root cause analysis)
8.1.21. SBO (Switch Board Officer)
8.1.22. LD (Liquidity Damage)
8.1.23. SAT (Site Acceptance Test)
8.1.24. MR (Management Representative)

ANNEXURE-2

Technical Specification
Over Head Transmission Line

TECHNICAL SPECIFICATION

OVER HEAD TRANSMISSION LINE

Specification No.	Version	Date of Issuance	Total Pages	Issuing Section / Department
PID/TS/TLOH/1.0	1.0	September 28, 2015	187	PID

	Name	Designation	Date	Signature
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Reviewed by	Zakir Hussain	GM-Telecom	6/11/2015	
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Final Review by	Anjum Ghufran	Dy. Director – TL	16/11/2015	
	Bilāl Ahmed Mirza	Dy. Director – PID	03.12.15	
Approved by	Muhammad Adil	DCTO – Transmission	3/12/15	

Contents

ANNEXURES: SPECIFIC WORKS DATASHEETS (SWDs)

- Self-Supporting Lattice Steel Tower
- Self-Supporting Tubular Poles
- Long Rod/Disc Insulators
- Conductor, Earthing & Accessories
- OPGW
- Joint Box
- Hardware
- Earthing

1. Scope

This specification covers for 220 kV & 132 kV Overhead Transmission Lines which have to be delivered under the Contract. This Contract includes the design, engineering, manufacture, supply, installation, erection, painting, insurance, packing for export shipment to a tropical climate, delivery to site, unloading, profile survey, plotting of support position, pegging out, clearing of trees, bushes etc. from line route, clearing for and provision of access roads, dismantling old materials if and when required (handed over to KE's Store), testing, commissioning, energization and handing overin satisfactory operating conditionof complete transmission lines.

1.1. Expected Life of Materials

All materials tobe used in the project should have the expected life of 25 years or greater. Main materials should also be type tested from the internationally recognized third party laboratory.

1.2. Factory Acceptance Test

Factory acceptance test shall be witnessed by the personnel of the Employer. Main materials should be type tested from the internationally recognized third party laboratory.All cost in connection with witnessing of factory acceptance test by the Employer shall be borne by the contractor. These shall include the cost of the air travel to the place of testing/inspection and back, hotel accommodation, boarding, lodging, inland transportation and daily allowance per day per person.

1.3. Trainings

1.3.1. Site Training (on Job)

The contractor will provide onsite trainings to the Employer's staff to maintain and operate them properly. The cost shall be borne by contractor.

1.3.2. Foreign Training

The contractor shall provide foreign trainings to the Employer's staff in the contractor premises/factory or wherever else work in connection with the contract is in hand. All cost in connection with the foreign training shall be borne by the contractor. These cost include; air travel to the place of training and back, hotel accommodation, boarding, lodging, inland transportation and daily allowance per day per person.

1.4. Compliance of HSEQ and EIA policy

Contractor will strictly comply with K-Electric safety & EIA policy documents such as SP-022 & EIA 15, 16 and 17 etc.

1.5. Spares

The contractor shall provide the essential spare parts as selected by the Employer from the recommended list provided in the tender document.

1.6. ROW

The contractor shall submit details regarding all underground services lying on the transmission line route after trial pit activity on complete proposed route so that the final Right of way (ROW) can be acquired from respective civic agencies. Acquiring ROWs from Civic and all concerned agencies/stakeholders along with necessary coordination and relocation of utilities from proposed route will be responsibility of the Contractor.

SITE CONDITIONS AND METEOROLOGICAL DATA

The following shall form the basis of Tenderer / contractor to optimise his proposal with regard to local facts and to prevailing technical realities:

General Project Location & Environmental Conditions:

Location of Karachi:

a. Longitude 67 E
b. Latitude 25 N

Climatic conditions are moderate, sunny but during some months rather humid with up to 90% mean relative humidity in summer and down to around 40% in winter. In coastal areas the atmosphere is calciferous, humid and highly corrosive thus particular attention shall be paid to the severe corrosion conditions. The mean maximum temperature is close to 45°C (113° F). The coldest time is during January when the temperature may drop to less than 3°C (37° F).
Rainfall is very small in average during the summer months. The structural design shall be based on seismic zone 2B with accretion of 0.2g and a wind velocity of 160 km/h (DIN 1055) shall be taken simultaneously.

2. Design

This section of the Specification shall cover the design and design parameters for the construction of the overhead lines.

2.1. Design Spans

The design of all towers shall provide for the basic, wind and weight spans.

a. The term **basic span** shall mean the horizontal distance between centres of adjacent supports on level ground from which the height of standard supports is derived with the specified conductor clearances to ground in still air at maximum temperature.

b. The term **wind span** shall mean half the sum of adjacent horizontal span length supported on any one tower.

c. The term **weight span** shall mean the length of conductor, the weight of which is supported at any tower at minimum temperature in still air. At suspension position, the minimum weight of conductor support shall not be less than 25% of the total weight of conductor in the two adjacent spans.

d. The terms **maximum span** shall mean the maximum single span for which the distances between the conductors are designed.

For all 220kV & 132kV Tubular towers & all alternative lattice towers in place of tubular towers, weight span, wind span & basic span should be 300m.

2.2. Design Loads

The design shall be based on the following considerations:

2.2.1. Normal Conditions

1. **Vertical loads (V)** consisting of:

a. Weight produced by the effective portion of the adjacent conductors and earth wire spans

b. Weight of insulator strings and lineman with tackles

2. **Transverse loads (T)** consisting of:

   a. Wind loads produced by the effective portion of the adjacent conductor and earth wire spans

   b. Wind loads pulls corresponding to type of towers

3. **Longitudinal loads (L)**

   Longitudinal loads are the resultant forces produced by the maximum tension of conductors or earth wire in the direction perpendicular to cross arms.

2.2.2. Broken wire conditions (Abnormal conditions)

1. **Suspension tower**

   A1 - Any two phases of one circuit broken (No wind)

   A2 - Any one phase and earthwire broken (No wind)

2. **Angle Tension tower**

   B1 - Three phases of one circuit broken (No wind)

3. **Terminal tower (Dead end) tower**

   C1 - Three phases of one circuit and earth wire strung (No wind)

(No load will be assumed on the slack span side)

4. **Vertical loads (V) consisting of;**

   a. 50% of weight produced by the effective portion of the adjacent conductor and earth wire spans

   b. Weight of the insulator strings and line man with tackles

5. **Transverse loads (T)**

a. To be calculated with following formula (80 m + 60% of wind Span) x wind load per m. of conductor + wind load on insulators.

b. 50% of normal condition for maximum angle pulls.

6. Longitudinal Loads (L)

a. 50% of the maximum working tension of all conductors comprising one phase or 100% maximum tension of earth wire **for suspension towers**.

b. 100% of maximum working tension of conductors or earth wire **for angle, tension and terminal towers**.

The decrease of the vertical and transverse loads above refers only to phases where conductors are broken.

Towers shall be designed so that all members will withstand normal and broken wire conditions with safety factors as specified in the document. The total loading for the tower shall include the dead weight of the tower plus transverse wind load on tower plus the simultaneous application of loading as specified above for each tower type. Wind loads on tower leg extension shall be taken into consideration. Terminal towers shall be designed to face the direction of the incoming line, and shall withstand the load of all conductors and earth wire(s).

Design of all RCC structures along with complete drawings shall be submitted by the contractor after vetting through a renowned and approved structural consultant, for approval from KE.

2.3. Standards

The work to be performed by the Contractor shall strictly comply with the clauses, and Schedules of these Specifications. If standards/particular requirements are not specified, the work shall comply with International or National Standards acceptable to K-Electric.

When equipment/material offered does not comply with the Specifications the specific exceptions thereto shall be stated at the time of the Bidding.

The Owner reserves the right to ask the Contractor to provide an English translation at no extra cost to the Contract of all the major standards upon which the Bid is based and subsequently the Contractor shall provide one copy in English when so requested.

2.4. Documents to be submitted with the Bid

The Bidder shall submit with his Bid the following drawings and documents:

a. Outline drawings with dimensions of all types of towers/tubular poles (with extensions), gantries and supports for sealing ends, coupling capacitors and surge arresters. Outline drawings should be such that verification of solidity ratio is possible.

b. Loading diagrams for all loading conditions of all types of towers/tubular poles and gantries.

c. Technical data of the structural and high tension steels for the towers, tubular poles, gantries and bolts.

d. Stress analysis of tower members, tubular poles sections and calculation of typical foundations, for evaluating preliminary design.

e. Drawings of all insulator units and insulator strings.

f. Drawings of suspension and tension clamps.

g. Drawings of dampers.

h. Type test reports of similar tower, insulator assemblies, hardware, accessories equipment's as offered

i. Calculation results of zero sequence impedance and positive sequence impedance.

j. Report of onsite measurements of the actual zero sequence impedance and positive sequence impedance.

3. Towers

3.1. General

a) Self-supporting lattice type towers shall be used throughout the entire route, where access is obstructed to transportation of tubular poles and erection cranes.

b) All gantries shall be steel lattice type structures.

Steel lattice towers shall be square-base type. The members of lattice steel structure shall be hot rolled steel angle sections, and plates. All tower material shall be factory made and entirely galvanized by the hot dip process. The tower should have minimum service life of guaranteed 30 years with satisfactory operation. Contractor will provide the guarantee.

All material shall be tested at the steel mill in accordance with the applicable specification and standards under which they are manufactured. The Contractor shall supply the Owner with all certified mill tests. Tests shall be conducted in accordance with DIN Regulations or their equivalent. The tests to be conducted shall include, but are not limited to, uniformity of galvanizing coating, mechanical and chemical properties of all steel and additional embrittlement tests on high strength steel.

3.2. Types of Towers (Steel lattice towers)

The towers shall be designed that their heights may be extended or reduced at suitable intervals (preferably in accordance with already in practice in Owner's system). An extended or reduced tower shall be denoted by the addition of the height of extension or reduction to its basic designation. For the use of steeply sloped ground basic and extended towers shall be designed with different leg extensions, without reducing the specified factors of safety in any manner, to compensate for variations in topography. The Contractor shall determine the definitive requirements during tower site survey and supply all leg extensions required.

For the installation of joint Box for OPGW, the contractor shall provide two bolt holes near the top of each tower. The exact size and locations of these holes shall be agreed between the contractor and KE during approval of tower drawings.

3.3. Material (Steel lattice towers)

Material for the steel towers shall be of the type and grade most suitable for the application intended and shall conform to the latest applicable standard, specifications and recommended practices of the industry. Mild steel and high strength steel shall be used for the fabrication of redundant members and stress bearing members of the towers. Only high strength tower bolts shall be used. All bolts shall be of the same strength.

The quality of steel to be used for the fabrication of the towers shall at least correspond with the requirements or such other standards as may be approved. The steel to be used shall be of a quality that will not have its physical properties changed by hot-dip galvanizing.

3.4. Design (Steel lattice towers)

The unit stresses in members and connections for the structural design calculation for the design loadings and design unbalanced loadings (broken wire conditions) multiplied by safety factor shall not exceed specified values. The towers shall be designed with an overload capacity (factor of safety) for normal design loads and for unbalanced design loads (broken wire conditions) as specified. No damage or permanent distortion of any members, bolts, and connections of fittings or elongations of bolts holes shall be permitted for these design conditions.

The slenderness ratios (L/R) of members shall not be exceeded as specified. "L" is unsupported length of member, and "R" is the corresponding radius of gyration of the members to their loading positions.

Each member whose longitudinal axis makes an angle less than 45 degrees with the horizontal shall be of sufficient section to withstand independently of all other loadings a concentrated load of 1000 N applied normal to the longitudinal axis at any point along with length.

For calculation of stresses in compression members reference is made to the "Guide for Design of Steel Transmission Towers of American Society of Civil Engineers" and to German Standard VDE 0210. Other approved, calculation methods may be applied according to the Standards specified.

The Contractor shall submit the stress analysis calculation for tower member of all tower types. An explanation shall be submitted with computer calculation.

3.5. Construction (Steel lattice towers)

The towers shall be of standard construction and shall be designed to reduce the number of different parts to a minimum, thus facilitating transport and erection. The minimum thickness for legs and compression members in cross arms and in earth wire peaks, gusset plates etc. shall not be less than as indicated. Stub angles shall be at least 2 mm thicker than the attached steel leg angle. Maximum width of the steel leg angle: 16 times the thickness of this steel leg angle. Tilted steel angles, flat and rods shall not be used for tower members.

The diameter of bolt holes for all types of towers shall not be more than 1.5 mm larger than the nominal diameter of the bolt. All members of the towers shall be connected by bolts. Connections of members shall be designed to avoid eccentricity as much as possible.

3.6. Bolts and Nuts

The diameter of all bolts for the connection of tower parts shall not be less than as indicated in accordance with metric thread (coarse) standard.

The length of bolts and the length of threads shall be such that bearing is upon the shank and not upon the threads.

Bolts shall have hexagonal head and hexagonal nuts. Bolts and nuts shall be of high tensile steel. All nuts shall be secured by use of helical spring lock washers. Threads before galvanising shall be coarse thread. There shall be no excess of galvanizing at the root of the thread and nuts shall turn easily on the completed bolts without excessive looseness. Nut thread shall be taped after galvanizing so as to produce a finger-free fit on the galvanizing bolts.

3.7. Conductor Attachments

Conductor attachments shall be provided as required by their respective towers and all brackets shall be considered as part of their respective basic towers and shall be supplied as integral parts of them. Suspension towers shall have brackets (hangers) suitable for the attachment of insulator strings associated with suspension conductor support assemblies and shall be flexible on the direction of the line and rigid transverse to the line. The angle tension and terminal towers shall have brackets suitable for the attachment of insulator strings associated of an overhead earth wire clamp to the tower, holes shall be provided on the earth wire peak.

3.8. Anti-climbing and Steps (Steel lattice towers)

Each tower shall be fitted with an anti-climbing device to prevent unauthorized persons from climbing the tower. The anti-climbing device shall be the spiked type or other approved type, and shall be fixed at a height not less than 3 metres above ground.

Step bolts shall be provided on one leg for each tower. They shall begin as near the base as practicable and continue to the top and they shall be spaced on alternate faces of the leg angles at approximately 40 cm centre. After erection all step bolts shall be at least 20 mm in diameter, 20 cm long, appropriately headed, and uniform for all towers.

3.9. Workmanship

All work shall be equal to the best modern practice in the manufacture and fabrication of materials covered by these Specifications. The Contractor shall be responsible for the correct fitting of all parts, shall replace free of cost any defective materials discovered during erection and pay all costs of field corrections for such replacements. All parts of the structures shall be neatly finished and free from kinks, twists or bends. All holes shall be made with sharp tools and

shall be without torn or ragged edge. The fabrication shall be in strict accordance with the shop drawings prepared by the Contractor and approved by the Owner.
Structural material shall be straight and cleaned of all rust and dirt before laid out or worked in any manner. Shearing and cutting shall be performed carefully. Manually guided cutting torches shall not be used.

All bolt holes in steel members shall be punched, sub punched, reamed or drilled before galvanising. Holes shall be drilled instead of being punched if the thickness of the metal exceeds the diameter of the hole. All holes shall be clean-cut and without torn or ragged edges. All holes shall be cylindrical and perpendicular to the member.

The diameter of the finished bolt hole shall not be greater than the normal diameter of the bolt plus 1.5 mm. Plugging, welding or slotting of mispunched, mis-reamed or mis-drilled holes will not be permitted. The holes shall be located accurately so that when the members are in position the holes will be lined up before being bolted.

3.10. Galvanizing

After the shop work has been completed, all material shall be cleaned and then, including bolts, nuts and washers, hot-dip galvanized. The zinc coating for tower members shall be at least 610 gr/m^2.gram/m^2. Where members are of such length that they cannot be dipped in one operation, great care shall be exercised to prevent warping. All holes in materials shall be free of excess spelter after galvanizing. All materials shall be safeguarded against embrittlement during galvanizing. The zinc coating shall be of uniform thickness and so applied that it will adhere to the surface of the steel. Major damage to galvanizing shall be cause for rejection. Material on which galvanizing has been damaged shall be re-dipped unless the damage is minor and local and can be repaired by applying galvanizing repair paint. All towers shall be painted as stipulated in painting specifications.

3.11. Plates

Weather-resisting enamel coated aluminium alloy plates shall be supplied as number and circuit plates. The plate for danger signs shall depict in red a skull with cross bones. The text DANGER shall be boldly written in red in letters as shown in the drawing. Lettering and size of the plates shall be to the Owner's requirements and generally as indicated on the Bidding Document drawings.

3.12. Anti-Bird Devices

All suspension towers and tension towers having jumper insulator strings shall be provided with anti-bird devices on each cross arm over insulator strings. The anti-bird devices shall be spike type galvanized and fitted with bolts and nuts.

4. Insulators and Fittings

4.1. Insulator Units

Insulators shall be long-rod insulators/disc insulators with aerodynamic and self-cleaning shape suitable for desert and desert-like conditions with alternating large/small diameter (if porcelain) sheds. The design must ensure that the shape of the insulator should mostly exclude a critical reduction of the creepage distance as a result of accumulation of dust and sand. Therefore, the surface must be smooth and under ribs are not accepted. The ratio of shed spacing to shed protrusion shall be larger than 0.65. The insulators shall have a minimum specific creepage distance of 45 mm/kV (phase-to-phase operating voltage).

a. For 132 kV lines, two long rod units shall be used in one string, in case of porcelain long-rod insulators.

b. For 220 KV lines, three long rod units shall be used in one string, in case of porcelain long rod insulators.

Safety factor for insulator mechanical strength shall be minimum 3.5.

Two important tests of the insulator strings shall be carried out in a reputable laboratory.

1. Electro-Mechanical test with corresponding short-circuit current at 132 kV/220 KV strings (IEC-575).

2. Artificial pollution test of an insulator string for both 132 kV /220 KV lines.

These tests shall be carried out together with insulator supplier. The costs of these tests shall be separately quoted by the insulator supplier. If any such tests were performed by the supplier previously, for identical insulators, the certified test reports will be enough for evaluation.

4.2. Porcelain Insulators

All porcelain shall be sound, free from defects and thoroughly verified. The glaze shall be smooth, hard, of a uniform shade and shall cover completely all exposed parts of the insulator. Insulator and fittings shall be unaffected by atmospheric conditions due to weather, proximity to the coast, fumes, ozone, acids, alkalis, dust or rapid changes of air temperature under working conditions. The insulators must be made of high-strength alumina porcelain and the physical characteristics of the porcelain shall comply with KER 110.2 of Standard DIN 40685, brown-glazed.

Long rod insulators shall comply with the specifications indicated in the Standards DIN 40680, sheet 1 and sheet 2, DIN 40686, sheet 1, DIN 40685.

Only those suppliers who have experience on an industrial scale in connection with alumina porcelain will be approved.

4.3. Metal Components

All ferrous metal components except those of stainless steel shall be hot dipped galvanized to give an average coating of 150 micro meter with surface decarbonising method.

End caps shall be made of malleable cast iron and shall be of the clevis type. The pins shall be made of stainless steel or other suitable material of such quality that the unit shall comply with these Specifications. Pins and caps shall be of such design that they do not yield or distort under the specific mechanical loadings in such a manner as to add undue stresses to the porcelain.

4.4. Cement

Cement used in the construction of an insulator shall not fracture by virtue of expansion, or loosen by contraction, and proper care shall be taken to locate the individual parts correctly during cementing. The cement shall not give rise to chemical reaction with metal fittings and its thickness shall be as uniform as possible. Portland cement or a special lead antimony alloy has to be applied.

4.5. Insulator Fittings

All tower and conductor attachment hardware such as ball eyes, clevises, yokes plates, D-shackles, extension links, dead end bodies, jumper terminals etc. and arcing rings shall be supplied as required as part of the insulator strings. All ferrous parts shall be hot-dip galvanized. The zinc coating shall average 150 micron thick by utilizing surface de-carbonizing method. The utilizable height of tower - height of the tower from ground level to the attachment of lowest conductor is nominal as it does not take into account all forms of line fittings that could possibly reduce this height. The Contractor shall choose this line fittings and clamps so that this utilizable height is not reduced by more than 30 cm.

When selecting insulator string fittings, hot line maintenance shall be considered. The design of all conductor fittings and accessories shall avoid sharp corners or projections, which would produce high electrical stress in normal working. The design of the adjacent metal parts and mating surfaces shall be such as to avoid corrosion of the contact surfaces and to maintain good electrical contact under service conditions.

Arcing devices at line side and intermediate shall be designed to withstand a force of 1000 N, applied to the tip. Arcing accessories used in insulator strings shall, in principle, meet two requirements:

a. Protection of the insulant against intensive thermal radiation of the arc plasma.

b. Improvement respectively homogenizing of the electric field around the live end of the insulator string.

Both requirements are met by the following design characteristics of accessories and strings:

1. The arcing accessory shall ring the metallic cap at the insulator end (transfer of the arc root subsequent to flash-overdue to dirt accumulation).

2. The arc root shall be subject to unilateral short-circuit current supply at any point of the accessory (arc root shall safely and quickly be driven to the final burning point).

3. The final burning point shall be so designed that the reflection to the insulant is kept to a low level (shielding effect). The inevitable consumption at the final burning point must not impair appreciably the performance of accessory (final burning point designed as a ball). The shortest possible distance between final burning point and insulant with respect to current intensity and duration of radiation shall be determined in a way that no thermal damage to the insulant may occur. The plasma jet at the final burning point shall emerge about vertically to the insulator axis and burn down stably without pendulum motions. The arcing accessory shall be provided with one final burning point only. The metal loss at the final burning point (arcing horn or ball) shall not exceed 2 cm for the maximum short circuit current specified in Schedule A1.

4. The arcing accessory shall be made from solid material of small diameter. It shall be avoided that the arc root be supplied over a larger area (high moving speed of arc root).

5. Electrodes shall be made from steel (low consumption, poor thermal conductivity).

Aluminium or aluminium alloys are not admissible high consumption related with considerable pollution of insulant).

6. The maximum admissible temperature of the fittings with respect to the zinc coating and the hardness decrease of the material of fittings must not exceed 400° C. (This requirement is met at a short-circuit current density of 70 A/mm2 during 1 second.)

7. The attachment of the arcing accessory to the respective string element shall be designed in such a manner that a contact force of at least 40kN can be applied and that any welding be produced during short-circuit which may impair the performance.

8. The dimensions of arcing accessories shall be adapted to the used insulator types, the thermal and dynamical stresses and to the maximum service voltage.

9. On long rod insulator strings, in principle, each string end must be provided with an arcing accessory; the use of intermediate arcing accessories is imperative on multiple insulator strings.

10. Audible discharges on the arcing accessory at the live end of insulator string must not occur at maximum service voltage.

11. Arcing accessories must be hot dip galvanized to protect accessory against corrosion.

12. The manufacturer shall be bound to prove the thermal and electrical performance of arcing accessories.

4.6. Insulator Strings

The complete suspension and tension strings with all clamps, fittings, and arcing rings shall have the mechanical and electrical characteristics as stated in.

The insulator strings shall also be capable of withstanding the mechanical loads applied by the required conductor working tensions, wind spans and weight spans and in addition the wind on the insulator string and the weight of the insulator string itself and the weight of the line-man with tackles when multiplied by the factors of safety specified in the Schedule. All insulator strings shall be attached to cross arms by means of shackles. Hooks shall not be used.

All insulator strings shall be equipped with appropriate protective devices, such as arcing rings. The design of these protective devices shall be such as to support loadings during the installation of insulator strings and stringing of conductors and to reduce as far as possible damage to the conductors, clamps, insulator strings and arcing horns or rings themselves under all flashover conditions.

Long rod insulator/disc insulator sets shall have open arcing rings with one final burning point (horn or ball) at both earth and live ends.

The yoke assemblies located between the insulator strings and the conductor shall be capable of transferring the static tensile load acting on the string uniformly to the two or three insulator strings as well as to the particular conductor.

Double tension or suspension insulator strings shall withstand dynamic loadings as follows. The load during rupture of insulator from the initial state up to the quiescent state shall be displaced in such a manner that no rupture will occur on the second insulator string. The yoke assembly adjacent to the conductor shall be capable of weakening the dynamic motions and to reduce peak loads that may cause damage to the insulators.

Electrical insulation level must remain unchanged if one string is lost due to break.

A minimum extension of yoke assembly subsequent to the rupture shall be ensured (displacement of tension clamps into the span).

The performance of the yoke assembly shall be proven by calculation or test. The arising insulator stresses must not exceed a harmful stress level.

The yoke assemblies shall be capable of coping with the anticipated static and dynamic stresses.

All split pins for securing the attachment of fittings of insulator sets shall be of stainless steel and shall be backed by washers. Plated split pins shall not be used. The pins connecting the Long rod insulators shall be of stainless steel.

All bolts and nuts on insulator string fittings shall be galvanized as specified and shall be locked in an approved manner.

Adequate bearing area between fittings shall be provided and "point" and "line" contacts shall be avoided.

The general arrangement of the insulator strings which shall be used. With long rod tension insulator strings only double tension strings shall be used. For road crossings, railway crossings, power communication line crossings and waterway crossings etc., long rod/ disc insulators with double suspension strings shall be used.

The design of the fittings, as well as of the insulators, shall consider the radio interference performance of the insulator set. The noise limit for radio interference of the whole insulator string shall not exceed the values for grade V of BA 137: Part 2: 1973 and shall be proved by test if required by the Owner/Engineer without any extra cost to the Owner. As an alternative, tests according to VDE 0212.

Insulator string complete should have minimum service life of guaranteed 30 years with satisfactory operation. Contractor will provide the guarantee.

The insulator strings (Disc Insulator) shall consist of standard discs for a three phase 50 Hz, effectively earthed 220KV/132KV transmission system in a moderately polluted atmosphere. The discs shall be cap and pin, ball and socket type.

5. Conductors and Accessories

5.1. General

The particulars of the conductors to be supplied shall be as indicated in Data sheets.

5.2. Standards

The conductors shall be manufactured and tested in accordance with Standards as indicated in the document.

5.3. Surface Conditions

All wires making up the conductor shall be free of points, sharp edges, abrasions or other imperfections that would tend to increase radio interference and corona losses. The conductors shall also be free of metal particles and dirt. The make-up and the laying of the conductor strands shall be such as to produce a conductor free of a tendency to untwist or spring apart when cut. The stranding shall be such that, when subject to 50% of ultimate strength, there shall be no high wires but a real cylindrical form shall be maintained. The outermost layer of all conductors shall be stranded with a right-hand lay.

5.3.1. OPGW

The particulars of the OPGW to be supplied and installed shall be as indicated in the Schedule. The following Specification provides the key requirements and Tenders are required to provide all relevant information and a report and a list of comparison of the offered OPGW in case of deviations or due to an advanced technique as may be proposed besides the specified requirements.

The OPGW design shall be mechanically and electrically compatible with design of the transmission line. The OPGW shall be protected from Aeolian vibrations for life of the line. The total OPGW length shall be determined by the contractor taking into account sag, splices, drops at the joint locations etc.

The wires forming the outer strands of the OPGW shall be right hand lay and designed to prevent bird caging, strained popping and unravelling during normal handling and installation.

The OPGW shall be with approved and seals (waterproof) which shall not be removed until immediately prior to optical jointing.

The OPGW shall be designed to withstand the system fault currents and lightning currents without degradation of the optical attenuation of the fibres or mechanical damage to the ground wire strands.

The OPGW shall be associated with each circuit of a double circuit OHL.

The optical fibre shall be designed so as to prevent mechanical and optical degradation after thirty years of intermittent exposure to saline (marine) and desert and polluted weather.

No mid-span joints shall be allowed in the OPGW. All joints shall be performed in a tower joint box located at the top of the poles or towers.

5.3.2. Construction

Outer layer of OPGW shall be aluminium clad steel wire of smooth bodied construction. Optical fibre shall be of silicon type suitable to withstand temperature of about 100°C. Each fibre shall be jacketed by heat resistant material and stranded around central spongy rubber core. Considerations should be made on OPGW design to provide superior reliability on thermal resistance, water proof, and strain reduction to fibres, mechanical strength and corrosion resistance.

Optical unit shall be protected against water by an aluminium tube which shall not have any other metallic material inside to avoid any current distribution.

The following standards shall generally be applicable:

1. Aluminium clad steel wire: ASTM B 415, B 416, and VDE210
2. Optical fibre: CCITT DIN recommendation G 652 for single mode.

The Contractor shall submit recommended procedure for stringing the OPGW together with sketches.

5.3.3. Optical Unit

The structure of the OPGW shall in general be in accordance with the short circuit current level and other installations parameters specified elsewhere. However, OPGW offered shall provide the following minimum requirements:

Operating wave length	1310 nm
Attenuation at 1310 nm	0.36 db (maximum)
Number of optical fibres	24 single mode
Cut off wave length	1150 - 1285 nm
Optical loss variation in temperature range - 25 to 150°C	less or equal to ± 0,05 db/KM
Chromatic dispersion at 1285-1330 nm	Less or equal to 5ps/km

Physical design of the proposed OPGW for installation on new OHTL's shall take into account sag and tension restrictions for transmission lines ruling spans.

The contractor shall design and furnish OPGW mounting hardware including all the necessary hardware required for a complete operational OPGW. This shall include, but no be limited to vibration dampers, suspension tower hardware (including AGS units), angle tower hardware, dead-end tower hardware, repair sleeves, earth bonding leads and OPGW clamps for vertically mounting OPGW on tower steel work. The OPGW shall be clamped at approx. 1 meter spacing on the tower and substation gantry structures.

5.3.4. Joint Boxes

Two types of joint boxes shall be proposed:

Type A: To be used for OPGW-PTGW connection to be installed at the top portion of the pole, tower or portal structure. An extra length shall be left inside for repeated splices.

Type B: Terminal joint boxes for connection of OPGW to the optical cord. These shall be similar to above except for the connection arrangement.

Junction box technology shall ensure only bottom cable entry, quick removal of box cover giving access to fibre splices, repair of fibre splicing at least three times during transmission line's working life.

5.3.5. Delivery Lengths

OPGW shall be delivered in agreed lengths. A thermal pad shall be placed on the outer spirals and thermal protection shall be at least equivalent to that obtained with an aluminium sheet covered by 10 mm cellular polyethylene.

After factory inspection the inner end of the cable shall be fitted with a suitable cap to ensure water tightness. The outer end shall be fitted with a watertight head compatible with cable pulling.

5.3.6. Tests and Spare Parts/Tools

a) The Tenderer shall be responsible to perform type test of tower, conductor, poles and hardware as per therelevant International standards and recommendationsas mentioned in the Schedule H.

b) One set of all tools required by the CONTRACTOR for installation of terminations, splicing and for installation of repeater stations (if any) shall be supplied to the OWNER and the related price shall be stated in the proposal.

The Tenderer is required to submit a list of spare parts and tools together with the related prices in his proposal.

5.4. Conductor Grease

Only inner layers of copper conductors shall be greased. The grease shall be of neutral type and at a temperature of 100° C the grease shall neither flow within nor extrude from the conductor.

The grease shall retain its properties as resistance to oxidisation and chemical stability, at all service temperatures.

5.5. Accessories

5.5.1. General

Conductor accessories made of non-stainless steel shall be reliably protected against rusting. Materials and construction of conductor accessories shall be chosen to eliminate any possibility of electrolytic corrosion and radio interference.

The design of all conductor fittings, vibration and spacer dampers etc. shall be smooth and free from waves, ridges, sharp corners, projections and other irregularities to avoid corona.

5.5.2. Vibration Dampers

The vibration dampers shall preferably be of the Stockbridge type. The clamps of the dampers shall be designed to permit installation and removal by the use of hot-line tools. The dampers shall be attached to the conductor in a manner which will prevent damage thereto. Each damper weight shall be provided with one drain hole, positioned to be at the bottom of the weight when the damper is installed in a vertical place. The design of the damper is to be such as to ensure freedom from subsequent drops of the damper weights in service. The design shall avoid sharp corners or projections which would produce high electrical stress under normal working conditions.

Breakaway hexagonal bolts shall be used on all bolted clamps and shall ensure substantially consistent damping force. Dampers shall maintain gripping on the conductors through their life and shall not slip, twist or ratchet on the conductor. The materials comprising quality to withstand the exposure conditions encountered with a minimum operating life of 30 years.

The manufacturer shall calculate and submit the number of dampers per span, the position and the maximum span length for each damper size. These calculations shall be based on the following data:

1. conductor and conductor arrangement, without armour rods.
2. equivalent span lengths.
3. conductor height above ground.
4. local atmospheric conditions e.g. wind velocities etc.

The calculations shall be made for the following two terrain conditions, if not indicated otherwise or instructed.

a. flat terrain, no trees, no obstructions
b. undulating, relatively open country with some trees.
c. any other type of terrain from where the line is passing.

The manufacturer shall, for each damper size tendered, prove that the maximum bending strain in the conductor at the clamps must not exceed ± 150 micro/m for conductors and ± 250 micro/m for steel conductors for the calculated number of dampers per span, position and maximum span length.

The manufacturer shall describe the calculations method.

5.5.3. Conductor Accessories

5.5.3.1. Suspension Clamps

Suspension clamps for attachment of conductors to insulator strings at suspension towers shall be the trunnion type or equivalent and shall consist of a clamping piece of metal alloy with bolts and other details made of hot dip galvanized forged steel. Suspension clamps must be designed for the loadings to be applied and must also reliably hold the conductor in the case of unbalanced conductor tensions to be expected in operation, however, the clamp shall permit the complete conductor to slip in a range of 10% to 30% of the ultimate tensile strength of the conductor. The clamp shall be free to pivot in the vertical plane and the rotation axis of the clamp shall intersect the conductor axis. The clamp shall be dimensioned according to VDE 0210 regarding mechanical strength. The clamping area should be grooved to increase resistance to conductor slippage. The suspension clamping detail shall be in such a manner that no magnetic loop is formed around the conductor.

5.5.3.2. Tension Clamp Assembly

Conductor tension assemblies shall be the type and size for the conductor which will be used on this work and shall be of the tubular compression type complete with compression, dead-end bodies, jumper terminals and steel eye end. Each dead-end assembly shall be capable of developing not less than 95 per cent of the ultimate strength of the conductor and shall have conductivity not less than that of the conductor.

The conductor tension clamp shall be supplied with a jumper terminal which may be bolted at 0° or 30°angle.

5.5.3.3. Compression Joints

Compression joints for splicing conductors shall be of the tubular type suitable for the type and size of conductor used. Each connector shall be complete, consisting of one joint which shall be capable of developing strength not less than 95% of the rated ultimate strength of the conductor. The conductivity of the completed splices shall be not less than that of the conductor.

5.5.3.4. Repair Sleeves

Repair sleeves shall be the type and size for the conductor which will be used on this work and shall be composed of two pieces fitted into each other can be applied to reinforce a conductor having some of the strands damaged.

5.5.3.5. Spacer Dampers

For double bundle lines the spacer dampers shall be provided. Spacer dampers shall be designed to keep the individual conductors forming a bundle at the required distance, whatever service conditions may be prevailing, to prevent the conductors from clashing due to different wind - inducing lateral vibrations. Apart from that, the spacer dampers shall provide a measure of energy absorption which lessens the negative effects of line vibration. Contractor shall specify the positioning of the spacer dampers throughout the span.

The outer contours of the parts must be designed in such a way that at operating voltage no visible or audible corona discharges may occur on the spacer damper.

The rubber used between the spacer bar and clamp shells must be of a semi-conductive rubber that potential equalization between the bar and clamp shells is maintained. The rubber part must be completely protected from harmful ultraviolet light.

The clamp shells and spacer bar shall be made of corrosion-resistant, high strength aluminium alloy. All ferrous metal and iron parts shall be hot dip galvanized.

The spacer damper shall be permanently fixed on the conductors of the tensioned bundle by means of a clamping device.

It should be possible to secure all clamping screws in a form locking manner as to avoid their getting loose during service.

Contractor shall submit a full complete specification of the spacer dampers offered with drawings, together with laboratory test reports.
The grounding system shall be designed in accordance with "IEEE Guide for AC Substation Grounding".

The maximum resistance of the grounding system to earth at any point shall not exceed 0.5 ohms and tolerable potential differences. Step and touch voltages shall be in accordance with requirements and guidelines for safety defined in IEEE - Standard-80.

5.5.3.6. Grounding Grid

The grounding grid shall be made of 350 MCM (minimum) bare soft drawn, lead covered stranded copper of electrolytic grade and minimum 98% conductivity. The grounding grid shall be buried at a minimum depth of 0.6 m below ground level.

6. Foundations

6.1. General

a. The foundations for towers shall normally be of mass concrete or reinforced concrete. Where these are not applicable, the other forms of foundations (including pile foundations) shall also be used as required. Each tower foundation has to be proposed and justified by the Contractor but shall be approved by the Owner.

b. The Contractor shall stake out the tower locations and submit to the Owner the foundation conditions including permissible bearing pressure expected by him at each tower together with the type of foundation considered applicable by him. The Contractor has to perform soil investigations at tower sites to verify the foundation conditions and submit the soil investigation report.

c. The Contractor shall submit the actual maximum uplift and bearing load without any safety factor for each footing and for each type of tower. The stability of the foundations with respect to uplift shall be determined at a safety factor as indicated in the document The bearing pressure on the soil shall not exceed the limits laid down for each type of foundation and soil condition.

d. Unless otherwise directed all tower footings shall be designed by the Contractor as individual leg footings, four footings per steel lattice tower and one pile cap per tubular pole tower. Dimensions of all leg footings shall be determined for tower reaction for the maximum down thrust, uplift and horizontal shear. All tower base reactions shall be computed from design structure loadings including their specified safety factors.

e. All concrete foundations shall be made from Sulphate Resisting Cement, in Karachi Area.

f. If pile foundations are required after examining the soil investigations, the Owner shall be informed about the location and the design shall be made under strict control.

g. Ultimate foundation loadings per leg shall be calculated as follows:

1. <u>Compression and Uplift Loads for StraightLineTowers</u>

Compression:	(Overturning force + 1/4 max. applied vertical loads + 1/4 tower weight) x safety factor.
Uplift:	(Overturning force - 1/4 x 1/3 max. applied vertical loads - 1/4 tower weight) x safety factor.

2. <u>Compression and Uplift Loads for TensionTowers</u>

As above, but zero applied vertical loads in uplift case or special uplift loading for section towers.

In computing compression ultimate bearing stresses, the weight of concrete in foundations shall be multiplied by the relevant safety factors.

3. <u>Safety Factors of Foundations</u>

Safety factor in normal loading condition	: 1.8
Safety factor in unbalanced loading Condition	: 1.5

4. <u>Foundation Design for Tubular Poles</u>

The design for foundations of poles shall be made in accordance with "Design of Steel Transmission Pole Structures" prepared by ASCE.

5. <u>General note for all types of foundations</u>

Necessary measures shall be provided to protect the concrete from sulphates and acidic soil environment by coating bitumen on outer surfaces.

The foundation chimney will be extended minimum 50 cm. above ground level to provide concrete cover, for protection against debris and floods. On road crossings or islands guard rail protections suitably painted for warning to traffic will be also provided.
Grounding conductors of footings shall not be allowed to pass through concrete, nor shall they be allowed to have physical contact with reinforcing bars.

The backfill as well as undisturbed soil around the proposed foundation is to develop a minimum angle of internal friction of 25°. It will be reconfirmed by soil investigation by Contractors.

6.2. Types of Foundations

The following types of foundations for towers may be employed:

a. Concrete Block Foundation

This type of concrete block foundation shall be suitable for soft soil, sand or loose gravel occurring generally for the full depth.

b. Soft Rock Foundation

This type of concrete block foundation shall be suitable in the case where soft rock should occur from more than the bottom 50% of the soft soil foundation setting depth. The soft rock encountered may be of a homogeneous limestone or coral nature or of a harder limestone or other rock, but being fissured and stratified.

c. Hard Rock Foundation

This type of foundation shall be suitable for homogeneous hard rock.

d. Special Foundation

In addition, where special ground conditions exist, which do not allow any of the above designs in an original or modified form, special types of foundation as concrete piers, rafts or piling may be used.

e. Foundation in River/Wadi

This foundation type will be designed for protection of tower considering the highest water level/flood level in River/Wadi.

f. Pile type foundations for pole structures.

6.3. Soil Characteristics

The Contractor shall ascertain the soil conditions and characteristics performing sub-surface soil explorations at each tower location by one standard penetration test. The test shall be made to a depth equal to the distance from the ground surface to the bottom of the footing, plus two meters. The tools and equipment to be used for the test shall be of the approved standard type. The results of the tests shall be compiled in an approved form and submitted to the Owner for verification.

The Contractor shall then finalize the design of each type of the foundations in accordance with the results of soil penetration test obtained. A selection of the foundation type shall be made for each tower to suit its particular site conditions, and the final tower list prepared.

Throughout the line route the Contractor must, at regular intervals, obtain samples of subsoil and ground water, which he shall have analysed in order to assure that no foreign agents are present that might have an adverse effect on concrete. The results of the analyses shall be forwarded to the Owner.

All sub-soil tests described shall be made as soon as possible after award of the Contract.

6.4. Calculation

a. For all foundations the Contractor shall submit detailed calculations in accordance with VDE 0210 showing that the ultimate earth bearing capacity according to the table is not exceeded by the maximum lateral pressure, due to loads acting on the tower times the corresponding safety factor and due to the dead weight of the tower and footing including backfill resting vertically upon the base of the footing.

The foundation shall have a factor of safety against uplift for loading conditions as given below:

$$\frac{Wc + Ws}{T} = \text{factor of safety}$$

Where Wc = dead weight of concrete footing which is under ground

Ws= weight of soil in inverted pyramid shape on the base pad. The height of the pyramid shall be the depth to the base of foundation minus 25 cm

and T = maximum calculated uplift force

b. The Contractor shall also submit calculations and drawings showing the bearing capacity and stresses at each critical section of the concrete and the steel reinforcement.

c. The possible deterioration of the consistency of cohesive soils and the resulting reduction there from shall be considered in the bearing capacity. If ground water exists, the corresponding decrease of weight of earth and concrete due to uplift conditions shall be considered in the calculations.

d. Factors of safety for calculation of the maximum admissible earth pressure and the stability of foundation against uplift loads are stated in the document.

e. For bidding purposes the design of foundations shall follow the Specifications and assumptions for normal, soft rock and hard rock soil conditions. Such designs are subject to modifications to suit Site conditions as approved by the Owner.

f. The calculation of foundations have to be done in accordance with Standard VDE 0210. For tower foundations consisting of four footings Standard VDE 0210 makes a distinction in calculation for foundations concreted at the inherent soil, for undercut foundations concreted in the inherent soil, and for foundations concreted at the shuttering of the excavation.

6.5. Tower Grounding (Earthing)

All four legs of each tower will be separately grounded according to DIN 57141/VDE 0141.

According to previous measurements, the earth specific resistivity seems to average 45 ohms - meter, in this alluvial coastal region.

This 45 ohm-meter specific resistivity is quite favourable for towers grounding. A grounding resistance of max. 3 ohms shall be specified for any individual tower.

Since 4 legs shall be equally grounded, each leg shall have max. 12 ohm grounding resistance.

This will be achieved by utilizing an Armco-steel grounding conductor, looped with 200 cm diameter around each leg, buried 150 cm depth. The grounding conductor (Armco-steel) shall have a diameter of 2 cm and visibly connected to tower leg by a steel clamp without passing through the foundation concrete.

Armco steel is a very low carbon steel which is available from major steel manufacturers and has been used in many countries for grounding. Outer surface of Armco steel gets oxidized and serves as protective layer for inside metal against corrosion.

For tubular steel poles additional vertical grounding electrodes are recommended to achieve 3 ohms max. grounding resistance. Recommendation of "Design of steel Transmission Pole

Structures - item 5-7" published by American Society of Civil Engineers shall be followed for grounding of steel poles.

7. Inspection and Tests

7.1. General

All materials, apparatus and equipment supplied under these Specifications shall be subject to inspection and test by the Owner including during the period of manufacture, delivery and installation. The Contractor shall make adequate tests and inspections according to the best modern approved methods to ensure that all material supplied under these Specifications is strictly in accordance with the standard under which it is manufactured. KESC Engineer will Witness the Factory acceptance test (FAT) at manufacturer premises. All cost will be borne by contractor. In addition the Owner may inspect the material at the Contractor's plants, at the points of delivery or any location of the erection site. The Owner shall have free access at all times to all places of the Contractor's plants where materials are being designed, tested, manufactured, produced or fabricated.

Every facility is to be provided by the Contractor to enable the Owner to carry out the necessary inspections and tests and the costs of all tests and preparation of test records are to be borne by the Contractor.

The Standards according to which the tests shall be carried out are given in Schedules.

7.2. Towers

7.2.1. Material for Tower

All material shall be tested at the steel mill in accordance with the applicable specification and standards under which they are manufactured. The Contractor shall supply the Owner with all certified mill tests. Tests shall be conducted in accordance with DIN Regulations or their equivalent. The tests to be conducted shall include, but are not limited to, uniformity of galvanizing coating, mechanical and chemical properties of all steel and additional embrittlement tests on high strength steel.

7.2.2. FullScaleTower Tests (SteelLatticeTower)

Full scale tower load tests of selected assembled galvanized towers shall be carried out in accordance with Standards IEC Publication No. 652 (1979) and Standards indicated. in the presence of personnel of Owner. Owner shall be notified at least six weeks in advance of the dates the tests are to be conducted.

The following requirements shall be fulfilled in the load tests of the tower:

1. The members in a test tower shall be of the same grade and quality of fabrication as those to be supplied for the towers under these Bidding Documents. The Contractor shall furnish certified test reports of the heats from which the material was rolled and a record showing the heat from which each member was obtained. The inspector may at his opinion, select any or some members from the test tower after completion of full scale tower test to conduct standard tensile tests and chemical analysis at Contractor's expense.

2. Test towers shall not be specially fitted other than with such fittings as are required on similar towers to be erected in the field.

3. The tower shall be erected on a foundation structure and tower anchorages which shall be of adequate strength and stiffness to safely withstand the tower reactions under test loadings without noticeable distortion or displacement. The leg members shall be connected to the anchorage in the same manner as used in the normal stub-angle or grillage space details.

4. In preparing for the tests, the Contractor shall supply the Owner with a test program together with diagrams indicating the proposed methods of applying the various loads and measuring deflections. The Contractor shall calibrate dynameters and gauges before testing the tower.

5. The test loads shall be those obtained from the design loads multiplied by the specified safety factor. Any combination of the test loads shall be applied to prove the capability of the structure to withstand all required loadings. Each tower shall withstand the test loads for one minute without failure or permanent distortion of any member, fitting, bolt or part and without elongation of bolt holes. There shall be no slacking off adjustment of loads during the one minute period. Should it become necessary to adjust the loading the one minute period shall start after the adjustment is completed. All test loads shall be removed completely before the loads for the next test are applied. Test loads corresponding to conductor loading shall be applied to the attachments provided for these loads while test loads equivalent to wind load on the tower shall be applied where convenient. Friction

losses in rigging shall be taken into account in the application of the test loads.

6. Any conspicuous yielding or any failure under any of the test loadings shall be considered a defect, in which case the Contractor shall modify the design and shall repeat at his own expense, the test case in which a defect developed.

7. After all defects, having developed during the regular tests, have been corrected and after the tower satisfactorily carries design loads multiplied by safety factor, the suspension tower only shall then be tested to destruction. The cost of replacing the destroyed parts of the towers under destruction test shall be borne by the Contractor. The Owner reserves the right to eliminate the requirements for performing any or all tests and the Contractor will not be entitled to any compensation by reason of such elimination.

8. Test samples shall be cut from members which fail in destruction tests and standard tensile tests shall be performed at the Contractors expense. The results of the tests on these samples shall be used to correct the assembled tower test results for comparison with design.

9. The Contractor shall submit full reports of all tower physical load tests including clear photograph of the test step-ups and nature of all failures, certified calibration reports, detailed diagrams showing the manner in which test loads were applied and deflection records.

10. The prices tendered for tower/pole tests shall include the cost of fabricating, transporting to test station, erecting, testing and dismantling of towers/poles, together with all rigging, accessories, dynameters, gauges, and personnel necessary for the performance of the tests.

11. The towers, which have been submitted to the destruction test, may be used in the construction of the lines provided that damaged members are replaced. Such towers shall be subject to the requirements of these Specifications as though no loading tests had been performed on them.

12. Tower structures one each of types of tower shall be tested to full design loads, with the optional destruction test if so instructed by the Owner. The tests shall be conducted on towers with highest extension used in longitudinal profiles for the corresponding tower type.

7.3. Insulators

For long-rod/disc porcelain insulators, type, sample and routine tests shall be carried out in accordance with IEC Publication 383 and further Standards given in Schedule on insulator strings as well as individual units.

Long rod/disc insulators of porcelain shall be subject to thermal mechanical performance test in accordance with the requirements of IEC 575.

Corona type tests and radio interference tests (IEC 437) shall be carried out on one complete insulator string of each type to be supplied. The insulator strings complete with all fittings shall be set up as in service with not less than 2 m of conductor.

A voltage of 15 percent in excess of the nominal voltage to earth shall be applied between the conductor and earth for three minutes, during which time no corona formation shall be audible or visible with the room in complete darkness.

7.4. Conductors and Accessories

Mechanical and electrical tests on conductors and accessories like dampers, clamps, joints etc. shall be carried out according to standards indicated.

For conductors tensile destruction tests on the stranded conductor shall be carried out if requested by the Owner.

Copper conductors shall be subject to grease test, if required by the Owner, which shall be performed as follows:

A sample of the specified conductor, not less than 1500 mm long shall be held at an angle of 25° to the horizontal and heated automatically controlled to a temperature of 100° C for a period of 24 hours. During the test there shall be no migration or loss of grease.

7.5. Foundation

Test on foundation or foundation material as concrete, steel reinforcement etc. to be performed by the Contractor are indicated in the document.

7.5.1. Testing Concrete

The Contractor shall, at his own expense, prepare concrete test cubes as directed by the Owner and have them tested in a concrete laboratory approved by the Owner in accordance with Standard DIN 1045 (1978). A sufficient number of such cubes shall be made to obtain a comprehensive record of the strength of the concrete at each day's work.

8. Erection Work

8.1. General

The Contractor shall be responsible for the true and proper setting out of the erection work in relation to the survey lines and reference bench-marks and for the correctness of the position, levels, dimensions, and alignment of all parts of the lines.
All erection work shall be done in the presence of and under the supervision of the Owner. All erection drawings, setting diagrams and other relevant information shall be approved.

Erection work shall not commence before all such drawings, etc. are approved by the Owner. The Contractor shall also provide, when required, reasonable use of his facilities and equipment to enable inspection, measurement and testing of erection work by the Owner.

The Contractor shall keep damage within the right-of-way to a minimum consistent with the successful execution of the erection work. The Contractor shall exercise all precautions to avoid damage to crops and other property. The Contractor shall comply with all national and local regulations regarding barricades, detour arrangements and warning signs. Damage to roads, footpaths, bridges, ditches, etc., caused by the Contractor shall be repaired at his expense.

8.2. Access

The Contractor shall provide and maintain all access from the main roads to the transmission line routes during erection. No separate payment shall be made to the Contractor on account of building or repairing access roads.

8.3. Tower Site Survey

The Contractor shall make all necessary site surveys, prepare longitudinal profiles of the transmission line, locate ground positions of the towers, stake out tower footings and determine leg extension requirements.

The Contractor shall locate the bench marks, and reference point already existing and where these do not exist shall provide for them as required. All stakes or other marks shall be preserved until their removal is authorized by the Owner.

Each tower shall be located and centred within 15 cm of the centre line transversely and within a 0.5% deviation of its back span length longitudinally of its specified position on the plan and profiles. Relocation of a tower exceeding the longitudinal and transversal deviation limit will be allowed only if approved by the Owner and for purposes of improving soil conditions for foundation work. Such relocation shall in any case not exceed more than 10 m in either longitudinal direction and will be allowed provided ground clearance is not impaired and specific loading of the particular tower is not exceeded.

Towers in tangent positions shall be oriented with the transverse faces at right angles to the transmission line centre line, and towers in angle positions shall be oriented with the transverse face at right angles to the bisector of the deviation angle.

The Contractor shall assess the soil bearing capacity and weight at each tower location and finalize during the tower site survey the requirements of types of foundations to be applied. The Owner may require the Contractor to make soil tests to verify and/or justify the type of foundation proposed, which will be done at no extra cost to the Owner.

8.4. Retaining Walls

At locations where earth moving by landslides, boulders, water etc. is likely to occur, the tower leg structure/poles shall be protected against this effect by means of retaining walls, without any extra cost.

The retaining wall may be built of prefabricated concrete beams arranged in horizontal layers and fixed with their ends in vertically mounted double U-shaped steel beams. Appropriate alternative solutions may be indicated by the Contractor.

The tower location where the retaining walls are needed shall be decided by the Owner at Site.

8.5. Clearing of Right-of-way

The Contractor shall clear the transmission line right-of-way, fell any vegetation and dispose of waste material along the entire length of a transmission line. All trees, stumps, shrubbery and undergrowth exceeding 2 m in height shall be cut to a maximum stump of 50 cm all along the right-of-way.

All trees adjacent to the right-of-way which could fall across the conductors or against the towers shall be cut.

In addition to the clearing required on the right-of-way all trees, bush stumps and snags at each tower location, shall be cut regardless of height and clearance to conductor to a maximum stump of 25 cm, in an area of 30 by 30 m around a tower.

In the case where plantations are to be crossed by the transmission line, towers with leg extension shall be used. Cutting of trees shall be avoided if possible. Prior to cutting any plant a written confirmation from the Owner or from the relevant authority or department or from land owner (as the case may be) must be available with the Contractor.

The Owner will help the Contractor to make the necessary arrangements/settlements with property owners so as to permit the Contractor the cutting or trimming of trees located both inside and outside the right-of-way where such cutting or trimming is necessary.

Clearing operations shall be conducted so as to prevent damage to existing structures and installations and to those under construction and so as to provide for the safety of employees and the public.

All timber, logs, large stumps and useable material shall be available to the land owner. All roots, bushes, rotten wood and other refuse from the cleaning operation shall be disposed by the methods directed by the Owner.

8.6. Installation of Foundation

8.6.1. General

The tower foundation installation shall include tower site preparation, excavation, foundation placement measurements, assembly and placement of the approved foundation, backfill and clean-up.

The Contractor shall remove all vegetation and other debris from the tower site which will interfere with his operation. Tower preparation shall be done in a manner which will prevent revision of the footing designs of requirements of leg or body extensions.

Vegetation and debris removed from the tower side shall not be disposed of within 15 meters of the centre of the tower.

The ground levels existing before the installation of foundations have been considered in determining tower heights. The Contractor shall dispose of material and regulate the movement of equipment so that grades shall not be exposed, and slopes necessary to develop required loading characteristics shall be maintained, especially in side hill locations.

The depth of the footing shall be measured from the lowest ground elevation in the area occupied by the footing.

8.6.2. Excavation

a. The Contractor shall make the excavation necessary for the approved foundation type.

b. Excavation operations shall be confined to a minimum working area consistent with efficient operations.

c. The Contractor shall perform all pumping of water required to construct the foundations and to keep the foundation base dry. Excavation in areas of unstable soil conditions shall be adequately protected by adequate shoring or soil stabilization.

d. All excavations shall be made according to the specified grade and depth. The foundation bearing area shall be free of all vegetable matter and projecting rock and boulders and shall conform to the size and shape of the footings.

8.6.3. Setting

a. All foundations shall be assembled, placed, and set to the levels, measurements and batters shown on the approved setting diagrams.

b. For all settings a maximum tolerance of 6 mm will be allowed on any dimension.

c. Care shall be taken to ensure that all stub angles are held in place as required to maintain their correct positions during backfilling or placing of concrete for a period of 48 hours thereafter.

d. The Contractor shall provide rigid steel templates or other means for accurately positioning the stub angles to the specified dimensional tolerance. The templates shall be of a design approved by the Owner.

e. In addition to stubs of normal length, short stubs may be used with approval, provided that provision is made for the bolting of cleats. Stubs shall not be bent or cranked.

8.6.4. Back-fill and Clear-up

a. All backfill material shall be clean and free from organic material and other deleterious substances. Any excavated material not acceptable for backfill shall be wasted and disposed of in a place and manner satisfactory to the Owner. All timber shoring and other construction materials shall be removed from the excavation before backfilling. The backfill of tower foundations and correction of unsatisfactory backfill shall be completed before tower erection.

b. All backfill shall be thoroughly compacted to minimum compactness of 90% by tamping in 15 cm layers. Mechanical ramming device shall be used for compaction.

c. The top of the concrete footings shall be at least 25 cm above approved ground or backfill line. Backfill for concrete foundations shall be of fine material for the first 30 cm. Before using coarser materials, backfill shall not be placed for at least 3 days after concrete placement. Backfill shall be placed as in b) above. Backfilling from one side or corner only shall not be allowed.

d. On cultivated land, the tower side shall be promptly cleaned and levelled. The original top soil shall be replaced at the surface. All surplus excavated materials, debris, construction materials and foreign matter shall be removed and disposed of from the tower site to the satisfaction of the Owner.

8.6.5. Concrete Foundation

8.6.5.1. General

a) The Contractor shall provide all materials and facilities, machinery and equipment to install foundations, and design, transport, place, finish, protect a cure concrete. He shall also construct, erect and dismantle forms.

b) Non-reinforced or reinforced concrete shall be provided as required. Reinforced concrete shall be used at locations where foundations of non-reinforced concrete are inadequate to meet loading requirements and ground conditions.

8.6.5.2. Concrete Quality

Concrete shall be composed of Sulphate Resisting Portland cement, water, fine and coarse aggregate, and, when approved or directed by the Owner, set-accelerating admixtures. The design of concrete mixtures will be based on securing a plastic, workable mixture suitable for the specific conditions at placement and when properly cured, a product having durability, impermeability and strength in accordance with foundation requirements. Minimum concrete quality requirements B25 according to DIN 1045 (1978) or equivalent standards.

The Contractor shall engage an independent testing laboratory to determine the prior design mix for the concrete strength and shall submit the Owner the proportions selected and the test results for his approval.

8.6.5.3. Portland Cement

All cement shall be Sulphate Resisting Portland composition obtained from an approved maker. Portland cement shall conform in all respects to Standards DIN 1164 (1978) or ASTM C-150-66 or BS 12 or equivalent standards. Where Portland cement concrete may be liable to chemical attack, higher resistant cement concrete may be used when approved by the Owner.

8.6.5.4. Aggregate

a. General

All aggregates shall consist of hard, tough, durable and uncoated particles. The Contractor shall select the sources of aggregates, and the aggregate sources shall be approved by the Owner. The aggregates shall be clean and free of clay, earth, organic matter, salt or other impurities and shall comply generally with the requirements of Standard DIN 1045 (1978).

b. Fine Aggregate

Fine aggregate, washed and free of clay, shall be either well graded natural sand (from an approved source) or well graded manufactured sand conforming to ASTM C-33 latest edition with fineness modulus of not less than 2.3 and not more than 3.1. No seashore sand shall be used.

c. Coarse Aggregate

Coarse aggregate, washed and free of clay, shall consist of crushed stone, or other approved inert materials with similar characteristics or a combination thereof conforming to ASTM C-33 and shall pass a mesh of not more than 3 cm.

8.6.5.5. Steel Reinforcement

Reinforcing bars shall be structural grade steel and shall comply with the concerning standard. They shall be free of loose, flaky crust and scale and of oil, grease, mud, concrete or other coating which might destroy or reduce its bond with concrete. Bends, cranks and overlappings on reinforcing bars shall be carefully formed in exact accordance with the appropriate standard, and as shown on the approved drawings. Deformed bars of high tensile steel may be used if approved by the Owner or if shown on the approved drawings.

8.6.5.6. Water

Water used in mixing concrete shall be clean and free from harmful amounts of rock flour, sewage, oil, acid, alkalis, salts, organic matter or other detritus substances.

8.6.5.7. Forms

The Contractor shall construct, erect, and maintain all appropriate forms necessary to confine the concrete within the lines and grades shown on the drawings. Form surfaces shall be thoroughly cleaned before erection to be left smooth and free from sawdust, dirt, rust, and foreign matter.

Forms shall be left in place until the concrete has gained sufficient strength to support its own weight and any loads imposed thereon, but form removal shall be made as soon as practicable to avoid delay incurring and repairs of surface imperfections.

8.6.5.8. Foundation Preparation

The preparation of all base surfaces shall be properly completed before concrete is placed. Rock surfaces shall be worked clean of all loose particles, mud, debris, and other material not an integral part of the base rock, using water jets, air and water jets, sand blast or other means. Surfaces shall be thoroughly moistened before concreting. Surfaces of parts to be embedded shall be free from dirt, dried mortar, grout, grease, oil or other substance which would interfere with the bond.

8.6.5.9. Proportioning of Concrete

The quantities of cement, aggregates and water shall be proportioned that when combined and mixed, they will produce concrete of uniform consistency and characteristics to meet adequately the strength and finish requirements. The proportions shall be adjusted whenever such change is necessary in order to maintain the standard quality required by these Specifications.

8.6.5.10. Batching and Mixing

All concrete shall be thoroughly mixed in a mechanical batch mixer of approved type and size, and one so designed as to ensure a positively uniform distribution of all the component materials throughout the mass during the mixing operation. Cement shall be measured by weight and fine and coarse aggregate in gauge boxes to be approved by the Owner.

8.6.5.11. Conveying, Placing and Curing

a) Only methods of transporting and placing which will prevent segregation or loss of ingredients and deliver concrete of the proper consistency will be permitted.

b) Concrete shall be placed before the cement takes its initial set or within 30 minutes from the original mixing times, whichever is sooner.

c) There shall be no vertical drop of concrete mix greater than 1.5 m, except where suitable equipment is provided to prevent segregation and where this is specifically authorized.

d) Concrete shall be worked readily into the corners and angles of the forms and around all reinforcement and embedded items without permitting the component concrete materials to segregate.

e) Concrete shall be placed with the aid of mechanical vibrating equipment and supplemented by hand spading and tamping.

f) All concrete shall be cured by use of a membrane curing compound or by keeping the concrete continuously wet for a period of not less than 7 days by methods approved by the 0wner. After curing the foundations shall be air-dried for a period of 7 days.

8.6.5.12. Concreting under Extreme Weather Conditions

Concreting in Hot Weather

For the purpose of these Specifications, hot weather shall be defined as any combination of high air temperature, low relative humidity and wind velocity which tends to impair the quality of new or hardened concrete, or otherwise result in abnormal properties.

In hot weather and in places where the ambient shade temperature exceeds 30°C, the Contractor shall take special measures in mixing, placing and curing of concrete. These shall be such as to ensure that the temperature of the concrete during mixing, transporting, placing, setting and curing shall not exceed 30°C.

Care shall be taken to protect all stored materials from the harmful effects of hot weather. Silos, mixers and water tanks being painted white. Cement shall be stored in watertight silos free from internal condensation, or as otherwise approved by the Engineer, and shall have a temperature not higher than 77°C. Aggregate stockpiles shall be shaded, carefully sprinkled or fog sprayed to maintain constant surface moisture content.

Additional water shall not be added to the mix to improve workability without the Owner's permission.

8.6.6. Grillage Foundation

Where grillage foundations are used, the grillage members and those parts of the towers which are under the ground surface shall be provided with a triple bitumen coating before installation and backfill. This protective coating shall be extended on the tower up to a height of 50 cm above ground level.

8.6.7. Rock Anchor Foundation

Where rock anchor foundations are used the following has to be applied:

a) Rock anchor holes shall be drilled at the locations and to the depths and diameter specified on the approved Contractor's foundation design drawings. Immediately before placing grouting mortar, the drilled holes shall be washed and blown out with an air jet until no water or dirt remains in the holes. If rock anchors are not to be grouted in place immediately, the holes shall be tightly plugged and again washed and cleaned immediately before placing and grouting of bars. At the time of placing, the hole shall be partially filled with a thoroughly mixed thick sand-cement grout, having a water-cement ratio of less than 0.5 and a sand cement ratio of 3 by weight. The rock anchor bar shall be forced into place while being vibrated by a concrete vibrating machine after which any remaining void shall be filled with grout. Holes into which water is seeping or running shall be grouted upward from the bottom by means of termite pipe to prevent dilution of the grout.

b) The embedment shall be adequate to develop the full yield strength of the anchor rods. Grout shall be allowed to set for at least 7 days before bending rock anchors into position and placing concrete. Any bars which are found to be loose after the grout has set up shall be removed and reset at the expense of the Contractor.

c) The entire grouting procedure shall be subject to approval.

8.6.8. Undercut Foundations in Rock

Undercut foundations may be used where the rock is sound, homogeneous and free from fissures. These foundations will either comprise a concrete block at or below ground level, with the base undercut into the rock with ultimate compression and uplift forces on the foundation resisted by the skin friction/bond developed at the concrete-rock interface: or a concrete block at or below ground level and suitably designed rods grouted into holes previously drilled into the rock. Care shall be taken during excavation to ensure that the surrounding rock is not cracked. The top of pads shall be sloped at not less than 1:10 in order to shed water.

8.6.9. Augured Foundations

Augured foundations may be used provided satisfactory type tests are carried out to the owner's approval. These foundations will comprise either a single shaft with a minimum diameter of 800 mm suitably under reamed at the bottom, or multiple augers with a minimum diameter of 400 mm suitably connected at or below ground level by a concrete cap.

The shear strength of the soil shall be determined from the soil properties measured on undisturbed samples in undrained triaxial compression test. The mean value of the shear strength taken over the effective length of the foundation shall be used in the calculations.

The Contractor's design method shall be submitted for approval, together with the appropriate values of friction/adhesion coefficient and end bearing coefficient prior to any foundation test being undertaken. Where shear forces are resisted by the cap, an appropriate reduction in the mean value of the shear strength shall be taken for the determination of the cap friction/adhesion coefficient.

For single large diameter augured foundations the main reinforcement shall be adequate to carry the total load for the full length of the foundation.

The minimum concrete cover to all reinforcement, including stirrups, shall be 100 mm.

For small diameter augers the concrete cover shall not be less than 50 mm.

8.6.10. Augured or Driven Piles

Ultimate uplift loads shall be obtained assuming the actual dead-weight of pile caps (and tie-beams, etc.) plus the guaranteed ultimate uplift resistance of piles. Allowance shall be made for buoyancy effects.

Ultimate compressive loads shall include the superimposed weight of earth, pile caps (and tie-beams, etc.) multiplied by the appropriate withstand factor and shall be obtained by the guaranteed ultimate resistance of the piles.

The ultimate resistance of piles shall be resistance at which the movement does not exceed 25 mm. Piles will be subjected to uplift or compression tests at the discretion of the Owner.

8.7. Site Tests and Test Laboratory

In order to carry out specified tests the Contractor shall provide a site laboratory which shall be available for the use of the Owner as required and shall be properly staffed and equipped in accordance with the standards indicated in Schedule.

General tests or rare tests can be commissioned to an experienced external laboratory.

The whole cost of such tests, relevant to construction including the provision and use of equipment, shall be included in the Contract.

8.8. Erection of Towers

8.8.1. General

The Contractor shall ascertain that all concrete foundations or rock anchor grouting are cured and that all backfill is compacted to its approved level before placing or erecting tower steel on the foundations. Concrete in tower foundations shall be allowed to set a minimum of 10 days before erection of the tower and a minimum of 28 days before conductor installation on the tower.

The Contractor shall erect the types of towers specified at the locations indicated on the Contract Drawings.

Towers shall be assembled in accordance with the approved Contractor's drawings and erected by any suitable method approved by the Owner which will not overstrain structural members or their foundations.

All tools and equipment required for tower erection shall be supplied by the Contractor.

8.8.2. Handling and Storage

a) Steel in storage shall be blocked off the ground and all necessary measures shall be taken to prevent structural injury to members or damage to galvanized coatings.

b) Members shall not be dragged on the ground nor will the practice of throwing tower steel into piles on conveyances or from conveyances onto the ground and of skidding steel members over each other be permitted.

c) Tower material damaged shall be replaced by the Contractor at no cost to the Owner.

d) Where galvanizing is broken by any cause, the bare metal shall be painted or regalvanized by the Contractor in accordance with the relevant clause of these Specifications.

e) All galvanized structures shall be painted partly before and partly after erection in accordance with attached painting specification.

8.8.3. Erection

a) After conductors have been installed and sagged, all towers shall be plumb with a tolerance on vertical deviation not exceeding 3 mm/m.

b) During the erection, no tools shall be taken up to the towers except structure wrenches. Only such wrenches will be allowed which do neither deform nor injure the galvanized coating of the nuts.

c) Each bolt shall be securely tightened with adequate but non-excessive torque. Proper tightness shall be spot checked by the Contractor with an accurately calibrated torque wrench. The Contractor shall specify the maximum torque that can be applied for each bolt size.

d) In order to prevent pilfering all bolts and nuts below a minimum height of 3 m above ground shall be secured by means of punching the bolt thread. All towers shall be completely tightened immediately after they are erected and left in workmanlike condition, complete and safe in every respect.

e) A reasonable amount of drifting will be allowed in assembly of towers, but reaming for correction of mismatched holes due to shop errors will not be tolerated. Any drifting used shall not distort the metal or enlarge the hole.

f) Danger signs shall be installed on each longitudinal side of each tower, approximately 2 m above the top of tower footing. A tower number sign and 2 circuit number signs shall be provided for each tower. The phase signs are not required. Anti-bird devices shall be installed on the cross arms as specified.

g) Towers must be completely erected with all members in place and bolts securely tightened before any stringing of conductors or earth wires may be started. All towers shall be inspected by the Owner accompanied by the Contractor before the stringing operation.

h) The Contractor shall assemble and erect the towers completely and carefully. If the stubs are installed separately, they shall be installed by means of rigid frames, which must be supplied by the Contractor for each tower type. The setting templates shall remain in position until the concrete foundations have cured for a period of 24 hours. If possible, the stubs shall be installed together with the lower parts of the tower.

The stubs shall be aligned exactly by means of theodolite or level instruments. The difference in elevation between identical parts of any stub angles shall not exceed 1/1000 of the horizontal distance between the stubs. The actual elevation of any stub angle shall not differ from the calculated elevation by more than 5 mm. The stub angles shall be located horizontally so that each is within 5 mm of its correct position and the batter of the stub angles shall not differ from the correct batter by more than 5 mm per meter of exposed stub.

The Contractor's erection method shall be approved by the Owner.

The concrete foundations can be loaded at the earliest ten days after casting. Before commencement of erection back-filling and compaction have to be completed.

Angle tension towers and terminal tension towers must be erected out of plumb. The direction of the deviation from the vertical shall be against the resulting tension. The extent of the deviation has to be determined by the Contractor according to the value of the resulting tension and depending on the specific tower design after stringing of conductors a max. tolerance of 10 cm from the designed deviation is allowed, but only in the direction of the deviation.

If the Contractor's proposed tower erection method is to assemble the tower or portions thereof on the ground and raise this to the vertical position, this shall be taken into account during detail planning of towers and foundation. If the towers are erected by assembling in sections, initial bolting shall be adequate for all loads and erection stresses, but also to allow alignment.

The earthing system must satisfy the requirements of VDE 0141 or an equivalent standard. It is left to the Contractor to determine the equipment, nature, scope and extent of the particular tower earthing system subject to the requirement that other areas (sites, owner’s property etc.) are not adversely affected by it. If consequential costs arise in this connection, associated with the construction of the earthing installation, these costs shall be bourn by the Contractor.

8.9. Installation of Grounding

a) For lattice towers an Armco steel grounding conductor, looped with 200 cm diameter around each leg, buried 150 cm depth shall be used. The grounding conductor (Armco steel) shall have a diameter of 2 cm and visibly connected to tower leg by a steel clamp without passing through the foundation concrete.

For tubular poles, ground rods shall be installed for grounding and Armco steel shall be used for connection to tower. It is also possible to drill 6-7 m deep vertical holes and install Armco steel directly in place of rods.

A grounding resistance of max. 3 ohms is required for any tower.

b) For tower locations where the rods cannot be used due to soil conditions the Contractor shall at least install two ground strips each 20 m long, connected to the stubs inside the concrete foundations.

c) After the erection of the towers and ground rods or strips, the ground resistance of each tower shall be measured by means of a "Megger" type instrument.

d) Where the value of such resistance is greater than 3 Ohm the Contractor shall install further ground electrodes until the tower ground resistance is lowered to the specified values. If it will be necessary to add a counterpoise type of grounding system, the Contractor will design, furnish and install such a counterpoise system.

e) All contact surfaces on the tower stubs, connectors, rods, strips and wire leads shall be thoroughly cleaned and covered with a liberal coating of appropriate compound.

f) All wire leads shall be properly sealed in the connectors and all bolts shall be firmly tightened to ensure that a good electrical connection is obtained. All wires and strips shall be handed over and installed in a workmanlike manner, free from kinks and damage of any kind. Backfill for strip trenches shall be thoroughly compacted.

g) After final installation, measurement of the earth resistance at each tower structure shall be made before stringing and the results of such measurement submitted to the Owner for approval.

h) Detailed records of the location of all electrodes together with the length of the driven rods, individual earth readings and the routes of all conductors buried in the ground shall be prepared and kept on site and final records produced on completion of the Contract and handed over to the Owner. Earth resistance values of each earth electrode or electrode group shall be measured as under.

- during initial installation;
- 28 days after installation;
- Immediately before commissioning.

8.10. Installation of Insulator Strings

a) Insulators shall be clean when hung. Steel wool and clean rags shall be used to remove mud, grease, dirt and other foreign matter. Porcelain surfaces shall be wiped to a bright finish and metal surface shall be free from any noticeable contamination.

b) The bending or straining of insulator ball pins, which occurs when insulator strings are picked up by a rope sling placed near the centre of the string, must be avoided. The rope sling shall always be attached near the top unit of the insulator string.

c) Workmen shall not climb upon insulator strings after installation.

d) Hardware and accessories shall be handled to prevent contact with the ground. All items shall be clean and inspected for missing parts or visual defects before installation. All connections shall be made in accordance with the Contractor's drawings or as recommended by the manufacturer, bolts firmly tightened, split pins inserted where required, all in a good workmanlike manner according to the best practice of transmission line construction.

e) All split pins in each insulator string shall be carefully checked to ensure that they are properly seated to avoid accidental uncoupling of insulator units. All split pins shall be faced towards the stepped leg of the tower to facilitate inspection.

f) Damaged insulator string, hardware and imperfectly or poorly galvanized hardware as determined by the Owner shall not be used. Such pieces shall be replaced with new insulator strings/hardware at no cost to the Owner.

8.11. Installation of Conductors and Accessories

8.11.1. Requirements

The Contractor shall sag the conductors in accordance with the initial sag and tension tables to be prepared by him.

8.11.2. Clearances

Requirements for the minimum clearances between live conductors and other objects, which correspond to the maximum conductor sag conditions, are stated in the bid document. For other objects, not listed in this Schedule, the requirements for minimum clearances shall comply with Standard VDE 0210.

8.11.3. Crossing of Public Services

When the Contractor is about to carry out erection of the conductors along or across power lines or telecommunication circuits, public roads, waterways or railways, he shall be responsible for giving requisite notice to the appropriate authorities of the date and time at which he proposes to carry out the work and shall obtain a written acknowledgement of such notice, before stringing of such span is started.

The Contractor shall supply and install all guard structures required for crossings over electric supply and communication lines, railways, roads, highways, obstructions and for the protection of the conductor. All guard structures shall be of adequate strength to withstand the stresses to which they may be subjected. The erection and removal of guard structures is subject to the approval of the Owner.

The Contractor shall provide, erect and maintain all necessary barricades, suitable and sufficient red lights, danger signals and signs and take all necessary precautions for the protection of the work and safety of public. Roads and highways closed to traffic shall be protected by effective barricades on which shall be placed acceptable warning and detour signs. All barricades and obstructions shall be illuminated at night and all lights shall be kept burning from sunset until sunrise.

The cost of providing all such measures and providing necessary repairs and if required by relevant authorities, providing indemnity or other bonds shall be paid by the Contractor and to be included in the Bid Price.

8.11.4. Stringing

a) The Contractor shall take special care that the conductors do not at any time during erection come into contact with the ground or any obstacles such as walls, fences or buildings etc., nor shall they be overstrained during erection. Under no circumstances shall the conductor be dragged on the ground during stringing operation. The conductors shall be strung under tension through stringing sheaves by means of pilot cables. Approved means shall be provided to prevent any damage to conductors where these are run over temporary supports or sheaves.

b) Drum battens shall not be removed until conductor drums are properly mounted at the drum station on the line, and battens shall be immediately refitted to the drum if any surplus conductor is left therein.

c) The conductors, joints and clamps shall be erected in such a manner that no bird caging over tensioning of individual wires or layers or other deformation damage to the conductors shall occur. Clamps or hauling devices shall, under erection conditions, allow no relative movement of strands or layers of the conductors, if required by the Owner; this property shall be demonstrated by actual tests.

d) If the conductors are damaged, the Contractor shall repair or replace the damaged section in approved manner, and at no additional cost to the owner. All sections of conductors damaged by the application of gripping attachments shall be repaired or replaced before the conductors are sagged in place. The Contractor shall at his own expenses make suitable arrangements for temporary guying of towers, where necessary suitable plates (detachable or otherwise) shall be provided on the towers for the attachment of temporary guys. The additional loads imposed on specific towers during erection by the use of temporary guys shall be calculated and approved prior to conductor stringing commencing. The stringing equipment and operation shall be such as to avoid overstressing tower structures or foundations. Any damage to towers or foundations occurring in such an operation shall be made good at the expense of the Contractor.

Conductors shall be strung carefully to avoid kinking, loosening of strands, scraping, nicks or other damage. Bends of less than the minimum bending radius of 18 times the conductor diameter will not be permitted. Jumper loops shall be made up between terminal fittings and formed into such a shape as will afford the minimum clearances specified on the tower outline drawings and so that the jumper insulator string, if any supplied, is not deflected from a plumb alignment.

Appropriate stringing sheaves or travellers shall be used which will not damage the conductor. Stringing sheaves shall have a minimum diameter measured at the bottom of the groove of 16 times conductor's diameter. Stringing sheaves may be hung on the insulator strings or from hangers of suitable length and design to properly distribute loads to the cross arm. They shall be installed at such height as to support the conductor or earth wire at its permanent elevation when clipped in.

The stringing operation shall be executed with due regard to the safety of erection, of personnel and the public. While conductors are being run out, and when being tensioned and finally clipped in, all conductors shall be earthed by the Contractor at points approved by the Owner.

The Contractor shall supply and install all guard structures required for crossings over electric supply and communication lines, railways, roads, highways, obstructions and for the protection of the conductor. All guard structures shall be of adequate strength to withstand the stresses to which they may be subjected.

After being sagged, the conductors shall be allowed to hang in the stringing sheaves for not less than 2 hours before being clamped in, to permit the conductor tension to equalize. The conductors shall be sagged in accordance with sag tables approved by the Owner.

The length of conductor sagged in one operation shall be limited to the length that can be sagged satisfactorily. In sagging one reel length, the sag of 2 spans shall be checked. In sagging lengths of more than one reel, the sag of 3 or more spans near each end and the middle of the length being sagged shall be checked. The length of the spans used for checking shall be approximately equal to the ruling span.

All spans which exceed the ruling span by 60 m or more shall be inspected for sag. At sharp vertical angles, the sag shall be verified on both sides of the angle. The sag of spans on both sides of all horizontal angles of more than 10 degrees shall be verified. After the conductors have been pulled to the required sag, the intermediate spans shall be inspected to determine whether the sags are uniform and correct. Sagging operation shall not be carried out when, in the opinion of the Owner, wind, extremely low temperature, or other adverse weather conditions prevents satisfactory sagging.

A tolerance of plus or minus 4 cm of sag per 100 m of span length, but not to exceed 15 cm in any one span, will be permitted, provided the following conditions occur:

-All conductors in the span assume the same sag and the necessary ground clearance are obtained.

-That the conductor tension between successive sagging operations is equalized so that the suspension insulator assemblies will assume the proper position when the conductor is clipped in.

The tension in the ground conductor must be such that the sag is less than that of the conductors.

The Owner will check the sag at all points to be checked and the Contractor shall furnish the necessary personnel for signalling and climbing purposes.

At all suspension or tension structures, the conductors shall be attached to the insulator assemblies by suspension clamps or dead end fittings as shown and all nuts shall be tightened adequately but not excessively. Spans attached to grid station shall be "Slack Spans". The conductor shall be coated with an approved grease immediately before final assembly in any fitting.

8.11.5. Splices

a. Full tension splices shall be made with strain compression joints.

b. When damage to a conductor does not exceed three strands, either broken or nicked deeper than one third of their diameter a repair sleeve shall be installed and where this limit is exceeded the damaged section of the conductor shall be cut out and spliced with strain compression joint.

c. A maximum of one splice per conductor will be allowed in any phase in any span. No splices shall be located in any span crossing main roads, railways, major canals, rivers, major communication or power lines and in sections between towers of less than three spans.

d. All joints or splices and repair sleeves shall be located at least 10 meters away from the structure.

8.11.6. Sagging

a. Sags and tension tables for the conductor in still air for basic span shall be supplied by the Contractor. While calculating final sag and tensions creep factor shall also be considered.

b. The "equivalent span" method shall be used for the line conductors according to which the tension in any line section, i.e. between two tension towers is the one which would apply to a single span equal to the square root of the figure arrived at by dividing the sum of the cubes of the individual span lengths, in the section considered, by their sum.

c. The Contractor shall submit to the Owner for approval tables showing the initial sags and tensions of the conductor for various temperatures and spans. The initial sag should include allowances for such permanent stretch as may take place in service.

d. The length of conductors or sagged on one operation shall be limited to the length that can be sagged satisfactorily.

e. In order to dissipate the initial torsion energy conductor shall be left in the sheaves for at least 48 hours after sagging before clipping in.

f. Before sagging the choice of control spans and the target setting calculations shall be submitted for approval. The tension prescribed in the sag and tension tables shall not be exceeded by more than 10 % at any time during stringing and sagging operations.

g. Conductor temperature at the moment of sagging shall be checked by an accurate thermometer. The core shall be pulled from a one meter length of conductor, the thermometer inserted into the space vacated by the core, and the length of conductor shall be hung fully exposed to the sun at least 3.5 meters above ground. The temperature reading after reaching its final value shall be used as the sagging temperature.

h. The sag shall preferably be measured with a theodolite subject to the approval of the Owner, the Contractor may employ other methods of checking sag. Sag control measurements will be done for every 5 towers and for all spans exceeding 250 m.

i. As soon as possible after completion of clipping in, the Contractor shall recheck the sags for correctness and shall then turn over his initial and check sagging results to the Owner.

j. Sagging operations shall not be carried out when, in the opinion of the Owner, wind, extremely low temperature or other adverse weather conditions prevent satisfactory sagging.

8.11.7. Vibration Dampers

Vibration dampers shall be installed on both ends of all spans and in positions calculated and proposed by the Contractor and approved by the Owner. The Contractor shall obtain from the vibration damper manufacturer the spacing's which the manufacturer has determined from tests to be the most effective in reducing vibrations under wind velocities 0 to 25 km/h.

8.11.8. Conductor Spacers

Spacer dampers shall be installed on all spans and in positions calculated and proposed by the contractor and approved by the Owner. The contractor shall obtain from the spacer damper manufacturer the spacing's which the manufacturer has determined from tests to be the most effective whatever service conditions may be prevailing.

8.11.9. Counter Weights

For suspension strings counter weights (hold down weights) may be used to counter uplift, provided the counter weight assembly does not interfere with movement of the suspension clamp. The iron hold down weights shall be composed of 50 kg units. The Contractor shall submit a detailed calculation of hold down weights.

8.12. Connections to Substations

The tensions of the conductors in the slack span between the terminal tower and gantry shall not exceed the tensions for loading diagrams.

The Contractor shall carry out all connections between transmission line and relevant substation in order to complete the work in every respect to enable the Owner to start operation of the new line(s).

Around the terminal structures and terminal equipment a 2.5 m high fence shall be constructed taking into account the minimum clearances between the fence and the live parts. Inside the fenced area an earthing mat in accordance with VDE 0141/7.76 is required to which all supporting structures and equipment must be connected.

9. Steel Poles for Transmission Lines

9.1. Types of Tubular Poles

The tubular transmission line poles shall consist of a galvanized steel pole with six cross arms and shall be bolted on an anchor bolt system embedded in foundation. The pole and cross arm shall be circular or polygonal in shape, and tapered uniformly. The poles shall be in several sections and assembly of sections shall be achieved by slip joints.

The poles are of following types:

i) Type PT - (0°-5° Angle)

ii) Type PS - "0°-30° Angle

iii) Type PLA -"0°-60° Angle

iv) Type PLB -"0°-90° Angle

v) PLT -"Terminal 0° Angle

vi) PLDB-"Dead end with platform

P stands for tubular steel poles whereas subscripts T,S,LA,LB etc. have been adopted from existing nomenclature used by KESC to indicate function, angle for which pole is designed.

9.1.1. Double Circuit Steel Pole Type PT

Double circuit suspension pole for straight line position and angle upto five degrees for a wind span of 250 m, a weight span of 250 m.

9.1.2. 30 Degree Double Circuit Steel Pole Type PS

Double circuit strain pole for line angle up to 30 degrees on a wind span of 250 m, a weight span of 250 m.

9.1.3. 60 Degree Double Circuit Steel Pole Type PLA

Double circuit strain pole for line angle upto 60 degrees on a wind span of 250 m, a weight span of 250 m.

9.1.4. 90 Degree Double Circuit Steel Pole Type PLB

Double circuit strain pole for line angle upto 90 degrees on a wind span of 250 m, a weight span of 250 m.

9.1.5. Double Circuit Steel Pole Type PLT

Double circuit strain (terminal) pole for line angle of 0 degree on a wind span of 250 m, a weight span of 250 m.

9.1.6. Double Circuit Steel Pole Type PLDP

Double circuit strain dead end pole for dead ending line on one side having platform to support surge arresters, line traps and coupling capacitors.

9.2. Loadings

Each type of pole shall be designed to safely withstand the loading due to wind on pole, conductors, hardware and dead weight of a pole and fittings, due to resultant transverse load at angles as indicated hereafter.

Maximum wind velocity (VM) has been taken as 39 m/sec and the Reference wind velocity (VR) as 26.2 m/sec taking into account ground roughness coefficient as 0.67. The magnitude of wind load on pole is a pressure of 43 kg/m^2. Wind Load on wires is 89 kg/m^2 on projected area having the width equal to the diameter of wire.

9.2.1. Wind on Pole

In order to determine the effect of the wind on the pole itself the latter shall be divided into elements of suitable height. The ultimate wind load in the transverse direction applied at the centre of gravity of an element shall be:

A_{TC}= qo.C_{XTC}.G_T.d.L. (kg.)
Qo= Dynamic Reference pressure = 43 kg/m^2
D = Average diameter of the pole (m)
L = Length of the element (m)
G_T = Gust response factor 2.22$(Z_T)^{0.175}$

Where Z_T= Height from centre of gravity of element
above ground (m)

Drag coefficient C_{XTC} shall be calculated in terms of Reynolds nos. which shall be equal to:

$R=20.8 \times 10^5 \times d \sqrt{G}_T$

Where d=Average diameter of pole (m)

C_{XTC}=1.2 for R $\leq 3 \times 10^5$

C_{XTC}=0.75 for R $\geq 4.5 \times 10^5$

For values of Reynolds's nos between 3×10^5 and 4.5×10^5 the value of C_{XTC} may be determined by:

C_{XTC}=15.195-2.555 log R

9.2.2. Ultimate Loads

Transverse, longitudinal and vertical loads on the pole body shall be along the pole.

The loads of and on conductors and insulators shall be assumed to act at the conductor attachment points.

Stringing conditions are mainly meant for design of crossarms. It shall be assumed that only two conductors shall be strung simultaneously and the Angle between the Anchorage and ground shall not be more than 15°.

Each pole shall be designed to withstand all combinations of vertical, transverse and longitudinal ultimate loads arising from the loading cases stated at relevant drawings.

9.3. Design Requirement

9.3.1. General

Each Pole shall be of self-supporting with embedded anchor bolts in foundations and shall be able to carry the loads and meet the loading conditions of this specification.

The general configuration and dimensions of poles and clearance shall be as per attached drawings. The diameters of poles shall not exceed the max. values used in present days practice. Section lengths shall not exceed 12 meters. The min. thickness of material used for poles shall be 6 mm.

The Contractor shall be fully responsible for the design of the poles and for their satisfactory performance. All design furnished by the Contractor and approved by the Owner shall be considered a part of this specification.

All designs and drawings submitted by the Contractor shall become the property of Owner. The Owner expressly reserves the right to use, reproduce in whole or in part to distribute, and to reuse any and all such drawings in connection with the installation, maintenance, replacement and repair of the materials to be furnished under the specification and also to make any and all such drawings and reproductions thereof available to subsequent Bidders and Contractors, where necessary in connection with fabricating and furnishing materials duplicating or closely similar to the materials to be furnished hereunder. The depositing of all such drawing with the Owner shall constitute a licence to the Owner to use said drawings in the manner herein stated.

9.3.2. Design Methods

All calculations for determination allowable stresses on pole shall be according to ASCE Methods "Design of Steel Transmission Pole Structures."

Poles shall be designed such that all sections will withstand normal and broken wire conditions with safety factors as specified.

All calculations carried out on computer shall be accompanied by a full explanation of the computer programmes and the methods used in the calculations.

As the poles are of cantilever type, consideration shall be given to the most unfavourable condition of simple buckling or combined buckling by bending and torsion.

Connection between the various parts to be achieved by slip joints, the overlapping length shall be at least equal to 1.5 times the Inside diameter of the female section.

In anchor base type poles the dimension and thickness of base plate as well as number, diameter and length of anchor bolts shall be determined by calculations and shall be selected from the range of International Standard.

9.3.3. Foundations

The foundations shall be designed on the following basis.

The foundation shall be able to withstand the ultimate forces tension, compression shear and uplift for the worst possible combination of ultimate loads.

For design purposes the weight of concrete may be taken as 2400 kg/m3 and of earth as 1600 kg/m 3.

9.4. Material

Poles shall be made of low alloy high tensile steel sheet or plate having the tensile properties as specified. The steel shall be made by open hearth or basic oxygen processes.

The manufacturer may propose steel conforming to latest applicable Industry Standards Specification and recommendation practices provided such steel has the minimum yield point and minimum Elongation as specified. The manufacturer shall indicate the grade of steel and identify the standard to which the steel complies. The specification of steel shall be approved by the Owner. The following information shall be supplied by the Manufacturer:

- Ultimate Tensile Strength
- Minimum Guaranteed Yield Strength
- Minimum Elongation
- Detail of Test Piece
- Chemical Composition

9.4.1. Tensile Properties

The steels shall conform to the requirements as to tensile properties prescribed below:

Yield point kg/mm^2 minimum 30 - 40

Elongation in 50 mm gauge
length percent, minimum, up to 5 mm thickness16

Elongation in 200 mm gauge length percent, minimum, 5 mm to 16 mm thickness13

Over 16 mm thickness17

9.4.2. Tolerances

The tolerance of Steel grade and Specification quoted by the Contractor shall be applicable.

Tolerances in the manufacture of the poles shall be as follows:

i) Overall length of pole ±1%
ii) Outside dia ± 1%
iii) Tube thickness ± 8%
iv) Twisting 1.5 Degree per 3 m
v) Weight ± 3%

The poles shall be straight within 1/300 of length.

9.5. Fabrication

All types of poles shall be made of one or several sections or elements tapered uniformly starting with the base or butt end, decreasing in diameter at a suitable rate. In the case of poles made of several sections their assembly shall be achieved by slip joints.

Poles and crossarms shall have no transverse joints or welds and only one longitudinal weld per thickness of pole shall be permissible.

The upper part of the pole shall be made to accommodate cross-arm of the dimensions and clearances shown on the drawing, necessary for the attachment of conductor and shall be made to match aesthetics of the pole. Crossarms connection to the pole shall be made by flange type or box type. For the installation of joint Box for OPGW, the Contractor shall provide two welded brackets each having two bolt holes near the top of each pole. The exact size and locations of the holes shall be agreed between the Contractor and the Owner during approval of tower drawings.

In anchor base type poles the lower part shall be equipped with a base plate to be anchored on a concrete foundation by means of anchor bolts.

The anchor base shall be of sufficient cross section to develop the full strength of the pole by means of two transverse Electric welds. The base shall telescope the pole and one weld shall be on the inside of the base at the end of the pole and other weld on the outside at the top of the base.

Anchor bolts shall be of suitable diameter and length to develop full ultimate strength of the pole. The upper ends of anchor bolt shall be threaded and furnished with hexagonal heads. The lower end of the bolt shall have "L" bend of length not less than 3 times the diameter of bolt. The anchor bolts and nuts shall be hot dip galvanized. Metal covers shall be provided for covering the nuts and the portion of the bolt extending about the base and metal cover shall be attached to the steel base by means of cap screws.

9.5.1. Welding

All welds shall be performed in works before galvanizing. All welding shall be Electric Arc according to International Standards and shall include the following processes:

- Shielded metal Arc welding
- Submerged Arc welding

- Gas metal Arc welding

The electrodes used shall be compatible with grade and chemical composition of the steel used and shall have mechanical properties at least equal to physical properties of the steel to be welded. Uncoated electrodes shall be used.

The welds shall conform to the following minimum requirements.

a. **Longitudinal Welds** 1.c. (For poles and crossarms)

- 90% penetration of all thickness of sheet steel.
- The weld shall be free from any inside and outside cracks.
- No blow holes on the surface of the weld shall be allowed.
- No surface blister shall be tolerated.

b. **Transverse Weld**1.c. (For Base Plate)

- 100% penetration between sheet steels regardless of thickness considerations.
- All welds shall be free from all cracks both inside and outside.
- No blow holes on the outside of the weld.
- The blisters, parasites, spherical inclusions exceeding 5% of the minimum thickness of the sheet steel shall be refused.

The detectible angular inclusions shall not be tolerated.

In order to maintain the quality of the weld manufacturer shall make use of the most adequate method and control instruments in order to verify the quality of completed weld: ultra-sonic or radio control methods (X or gamma rays) shall be used in the works.

9.5.2. Galvanizing

All parts of the poles and crossarms shall be hot dip galvanized after completion of manufacturing operations. No further manufacturing, touching up or modification shall be performed on the pole or crossarms after they have been galvanized.

The galvanizing shall be performed on both inside and outside faces of pole and crossarms.

The galvanizing of the relevant plate or sheet of steel used for the manufacturing of pole or crossarms and nuts and bolts shall be as per relevant standard stipulated in this specification.

9.6. Accessories

9.6.1. Sign Plates

All poles shall be fitted with Danger and number plates. The sign plates shall be fired ceramic surfaces on steel base plates the ceramic enamel shall completely cover the front and back of the interior edges of the attachment holes the enamel around the hole shall be protected by means of fibre washers.

9.6.2. Step Bolts

Removable step bolts of 16 mm dia and 130 mm step shall be provided in a staggered manner, every 450 mm on the pole above anti-climbing devices. Alternative type of step system can be offered by manufacturers.

9.6.3. Anti-Climbing Devices

The anti-climbing device shall consist of an arrangement of barbed wire around the pole to prevent unauthorised persons from climbing the pole. The anticlimbing device shall be fixed at about 3 m from ground level.

9.6.4. Anti-Bird Devices

All suspension poles shall have detachable anti-bird devices, over each suspension insulator string. These anti-bird devices shall be spike type and galvanized and can be fixed on cross-arms by use of bolts and nuts. The anti-bird devices shall be supplied by pole manufacturer.

All angle poles having jumper insulator strings will also be furnished with anti-bird devices.

9.7. Tests

9.7.1. Manufacturer Tests

The manufacturer shall select two samples from each heat to carry out the following tests to satisfy him that the products comply with this Specification.

a. For Steel

1. Chemical Analysis
2. Tensile Tests
3. Bend Tests

b. For Nuts Bolts and Washers

1. Tensile Strength Test
2. Bend Test

The manufacturer shall maintain a record of tests carried out by him for examination by Inspector.

9.7.2. Acceptance Tests

The following acceptance tests shall be carried out.

a. For Pole

1. Visual Examination
2. Verification of Dimensions and Weights
3. Prototype Test

b. For Nuts Bolts and Washers

1. Verification of Dimensions
2. Visual Inspection
3. Proof Load Test
4. Ultimate Tensile Strength Test
5. Galvanizing Test
6. Bend Test

9.7.3. Visual Examination

The test samples shall be examined visually for the following:

Visual Examination

Examination Defects

Material Not as specified in relevant clauses

Construction Not of the shape indicated

Finish Galvanizing not proper, presence of burrs, black and bare spots, dross and projection

Welding Not as specified

9.7.4. Verification of Dimensions and Weight

For conformity to the requirement of dimensions and weight, in case of the rejection number increases as specified in this specification, for the limits of tolerances mentioned in relevant clauses, the entire lot shall be rejected.

9.7.5. Prototype Test

Full scale tests shall be carried out on selected assembled poles of maximum height as shown on the drawings. Different cases are to be tested to the ultimate design loads without failure.

The pole shall be erected on a foundation structure or Anchored on Bolts which shall be of adequate strength and stiffness to withstand safely the pole reactions under test loadings without any mobility. The foundation structure or Anchor Bolt arrangement should be such that as simulating the conditions which will be encountered in service.

Each part of the pole and crossarm shall be of the same grade and class as those to be furnished for the specified poles of the same type.

The poles to be tested shall be galvanized and in all respects identical to the poles to be supplied.

The testing Bench shall be so designed as to prevent practically any introduction of appreciable error in measurement such as frictions. For that purpose the measuring device used shall be placed in such a manner as to directly record the loads.

Prior to testing, the Contractor shall submit for approval of the Owner a line diagram showing layout of the test site, rigging, location of load measuring instruments to be used and a series of line diagrams showing the loads to be applied, taking into account the weight of rigging and angle of load application. The Contractor shall submit for approval a tabulated form on which the applied load and corresponding deflection readings will be entered for each load case.

Testing Bench at the test site shall be capable of handling ultimate loads with safety. Testing Bench shall be capable of handling increased loads during destruction testing with adequate safety of personnel working on the test facility.

The load monitoring equipment shall be electronic transducers complete with appropriate digital readout meters and recorders with an overall accuracy ±1%. All load monitoring equipment shall be calibrated before and after testing of the poles.

The testing of pole shall be carried out in the presence of personnel of the Owner.

Owner shall be notified at least six weeks in advance of the date the tests are to be conducted.

The ultimate loads shall be applied. The loads shall be applied in five steps of 50%, 75%, 90% 95% and 100% of the ultimate loads. Each test loading shall be applied according to the drawings and maintained for not less than one minute during which time there shall be no slacking of or adjustment of the loads. Should it become necessary to adjust the loading, the one minute period shall start after the loading is stabilised and constant. All test loads shall be removed completely before the loads for the next test are applied. After each test load deformation due to longitudinal, transverse torque strain shall be measured (a 10% deformation residue of the maximum deformation recorded at the end of the pole due to the adjustment of the parts and to the remaining tension in the hoisting cables will be acceptable). All test loads corresponding to conductor loading shall be applied directly to the regular attachment detailed provided for these loads. Test load equivalent to wind load on the pole shall be applied at the centre of gravity the specified section of element, taking into account the drag coefficient as calculated according to this specification. To ensure application of full test loads to the pole, friction losses in rigging shall be added to specified loads, if there is rigging between the pole and the load measuring device. Application of impact loads shall be avoided.

Any conspicuous yielding or any failure under any of the above test loadings shall be considered a defect. If a defect develops because of faulty workmanship or materials, the Contractor shall correct the defect and repeat the test loading at his own expense, including any additional cost incurred by Owner for the witnessing of the repeat test loading by the Owner.

In the event of collapse of part under loads of value lower than 95% of ultimate loads, the part that has collapsed may be replaced by another with greater mechanical strength. The modified structure shall be required to pass the test for the specified 100% ultimate load.
If the collapse of a part occurs at loads between those corresponding to the 95% and 100% of the ultimate loads, one of the following two procedures may be adopted:

1. The poles shall be tested according to the procedures as mentioned above.

2. The test shall be repeated on another pole of the same batch and the structure shall be required to pass the 100% of the ultimate load as specified by the Owner.

Cost of repeating the test including cost incurred by Owner for witnessing of the repeat test shall be to the Contractor's account.

The bidder may submit the test certificates from independent international laboratory of repute for Type tests to the satisfaction of the Owner.

9.8. Drawings and Data

The Contractor shall submit outline drawings and design drawings of steel poles as indicated in relevant clauses. After placing of the Contract the Contractor shall submit for approval, drawings.

The following information shall be supplied:

i. Catalogues/Literature of Standardised item
ii. Test Certificate
iii. Detail of manufacturing welding and testing facilities available with the manufacturer.

9.8.1. Material Details

Information such as grade and standard of steel used giving ultimate tensile strength, min. elongation, min. yield strength, chemical composition of steel, standard and method of galvanizing and welding and method of fabrication of pole shall also be appended. English language copy of the particular standard according to which the steel is supplied, and the standard for all galvanizing, welding and other applicable steel shall be supplied with the Bid.

9.8.2. Outline Drawings

Outline drawings for each type of pole and showing the size, location and arrangement of all elements principal outline dimensions and conductor clearances to the poles, the size and length of elements shall be provided. It should be possible to verify the drag coefficient and weight of poles. Separate details to a large scale shall be shown for all insulator and ground wire connection. If necessary for clarification, a large scale shall also be used for plotting details.

9.8.3. Design Calculations and Stress Diagrams

Design calculations and stress diagrams shall show the following information. Detailed calculations of wind loadings on pole shall be included. Loading calculations, bending moments, stress diagrams, section modulus, and thicknesses, inside and outside diameter for each section or elements of pole.

Design calculations if carried out by computer shall be fully documented. Full details of the analytical methods used shall be provided. Documentations shall provide a full explanation of the methods of programming and the interpretation of the detailed results.

9.8.4. Foundation Drawing and Calculations

Fully dimensioned drawings of all foundations showing also the volume of the foundations. Calculations showing the loads imposed on the foundations and the resultant bearing pressure and uplift resistance of the foundations.

9.8.5. Shop Detail Drawings

Shop detail drawings showing all shop details including all dimensions slip joint or flanges, bevel cutting, bending and the identification mark and weight for each element. The Contractor shall not proceed with the shop detail drawings until the outline drawings and design stress diagrams have been approved by the Owner.

9.8.6. Erection Drawings

Erection drawings showing each element or section with its identification mark, location and position of the outstanding pole element number and size of connection bolts and all erection details.

9.8.7. Footing Installation Drawings

Footing erection drawings showing embedded part with its identification mark or all dimensions required for the proper setting and positioning of anchor bolts with relation to the centre of the pole.

9.8.8. Bills of Material

Bills of material for each pole shall show the quantity, kind, outside diameter, inside diameter thickness, length weight and assembly mark for each section, including bolts, washers, plates and all fittings complete for each poles.

10. Painting Specification of Galvanized OHL Structures

10.1. General Requirements

All galvanized steel poles and lattice towers are to be painted. Inside of the poles shall be painted in the manufacturers premises.

This specification defines the minimum requirements for the protective coating of the poles. Also for surface cleaning, preparation and application of paints.

The relevant requirements of the SA and DIN standards and of the standard SIS 05 5900, shall apply. If the above mentioned documents and the specifications are in conflict, the stricter one shall govern.

The Owner shall at all times have access to the work and materials for inspecting while the work is in preparation or progress.

If any work or material be found defective or not in compliance with the specifications, correction or replacement by the Contractor at his own cost is essential.

10.2. Responsibility and Guarantees

Inspection of coating by the Owner will neither relieve the manufacturer of the responsibility for the good quality of paint, nor the Contractor, of his responsibility for acquiring the specified quality of materials, nor for the correct performance of the work. The steel structures are to be protected against corrosion and damage through the influence of weathering, i.e. tropical conditions, including the incidence of dust, and storms and sea water spray. The Contractor shall bear the responsibility for all losses and damages that occur through inadequate corrosion protection and shall repair or replace the parts at his cost.

The Contractor shall bear the full responsibility for paint applied by him on surfaces primed or painted by others.

Corrosion protection is rated to last a guaranteed 15 (fifteen) years after Owner's Final Inspection and Acceptance.

10.3. Safety Precautions

All necessary precautions shall be taken by the supplier to protect personnel and property from hazards due to falls, injuries, toxic fumes, fires, explosion or other harm.

All paint and thinners shall be stored in an area that is well ventilated and protected from sparks, flame, direct rays of the sun and from excessive heat.

It shall be the responsibility of the Contractor that all work to be done and all equipment used is in accordance with the local authority regulations.

Temporary constructions, ladders, scaffolding runways etc, required for safe execution of the painting work shall be rigidly built of all materials, apparatus, equipment and men thereon.

10.4. Test Instruments

The dry film thickness on the steel will be measured above the peaks of surface by means of an electromagnetic dry film thickness gauge, such as the "Minitest" and magnetic one such as the "Micro test".

During application of the paint, the wet film thickness is to be checked continuously by means of an approved wet film thickness gauge. Also the dew point has to be controlled continuously by means of approved instrument.

An approved type of multi-cross cutter for adhesion tests is also required and test shave is to be carried out upon the request of the Owner.

10.5. Cleaning and Surface Preparation

Before painting of hot dip galvanized towers, poles and gantries, they shall be carefully cleaned to remove all foreign matters such as salt, dichromate solutions, dust, sand and dirt by the use of sand blasting and fresh warm water containing wax-free detergent and about 0.5% ammonium hydroxide. Application will be made by using sponges.

Where additional coats of paint are being applied to surfaces having one or more coats of paint in good condition, the existing paint shall be cleaned of all foreign matters.

10.6. Painting-General Preparation and Application

All materials in successive coats shall be of the same manufacturer unless otherwise approved and approval of manufacturers of all coating shall be obtained before relevant orders are placed.

The Contractor shall obtain the paint manufacturers specific recommendations and instructions on pot life and other specific provisions for applications of both inner and outer surface coats. These recommendations shall be considered as a particular part of the specification and shall be followed accordingly. The use of thinners is strictly restricted to the cleaning of tools.

Paints shall only be applied to clean, dry surfaces after the approval of the Owner and his representative.

All materials shall be evenly applied so as to be free from runs, sags, taps, skips, "holidays" or other defects only by use of approved "Strike Brushes". All finishes shall be clean and in good sound condition.

Successive coats should be of different colour shades.

Dry film thickness for all coats as specified herein shall be considered as minimum unless otherwise is indicated, and regular dry film thickness checks shall be made by employing the instruments stated above.

All paint should be delivered in original sealed containers and remained unopened until required for use, paint which has livered, gelled or otherwise deteriorated during storage, shall not be used.

Surfaces completed but not meeting the standards set forth in this specification shall be re-coated at the cost of the Contractor.

10.7. Paint Specification

All paint coating materials shall be of an approved quality obtained from reputable manufacturers. Only products with a proven reference record on galvanized transmission towers in Middle East or identical conditions in excess of 10 years are accepted.

The Contractor will provide a guarantee certificate for painting system on attached Schedule K stating that:

- Painting system will have a life time of rust and corrosion protection of fifteen (15) years for lower parts and twenty (20) years for the upper parts of the towers.

- Painting system will have a guaranteed life of five (5) years for all parts of the towers.

Inside the tubular poles and their crossarms are to be painted by approved spraying methods in the manufacturing plant after galvanizing.

The paint to be used inside the tubes shall be as follows:

- 1 coat of polyamide cured epoxy resin, m.i.o. type
- colour shade:(grey DB 702)
- dry film thickness:80 microns

Outside the poles and towers and their cross arms shall be painted at site after surface cleaning and before erection. Scratches occurring during erection shall be repaired after erection. No paint is allowed to drop on insulators.

- 3 coats of polyamide cured epoxy resin, m.i.o. type

- colour shade: 1st coat grey DB 702
- 2nd coat dark grey DB 703
- 3rd coat silver-grey DB 701

total dry film thickness: 240 microns

Product description

Binder: epoxy resin, molecular weight > 700
polyamine hardener

- Pigment:micaceous iron oxide
- Filler:mineral type
- Solvent:aromatic hydrocarbons
- Density:1.6

- Volume solids: 56%
- Solid content: 77 pbw
- Dynamic viscosity:1200-2000 mPa.s (component A)
- 1500-2300 mPa.s (component B)
- Mixing ratio: 90: 10 pbw

  - **Other particulars**

Pot life: 8 hours at + 23°C
5 hours at + 30°C
2 hours at + 40°C

Drying: touch dry after 1 hour at + 23 °C
waiting time between coats: 1 day

Application of protective coatings

-brush painting or
-roller application
max. 5% of thinner may be added if necessary.

Working conditions

Temperature in. + 8°Cmax. + 40 °C
(ambient temperature)
Humidity max. 85%

10.8. Areas not to be painted

- Grounding point of tubular poles and lattice towers above the concrete level.

- Insulator string attachment pins and their contact surfaces.

- Shield wire attachment pins and their contact surfaces.

10.9. Bolts and Nuts

Bolts and nuts shall be cleaned by washing them in fresh warm water containing wax-free detergent and about 0.5% ammonium hydroxide.

After the erection of towers, the heads of bolts and nuts shall be painted by brush, providing a touch up coat and final coat as explained above.

11. Inspection and Testing During Erection on Site

The Bidders shall submit with their offer procedures that they intend to use in the field to review the quality of work accomplished by the site personnel, so as to comply with the requirements of the Specification.

During the erection of all mechanical, electrical, and terminal equipment as well as during the civil construction, the Contractor shall make the equipment available at any reasonable time for inspection by the Owner should either so require.

To assist the Owner in their review of the quality of the work being performed, the Contractor's senior field representative shall provide the Owner with a schedule of the specific areas and items of work that will be performed during each work-week. The list shall be presented to the Owner prior to the start of work on a day approved by the Owner. All work that is executed prior to such notification shall, at the Owner's option, be subjected to removal and replacement by the Contractor at the Contractor's expense.

In particular the Contractor shall mark on his implementation schedules all stages of erection which are subject to the Owner's acceptance and shall notify the Owner in advance when such inspection for acceptance becomes due. The stages of erection subject to acceptance shall include but not be limited to the items indicated in the individual Sections of these Specifications.

The Contractor shall cooperate with the Owner to enable them to obtain any samples or specimens not otherwise required to be supplied by the Contractor, or to observe any field work that they consider necessary to monitor the quality and workmanship of the work being performed by the Contractor.

Erection work on major items of the equipment must not be continued without the Owner's approval given by the inspection report, by permission in writing or waiver of the inspection. If the Contractor continues with erection without waiting for the Owner's decision, he will be required to dismantle respective parts to make them accessible for inspection. Neither extra cost nor delay may be claimed by the Contractor on account of such dismantling.

The Contractor's scope of work shall include all site tests and inspection expenses, e.g. all labour, materials, consumables, chemicals and stores as well as the instruments and apparatus as may be required to carry out such tests efficiently.

When additional inspection and testing is required by the Owner, it shall be performed promptly and no claims for consequent delay or disruption of the work will be considered.

All instruments and apparatus used for site inspection and testing shall be of the best quality and subject to the Owner's approval, and if requested by the Owner shall be calibrated to an agreed standard at a laboratory of national standing to be nominated by the Contractor and approved by the Owner. The cost of carrying out such calibrations shall be borne by the Contractor in all cases.

The Contractor shall be responsible for and shall include in his delivery all safety measures such as barriers, warning signs etc. required for inspection and testing while erection is in progress and all interruption of work in this connection shall be at his expense.

12. Tests on Commissioning

The Contractor shall be responsible for the safe and efficient setting to work of the whole of the equipment. The methods adopted shall be to the general satisfaction of the Owner at site, and shall be in accordance with any safety and permit regulations in force by the Owner at the site.

The Contractor shall give sufficient detail in the Commissioning Programme to satisfy the Owner that the sequence and duration of the proposed setting to work activities are logical and realistic. Details of the Contractor's staff necessary to achieve the programme shall be given.

At least three months before commencing the commissioning of the overhead line systems, the Contractor shall submit for approval fully comprehensive schedules of pre-commissioning checks as applicable to each item of the overhead line system. The schedules shall then be used during commissioning as a guide to the methods to be followed and to record the actual activities carried out with the appropriate data.

The commissioning procedures shall ensure that the commissioning of any item of the works does not interrupt the normal operation of any previously commissioned item(s) or any item to be commissioned jointly with equipment of other Sections.

When the commissioning of any item or equipment of the Section is complete and before the Trial Operation Period is commenced, the Contractor shall carry out such preliminary tests as are necessary to establish that the overhead line system is functioning correctly and effectively and shall make adjustments required.

All test equipment, tools, materials, consumables, labour and spare parts etc. required during commissioning shall be provided by the Contractor.

13. Rejection

If any item fails to comply with the requirements of this Specification, in any respect whatsoever at any stage of manufacture, works test, erection, site test and commissioning or afterwards before Final Acceptance of Works the Owner may reject the item, or defective component thereof, whichever he considers necessary and after adjustment or modification as directed by the Owner, the Contractor shall submit the item for further inspection and/or test. In the event of a defect on any item being of such a nature that the requirements of this Specification cannot be fulfilled by adjustment or modification, such item shall be replaced by the Contractor at his own expense to the entire satisfaction of the Owner.

However, the Owner may at his discretion accept the faulty material on the implicit understanding that in such cases the Contractor shall compensate the Owner on the basis of the loss or injury to be agreed between the Owner and the Contractor.

14. SCHEDULE A1 – "DESIGN DATA"

Description	132 kV	220kV
Nominal voltage	132 kV	220kV
Max. Operation voltage	145 kV	245kV
Min. Operation voltage	120 kV	200kV
Impulse dry withstand voltage	650 kV	1050kV
One minute power freq. withstand Voltage	275 kV	460kV
Normal frequency	50 Hz	50Hz
Short Circuit Level	40 kA	40kA
Duration of short circuit	3 Sec.	3 Sec
Neutral point	Solidly earthed	Solidly earthed
Minimum air clearance to earth	Shown on tower outlines	Shown on tower outlines
Switching over voltage factor	3	3
Peak of switching over voltage	355 kV	600kV
Governing over voltage condition	Lightning Over-voltage	switching Over-voltage
Pollution degree for insulators	Very heavy pollution	Very heavy pollution
Isokraunic level days/annum	9.7	9.7
Minimum clearance over open country	8.0 m	8.0 m
Overhead line over road level (min)	10.5 m	10.5 m
Overhead line over rail level (min)	15.0	15.0

The above ground clearances must be maintained with no wind at 45°C ambient temperature and 80°C Copper conductor temperature. Clearances from buildings and structures shall be according to NESC National Electrical Safety Codes.

15. SCHEDULE A2 – "BASIC MECHANICAL AND CIVIL ENGINEERING DATA"

Description	132 kV	220kV
Max. ambient temperature	45°C	45°C
Min. ambient temperature	0°C	0°C
Everyday ambient temperature	30°C	30°C
Conductor max. temperature Copper and Copper weld	80°C	80°C
Max. relative humidity	90%	90%
Wind load on flat surfaces	146 kg/m²	146 kg/m²
Wind load on round surfaces at the projected area	89 kg/m²	89 kg/m²
Percentage of the load acting second surface of towers	72%	72%
Wind velocity for conductor cooling	2.0 ft/sec	2.0 ft/sec
Ice load on towers and conductors	-No-	-No-
+35°C still air (EDS)** max pull	18% UTS	18% UTS
Steel for masts	St 37 & 52 JIS-SS41, JIS-SS55	St 37 & 52 JIS-SS41, JIS-SS55
Steel for Bolts and nuts	ASTM A394 &A325 JIS 31180	ASTM A394 &A325 JIS 31180

Footnote:
* UTS: Ultimate Tensile Strength of Conductor
** EDS: Every Day Stress

16. SCHEDULE A3 – "MINIMUM CLEARANCES"

The following are the minimum clearances between live conductors and other objects, which correspond to the maximum conductor sag conditions.

Item	Description	**Minimum(in meters)**
1	Normal ground for pedestrians only	8
2	Residential areas	10.5
3	Roads and streets	10.5
4	Highways	10.5
5	Over railways-from top of rail (without electric line system)	15.0
6	Over pipelines-from top of pipe	10.5
7	Horizontal distance to metal clad or roofed buildings or buildings or structures upon which a man may stand	5.4
8	Power lines (above or below)	5.4
9	Telecommunication lines	5.4

For other objects not listed in the Schedule the requirements for minimum clearances shall comply also with VDE 0210.

Approximately 0.5 m has been added to the clearance values above to allow for survey and drawing errors.

17. SCHEDULE B1 – "TOWER/POLE TYPE"

Tower Type | **Position where used** | **Angle of Deviation** | **Type Insulator** | **Drawing No.**

TOWER POLES - 132 kV, COPPER/ALUMINIUM CONDUCTOR

PT-132 Straight line 0°-5°Suspension
PS-132 Light Angle 0°-30°Tension
PLA-132 Medium Angle0°-60°Tension
PLB-132 Heavy Angle 0°-90°Tension
PLT-132 Terminal 0°Tension
PLDP-132 Dead End with0°Tension
Platform forsurge arresters,
Coupling capacitors, line traps

TUBULAR POLES - 220 kV, COPPER/ALUMINIUM CONDUCTOR

2PT-220 Straight line 0°-5°Suspension
2PS-220 Light Angle 0°-30°Tension
2PLA-220 Medium Angle0°-60°Tension
2PLB-220 Heavy Angle 0°-90°Tension
2PLT-220 Terminal 0°Tension
2PLDP-220 Dead End with0°Tension
Platformfor surge arresters,
Coupling capacitors, line traps

LATTICE ALTERNATIVE FOR TUBULAR POLE STRUCTURES

T-132 / 2T-220 Alternative 0°-5°Suspension
for PT-132
TS-132 /2TS-220 Alternative0°-30°Tension
for big angle
TEE OFF-132/ 2T-OFF Alternative forPLT-132Terminal/90°
GANTRY-132 / 220 Gantry

18. SCHEDULE B2 – "DESIGN SPANS"

	Weight Span (m)	Wind Span (m)	Basic Span (m)
All Lattice towers for132 kV /220kv	250	250	250
All Alternative tubular pole in place of Lattice towers	250	250	250

19. SCHEDULE B3 – "SAGS AND TENSION"

Sag and Tension tables shall be submitted by the Contractor (obtained from conductor manufacturer) and following data will be obtained from these tables considering, everyday stress of conductor as 18% of ultimate strength.

- Sag Tension data for ruling span 40m-400m at an interval of 10 m.
- Sag tension data for initial and final condition of the above stated spans and for the temperature range of 2°C to 80°C with an interval of 2°C.
- Sag tension data for maximum wind condition.
- Sag tension data for every day stress.
- Stringing table for each ruling span.

OPGW tension limiting condition shall be 1.0m less than the conductor sag at corresponding span.

- Sag tension data for initial and final condition for the above stated spans and for the temperature range of 2°C to 80°C with an interval of 2°C.
- Sag tension data for maximum wind condition.
- Sag tension data for every day stress.
- Stringing table for each ruling span.

20. SCHEDULE B4 – "FACTORS OF SAFETY"

Item	Description	Minimum Factor of Safety
1	Towers/poles and Foundation	
1.1	All types of towers/poles under normal working loads	Tower/pole 1.5/1.25
1.2	All types of towers/poles underbroken wire loads (Unbalanced condition)	1.5/1.25
1.3	Foundations for all types of towers/poles based on normalworking loads	1.8
1.4	Foundations for all types oftowers/poles under broken wire loads	1.5
2	Insulator Strings	
2.1	Complete tension insulatorstrings and fittings at conductor maximum working tension based on minimumbreaking load of insulator	3.5
2.2	Complete suspension insulatorstrings and fittings at maximumvertical load at insulator attachment point based onminimum breaking load of insulator	4.0
3	Conductors	
3.1	Conductors at final maximumworking tension based onultimate strength	3.5
3.2	Conductors at still air. Every day temperatures final tension based on ultimate strength	5
3.3.	Dead end compression clampsand compression splices based on conductor ultimate strength	5
4.4	Complete suspension assembly atmaximum vertical load	4.0

21. SCHEDULE C1 – "STANDARDS"

All the following equipment should conform to latest revision/editions of applicable IEC standards. In addition, all following standards should also be followed.

Item	Description	Standards
1	Tower steel	
1.1	Structural steel/poles	DIN, Euronorm,JIS, BS, ASTM
1.2	High tensile steel	DIN, Euronorm, JIS, BSASTM
1.4	Bolts	DIN, JIS, ASTM
1.5	Galvanizing	ASTM (A123, A153), (Special Galv. For fittings)
2	Concrete	DIN, BS, ASTM, JIS
3	Reinforcement steel	DIN, BS, ASTM, JIS
4	Insulators	IEC, DIN, VDE
5	Line conductor	IEC 208
6	Earth wire	ASTM B 415, 416
7	Conductor, earth wire and insulator fittings	DIN, ASTM
8	Clearances on tower constructions and between conductors	VDE 0210/NESC
9	Additional standard proposed by Tenderer	

The Bidder shall enter above the international standards on which his Bid is based. The Contractor shall supply copies in the English language of all standards applied upon request of the owner.

22. SCHEDULE C2 – "TOWER STEEL PARTICULARS"

The quality of steel used for tower members and bolts shall not remain under the following values:

Item	Description	Unit	Data (Minimum Values)
1	Structural Steel		
1.1	Tensile strength	N/mm^2	370
1.2	Yield point	N/mm^2	240
2	High Strength Steel		
2.1	Tensile strength	N/mm^2	520
2.2	Yield point	N/mm^2	360
3	High Strength SteelBolts		
3.1	Tensile strength	N/mm^2	500
3.2	Yield point	N/mm^2	300

23. SCHEDULE C2(Continued) – "SLENDERNESS RATIOS"

Maximum allowable slenderness ratios (L/R).

The slenderness ratios (L/R) of members given below shall not be exceeded:

Item	Description	Data (Minimum Values)
1	Tower legs, main compressionmembers in cross arms	150
2	Other compression memberscarrying calculated stresses	200

3	Redundant members withoutcalculated stress	250
4	The tension members of cross arm hangers	350
5	All other tension members	500

24. SCHEDULE C2(Continued) – " TOWERMEMBER PARTICULARS

Minimum thickness and diameter of material used in members and bolts shall be as follows:

Item	Description	Unit	Data (Minimum Values)
1	Calculated members	mm	50 x 50 x 6
2	Redundant members	mm	50 x 50 x 6
3	Thickness of legs,members in cross arms and in earth wire peaks	mm	6
4	Diameter of bolts formembers carrying stress	mm	16
5	Diameter of bolts forredundant members without calculated stress	mm	12
6	Gusset plates	mm	6
7	Stub angles	mm	8

25. SCHEDULE D – "INSULATORS/INSULATOR STRINGS"

• Insulator type	Long Rod
• Material	Porcelain
• Type of coupling	Clevis
• Spacing approx.	1080 mm
• Minimum no. of studs	12 large+11 small
• Dia. of studs	205 mm large and 175 mm small
• Type of cement antimony alloy	Portland or special lead
• Creepage distance	(minimum) 45 mm/kV (Ph-Ph)
• Minimum failing load	160 kN
• No. of long rod insulators per string for 132 kV OHL	2
• Rated short duration power frequency withstand voltage for 132 kV string	275 kV (r.m.s)
• Rated lightning impulse withstand voltage for 132 kV string	650 kV (peak)

26. SCHEDULE E –

26.1. 500mm² Copper Conductor

• Cross section	500 mm²
• Stranding (no. of copper wires)	Minimum 53
• Diameter of copper wires	Minimum 3.25 mm
• Diameter of complete conductor	25.3-27.6 mm
• Direction of lay of outermost layer	Right hand lay
• Mass of conductor	4590 kg/km
• Ultimate strength	According to VDE 0210
• Modulus of elasticity final	12650 Kg
• Coefficient of linear expansion1.	$17x10^{-6}$ at 20 °C
• DC resistance at 20°C	0.0369 ohms/km
• Standard un-jointed length on drum	1500 meters

26.2. 300 mm² COPPER CONDUCTOR

• Cross section	300 mm²
• Stranding (no. of copper wires)	61
• Diameter of copper wires	2.5 mm
• Diameter of complete conductor	22.5 mm
• Direction of lay of outermost layer	Right hand lay
• Mass of conductor	2700 kg/km
• Ultimate strength (according to VDE 0210)	115.7 KN
• Modulus of elasticity final	117.3 KN/mm²
• Coefficient of linear expansion	1.764×10^{-5}
• DC resistance at 20°C	0.0595 ohms/km
• Standard unjointed length on drum	1500 meters

26.3. 400 mm² COPPER CONDUCTOR

• Cross section	400 mm²
• Stranding (no. of copper wires)	61
• Diameter of copper wires	2.89 mm
• Diameter of complete conductor	26 mm
• Direction of lay of outermost layer	Right hand lay
• Mass of conductor	3600 kg/km
• Ultimate strength (according to VDE 0210)	156.27 KN
• Modulus of elasticity final	117.3 KN/mm²
• Coefficient of linear expansion	1.764×10^{-5}
• DC resistance at 20°C	0.044 ohms/km
• Standard unjointedlength on drum	1500m

26.4. 240mm2 COPPER CONDUCTOR

• Cross section	240 mm²
• Stranding (no. of copper wires)	61
• Diameter of copper wires	mm
• Diameter of complete conductor	mm
• Direction of lay of outermost layer	

- Mass of conductor 2219 kg/km
- Ultimate strength
- (according to VDE 0210) KN
- Modulus of elasticity final 117.3 KN/mm²
- Coefficient of linear expansion
- DC resistance at 20°C 0.07181 ohms/km
- Standard unjointed length on drum mm

26.5. 185mm2 COPPER CONDUCTOR

- Cross section 185 mm²
- Stranding (no. of copper wires) 37
- Diameter of copper wires mm
- Diameter of complete conductor mm
- Direction of lay of outermost layer
- Mass of conductor 1699 kg/km
- Ultimate strength
  (according to VDE 0210) KN
- Modulus of elasticity final 117.3 KN/mm²
- Coefficient of linear expansion
- DC resistance at 20°C 0.09375 ohms/km
- Standard unjointed length on drum m

27. SCHEDULE E (continued) –

27.1. 500 mm² ALUMINIUM CONDUCTOR

• Cross section	500 mm²
• Stranding (no. of copper wires)	Minimum 53
• Diameter of copper wires	Minimum 3.25 mm
• Diameter of complete conductor	25.3 – 27.6 mm
• Direction of lay of outermost layer	Right hand lay
• Mass of conductor	1350 kg/km
• Ultimate strength	According to VDE 0210
• Modulus of elasticity final	6960 Kg
• Coefficient of linear expansion1.	$23x10^{-6}$ at 20^{0}C
• DC resistance at 20°C	0.0605 ohms/km
• Standard unjointed length on drum	1500 m

28. SCHEDULE E (continued) – “Optical Fibre Ground wire (OPGW)”

a) Ground wire features		
Manufacturer		
Type		
Ultimate strength	KN	214
Modulus of elasticity (final)	KN/mm²	155
Coefficient of linear expansion per °C		1.32x10-5
Standard mass of conductor per km	Kg	1225
Ambient Temperature range	°C	-25 to +80
Standard unjointed length On reel	M	4000
Overall diameter of OPGW	MM	17.5
Minimum bending radius -under normal conditions	Mm	500
b)Earth wire/Conductor features		
Aluminium clad steel		
Cross section of earthwire	mm²	184.3
No. and size of strands alu-clad	No.	22
Steel wire diameter	Mm	3.20
Electrical Resistance of earth wire conductor	Ohm/Km	0.435
Standards		ASTM B 415
c)Fibre Features		
Number of optical fibres		
Mode		24 Single mode
Operation wave length	nm	1310

Cut off wave length	nm	1150-1285
Attenuation at 1310 nm	Db/km (max)	0.36
Optical loss variation in temperature range - 25 to 100 °C	dB/km (max)	0.05
Chromatic dispersion at 1285-1330 nm	ps/nm km (max)	3.5
optical or mechanical degradation		
Standards	CCITT Rec. G 652	CCITT Rec. G 652

29. SCHEDULE F – “Material for Tower Grounding”

Item	Description
1.	Ground rods
1.1	Copper weld ground rods 16 mm dia. 3 m long
2.	Ground conductor
2.1	Armco Steel, 20 mm Dia
2.2	Copper conductor 70 mm^2 (insulated)/Copper Conductor 350MCM (minimum) bare soft drawn lead covered stranded copper of electrolytic grade.
3.	Connection of ground electrode with stub angle
3.1	For connection of copper weld rods: Copper conductor as above

30. SCHEDULE G – "Soil Characteristics"

Description	Soil Conditions			
	Normal Soil	**Non-Soft Hard**	**Cohesive**	**Cohesive Rock**
Assumed mass of earth of cubic meter (kg)	1800	1600	900	2200
Assumed angle of frustum of earth resistinguplift (Degree)	1525	1525	1525	1525
Assumed ultimate earth pressure for standard foundation underspecified loadingsincluding factor ofsafety (KN/m^2)	250	700	1000	1500

Soil characteristics:

Cohesive soil stiff, difficult to knead, with granular addition.

Non-cohesive soil, natural soil, gravel, boulder, uniform.

Assumed mass of concrete per cubic meter for all kinds of soil: 2400 kg.

31. SCHEDULE G – "Soil Characteristics"

Description	Soil Conditions			
	Normal Soil	Soft Hard	Hard Rock	Cohesive
Assumed mass of earth of cubic meter (kg)	1800	1600	900	2200
Assumed angle of frustum of earth resisting Uplift (Degree)	15	25	-	-
Assumed ultimate earth pressure for standard foundation underspecified loadings including factor of safety (KN/m^2)	250	700	1000	1500

Soil characteristics:

Cohesive soil stiff, difficult to knead, with granular addition.

Non-cohesive soil, natural soil, gravel, boulder, uniform.

Assumed mass of concrete per cubic meter for all kinds of soil: 2400 kg.

32. SCHEDULE H – "INSPECTION TESTS AT MANUFACTURER'S PLANT"

The following tests shall be carried out at the manufacturer's premises in the presence of the Owner.

Description / Standards

Rolled Steel Angles and Bolts

-Tensile strength test and Mill Test Certificate
Chemical analysis, Steel mill ASTM
Zinc coating test certificates

-Full scale tower load test IEC 652

Insulators

-Type tests, sample tests and
Routine tests. Radio
Interference tests on
Individual insulator and IEC 575/VDE 212
Insulator strings, IEC 383 (1976)
Artificial Pollution Test IEC 437/VDE 0446

Insulator Fittings

-Routine and sample
mechanical tests DIN, VDE
-Galvanizing tests VDE 210

Conductor and OPGW Fittings

Type, Routine and sample test and routine test,	IEC575/VDE212
Test, Radio interference test on individual insulator	IEC 383
And insulator strings, artificial pollution test	IEC437/VDE0446

Clamps and Joints

-Mechanical and electrical type tests, galvanizing and Mechanical routine tests	VDE

Dampers and Spacers

-Fatigue resistant test, -Test of clamp slippage resistance -Longitudinal deformation test -Damping performance test -Galvanizing tests	Relevant Standards

Line Conductors

-Mechanical test, grease test and resistivity test, ultimate tensile stress of complete conductor	IEC 209 DIN 48204

CONCRETE AND SOIL TESTS

The following tests shall be carried out by Contractor at Site, in the presence of the Owner.

Description /Standards

Drilling (Soil/Boulder/Rock)

Drilling/boring will be required to the approved. Standard penetration test. Depth with the minimum hole size of 127mm and Disturbed and undisturbed
Maximum of 203mm diameter or as directed by sampling rock coring the company. The drill holes/bores shall be Backfilled with grout as directed by the Engineer. No separate payment of backfilling of holes shall be made

Subsoil Tests

Tests by means of an approved type of penetrometer or other approved means shall be carried out at suitable intervals along the line route during survey work and atall tower locations. Where required the Contractor shall carry out Standard ground bearing tests to determine penetration the ground bearing capacity test

Laboratory Soil Tests

The Contractor shall obtain soil samples and submit these for tests to an approved laboratory to determine the necessary properties of the soils for purpose of foundation design .DIN,ASTM,BS

Soil Resistivity Tests

Tests by an approved method and using an approved instrument, shall be carried out by the Contractor at suitable intervals along the line route during the survey work, when ordered by the Owner. DIN, ASTM, BS

Tests on Cement and Concrete

Tests on cement, concrete, and steel reinforcement shall be carried out on samples obtained at Site to demonstrate compliance with Standards. DIN, ASTM, BS

33.SCHEDULE I – “Footing and Galvanising Tests”

During the erection the following tests shall be carried out by the Contractor in the presence of the Owner.

Description

Tower Footing Resistance Support
Footing Resistance

The resistance to earth of the complete foundation of individual structures shall be measured in an approved manner before the earth conductors are erected. The placing of the test electrodes shall normally be along the centre line of the route in such direction as to ensure that the lowest resistance to earth is recorded, and a note shall be made of the direction in the test log. The schedule used for recording earth resistance test shall contain in addition to the measured ohmic values, details of the surface soils and general ground conditions at the time of test.

Additional Tower Footing Tests

If in the opinion of the Owner it is necessary to reduce the tower footing resistance by approved means such as counterpoise tapes, the Contractor shall make further tests after the additional measures have been carried out. Any further re-testing shall be carried out as necessary without extra charge.

Measurement of Galvanizing Thickness

The Contractor shall have available on site for the Owner's use an instrument suitable for the accurate checking of galvanising thickness. The gauge shall be available from the time of arrival of the first consignment of steel work until the issue of the taking over certificate for the last line completed. The cost of the gauge and other operating expenses are deemed to be included in the Contract price and the gauge will remain the property of the Contractor.

Measurement of Tightness of Bolts

The Contractor shall have available on site torque wrenches calibrated according to required torque and capable to calibrate at any torque, for random check of bolts torque by the Owner.

34. SCHEDULE J – "Tests on Completion"

The lines shall be energised at full working voltage before handing over and the arrangement for this, and such other tests as the Employer shall desire to make on the completed lines, shall be assisted by the Contractor who shall provide such labour, transport and other assistance as required without extra charge.

The lines shall be tested for insulation by the continuous application for 24 hours of the rated line voltage between the phases.

The Contractor shall make any other measurements deemed necessary by the Owner having a connection with the completion of the Works.

The Contractor shall be responsible for satisfying the Owner when the lines are ready to be tested and shall conduct the tests in the presence of and as instructed by the Owner.

If any failure is detected, the Contractor shall locate and determine the cause of failure and shall make any replacement or repair necessary or correct any errors in the installation to the satisfaction of the Owner and at no cost to the Employer.

Prior to the energizing, the Contractor shall provide the Owner a written statement that all temporary erection earthing points are withdrawn.

35. SCHEDULE K – " Form of (Performance Guarantee for the Painting System)

Dear Sirs,

KNOW ALL MEN by these presents that Messers

a Company established and existing under and by virtue of the Laws of Pakistan and having its registered office in

....
(hereinafter referred to as CONTRACTOR and Karachi Electric Supply Company Limited, Karachi, a company registered under the Companies Act, 1882 as amended and having its registered office in Karachi (hereinafter referred to as OWNER) have already entered into a Contract Agreement on the

....
for goods and services for the Transmission Lines of Transmission System Expansion Projects.

WHEREAS THE CONTRACTOR has to provide painting system for the Transmission Line Towers as per General Project Requirements of this Bidding Documents. THE CONTRACTOR therefore hereby confirms that based on years of research work and experience over decades of the Paint Company, the correctly applied coating system and the conditions known to the

Contractor the: ....

....

a) Painting System will have a life time of rust and corrosion protection of fifteen (15) years for lower parts and twenty (20) years for the upper parts of the Towers.

b) Painting System will have a guaranteed life of five (5) years for all parts of the Towers.

WHEREAS to fulfil the obligations by the CONTRACTOR,

i) Test panels will be prepared at site in presence of KESC/CONTRACTOR and the Paint Company.

ii) The Owner will ensure that the Painting system will not be damaged during routine maintenance of the Transmission Line and, if damaged, will be repaired as per procedure outlined by the Paint Company which is attached to this Guarantee.

iii) If there is any major defect in the Painting system which can be traced back to the paint, either repair of the damaged areas or a recurring replacement of material or amount proportional to the damaged areas will be made by the CONTRACTOR which in any case will not exceed the preminal coating paint.

iv) The option to repair the damage or replacement of material or amount rests with CONTRACTOR.

The CONTRACTOR agrees to keep this GUARANTEE in full force from the date of provisional acceptance of the Transmission Lines for five (5) years of guaranteed life of the painting system, for fifteen (15) years life time of the corrosion and rust protection of the towers and twenty (20) years life time of rust and corrosion protection for the upper parts of the towers.

This Guarantee shall be binding on the CONTRACTOR and his successors and shall be irrevocable.

WITNESSES

1.

for and on behalf of,
(Name of Contractor)

2.

for and on behalf of,
(Name of Contractor)

1. SELF SUPPORTING LATTICE STEEL TOWERS

1.5 TOWER TYPE T-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
1.5.1 General Data		
Designer	Name & Address	
Origin of steels	Maker's	
	Name & Address	
Manufacturer	Name & Address	
Materials		
Load bearing members		
Material		
Standard	JIS G3101	
Minimum Size	(mm x mm)	
Redundant members		
Material		
Standard	JIS G3101	
Minimum Size	(mm x mm)	
Nuts & bolts		
Material		
Standard	JIS B1051	
Size	(Dia. mm)	
Galvanizing		
Type		

TENDERER'S STAMP & SIGNATURE

TECHNICAL DATA SHEETS

1. SELF SUPPORTING LATTICE STEEL TOWERS

1.5 TOWER TYPE T-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Standard	ASTM A123 & A153	
Thickness	(Micro meter)	
	(Gram/m²)	
Painting		
Primer		
* Manufacturer		
* Material		
* Application method		
Paint		
* Manufacturer		
* Material		
* Application method		
Cleaning method		
Dry film thickness of each coat	Microns	
Permissible stresses of structural members, bolts, and nuts	kg/cm^2	
Whether all bolt connections secured with helical spring lock washers		
Method for tower assembly / erection		
1.5.2 Specific Data		
Dimensions		
Total height of tower above ground	(m)	

TENDERER'S STAMP & SIGNATURE

TECHNICAL DATA SHEETS

1. SELF SUPPORTING LATTICE STEEL TOWERS

1.5 TOWER TYPE T-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Height of lower crossam above ground	(m)	
Spacing between crossarms		
Top-middle	(m)	
Middle-bottom	(m)	
Length of crossarm (trip to trip)		
Bottom	(m)	
Middel	(m)	
Top	(m)	
Heights of extensions		
	(m)	
	(m)	
	(m)	
	(m)	
Height of lower conductor above ground level for normal height	(m)	
Height of tower footing stubs	(m)	
Width between tower stubs for normal height	(cm)	
Increase in width between tower stubs for each tower extension		
	(cm)	
	(cm)	

TENDERER'S STAMP & SIGNATURE

1. SELF SUPPORTING LATTICE STEEL TOWERS

1.5 TOWER TYPE T-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
E+6M		
E+8M		
Minimum clearance between live part and steel structure (under consideration of wind load as per specification)	(cm)	
1.5.3 Design Data		
Angle limits (from deg. To deg.)		
Wind span	(m)	
Weight span	(m)	
Max. span	(m)	
Whether following data submitted with the bid	(give reference)	
Outline drawing and dimensions		
Loading diagrams for all loading conditions		
Technical data for structural and high tensile steel and nut, bolts and washers		
Stress analysis of tower members/and calculations of typical foundation		
Max. admissible forces		
Tension	kg	
Compression	kg	
Over turning	kg.m	

TENDERER'S STAMP & SIGNATURE

1. SELF SUPPORTING LATTICE STEEL TOWERS

1.5 TOWER TYPE T-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Shear	kg	
Bearing stress on bolts	kg/cm^2	
Factor of safety		
Forces per tower stub to be carried by foundation at maximum simultaneous acting load		
Max. stub tension	kg	
Max. stub compression	kg	
Estimated weight of basic tower	(KG)	
Estimated weight of basic extensions		
E+2M	(KG)	
E+4M	(KG)	
E+6M	(KG)	
E+8M	(KG)	

TENDERER'S STAMP & SIGNATURE

1. SELF SUPPORTING LATTICE STEEL TOWERS

1.6 TOWER TYPE TS-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
1.6.1 General Data		
Designer	Name & Address	
Origin of steels	Maker's	
	Name & Address	
Manufacturer	Name & Address	
Materials		
Load bearing members		
Materials		
Standard	JIS G3101	
Minimum size	(mm x mm)	
Redundant members		
Materials		
Standard	JIS G3101	
Minimum size	(mm x mm)	
Nuts and bolts		
Materials		
Standard	JIS B1051	
Size	(Dia. mm)	
Galvanizing		
Type		

TENDERER'S STAMP & SIGNATURE

TECHNICAL DATA SHEETS

1. SELF SUPPORTING LATTICE STEEL TOWERS

1.6 TOWER TYPE TS-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Standard	ASTM A123& A153	
Thickness	(Micro meter)	
	(Gram/m²)	
Painting		
Primer		
* Manufacturer		
* Material		
* Application method		
Paint		
* Manufacturer		
* Material		
* Application method		
Cleaning method		
Dry film thickness of each coat	Microns	
Permissible stresses of structural members, bolts, and nuts	kg/cm^2	
Whether all bolt connections secured with helical spring lock washers		
Method for tower assembly / erection		
1.6.2 Specific Data		
Dimensions		
Total height of tower above ground	(m)	

TENDERER'S STAMP & SIGNATURE

TECHNICAL DATA SHEETS

1. SELF SUPPORTING LATTICE STEEL TOWERS

1.6 TOWER TYPE TS-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Height of lower crossarm above ground	(m)	
Spacing between crossarms		
Top-middle		
Middle-bottom	(m)	
Length of crossarm (tip to tip)		
Bottom	(m)	
Middle	(m)	
Top	(m)	
Heights of extensions		
	(m)	
	(m)	
	(m)	
	(m)	
Height of lower conductor above ground level for normal height	(m)	
Height of tower footing stubs	(m)	
Width between tower stubs for normal height	(cm)	
Increase in width between tower stubs for each tower extension		
	(cm)	
	(cm)	

TENDERER'S STAMP & SIGNATURE

1. SELF SUPPORTING LATTICE STEEL TOWERS

1.6 TOWER TYPE TS-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
	(cm)	
	(cm)	
Minimum clearance between live part and steel structure (under consideration of wind load as per specification)	(cm)	
1.6.3 Design Data		
Angle limits (from deg. To deg.)		
Wind span	(m)	
Weight span	(m)	
Max. span	(m)	
Whether following data submitted with the bid	(give reference)	
Outline drawing and dimensions		
Loading diagrams for all loading conditions		
Technical data for structural and high tensile steel and nut, bolts and washers		
Stress analysis of tower members/and calculations of typical foundation		
Max. admissible forces		
Tension	kg	
Compression	kg	
Over turning	kg.m	
Shear	kg	

TENDERER'S STAMP & SIGNATURE

TECHNICAL DATA SHEETS

1. SELF SUPPORTING LATTICE STEEL TOWERS

1.6 TOWER TYPE TS-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Bearing stress on bolts	kg/cm^2	
Factor of safety		
Forces per tower stub to be carried by foundation at maximum simultaneous acting load		
Max. stub tension	kg	
Max. stub compression	kg	
Estimated weight of basic tower	(KG)	
Estimated weight of extensions		
	(KG)	
	(KG)	
	(KG)	
	(KG)	

TENDERER'S STAMP & SIGNATURE

1. SELF SUPPORTING LATTICE STEEL TOWERS

1.7 TOWER TYPE TLA-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
1.7.1 General Data		
Designer	Name & Address	
Origin of steels	Maker's	
	Name & Address	
Manufacturer		
Materials		
Main body		
Material		
Standard	JISG3101	
Minimum Size	(mm thickness)	
Cross arms		
Material		
Standard	JISG3101	
Minimum Size	(mm thickness)	
Nuts & bolts		
Material		
Standard	JISB1051	
Size	(Dia. mm)	
Galvanizing		
Type		

TENDERER'S STAMP & SIGNATURE

1. SELF SUPPORTING LATTICE STEEL TOWERS

1.7 TOWER TYPE TLA-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Standard	ASTM A123 & A153	
Thickness	(Micro meter)	
	(Gram/m²)	
Painting		
Inner surfaces		
* Manufacturer		
* Material		
* Application method		
* Dry film thickness	Microns	
Outer surface		
* Manufacturer		
* Material		
* Primer		
* Paint		
Application method		
Dry film thickness of each coat	Microns	
Permissible stresses of structural members, bolts, and nuts	kg/cm^2	
Walding process		
Method for pole erection		
1.5.2 Specific Data		

TENDERER'S STAMP & SIGNATURE

1. SELF SUPPORTING LATTICE STEEL TOWERS

1.7 TOWER TYPE TLA-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Dimensions		
Total height of pole above ground	(m)	
Height of lower crossam above ground	(m)	
Spacing between crossarms		
Top-middle	(m)	
Middle-bottom	(m)	
Length of crossarm (trip to trip)		
Bottom	(m)	
Middel	(m)	
Top	(m)	
Heights of extensions		
E+2M	(m)	
E+4M	(m)	
E+6M	(m)	
E+8M	(m)	
Height of lower conductor above ground level for normal height	(m)	
Minimum clearance between live part and steel pole (under consideration of wind load as per specification)	(cm)	
1.7.3 Design Data		
Angle limits (from deg. to deg.)		

TENDERER'S STAMP & SIGNATURE

1. SELF SUPPORTING LATTICE STEEL TOWERS

1.7 TOWER TYPE TLA-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Wind span	(m)	
Weight span	(m)	
Max. span	(m)	
Whether following data submitted with the bid		
Outline drawing and dimensions		
Loading diagrams for all loading conditions		
Technical data for high tensile steel and nut, bolts and washers		
Stress analysis of pole section and calculations of typical foundation		
Max. admissible forces		
Tension	kg	
Compression	kg	
Over turning	kg.m	
Shear	kg	
Factor of safety		
Forces to be carried by foundation at maximum simultaneous acting load		
Max. tension		
Max. compression		
Estimated weight of basic pole		

TENDERER'S STAMP & SIGNATURE

1. SELF SUPPORTING LATTICE STEEL TOWERS

1.7 TOWER TYPE TLA-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Estimated weight of extensions		
E+2M	(KG)	
E+4M	(KG)	
E+6M	(KG)	
E+8M	(KG)	

TENDERER'S STAMP & SIGNATURE

1. SELF SUPPORTING LATTICE STEEL TOWERS

1.8 TOWER TYPE TEE OFF-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
1.8.1 General Data		
Designer	Name & Address	
Origin of steels	Maker's	
	Name & Address	
Manufacturer	Name & Address	
Materials		
Main body		
Material		
Standard	JISG3101	
Minimum Size	(mm thickness)	
Cross arms		
Material		
Standard	JISG3101	
Minimum Size	(mm thickness)	
Nuts & bolts		
Material		
Standard	JISB1051	
Size	(Dia. mm)	
Galvanizing		
Type		

TENDERER'S STAMP & SIGNATURE

1. SELF SUPPORTING LATTICE STEEL TOWERS

1.8 TOWER TYPE TEE OFF-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Standard	ASTM A123 & A153	
Thickness	(Micro meter)	
	(Gram/m²)	
Painting		
Inner surfaces		
* Manufacturer		
* Material		
* Application method		
* Dry flim thickness	Microns	
Outer surfaces		
* Manufacturer		
* Material		
* Primer		
* Paint		
Application method		
Dry film thickness of each coat	Microns	
Permissible stresses of structural members, bolts, and nuts	kg/cm^2	
Walding process		
Method of pole erection		
1.8.2 Specific Data		

TENDERER'S STAMP & SIGNATURE

1. SELF SUPPORTING LATTICE STEEL TOWERS

1.8 TOWER TYPE TEE OFF-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Dimensions		
Total height of pole above ground	(m)	
Height of lower crossam above ground	(m)	
Spacing between crossarms		
Top-middle	(m)	
Middle-bottom	(m)	
Length of crossarm (trip to trip)		
Bottom	(m)	
Middel	(m)	
Top	(m)	
Heights of extensions		
E+2M	(m)	
E+4M	(m)	
E+6M	(m)	
E+8M	(m)	
Height of lower conductor above ground level for normal height	(m)	
Minimum clearance between live part and steel pole (under consideration of wind load as per specification)	(cm)	
1.8.3 Design Data		
Angle limits (from deg. to deg.)		

TENDERER'S STAMP & SIGNATURE

TECHNICAL DATA SHEETS

1. SELF SUPPORTING LATTICE STEEL TOWERS

1.8 TOWER TYPE TEE OFF-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Wind span	(m)	
Weight span	(m)	
Max. span	(m)	
Whether following data submitted with the bid		
Outline drawing and dimensions		
Loading diagrams for all loading conditions		
Technical data for high tensile steel and nut, bolts and washers		
Stress analysis of pole section and calculations of typical foundation		
Max. admissible forces		
Tension	kg	
Compression	kg	
Over turning	kg.m	
Shear	kg	
Factor of safety		
Forces to be carried by foundation at maximum simultaneous acting load		
Max. tension		
Max. compression		
Estimated weight of basic pole		

TENDERER'S STAMP & SIGNATURE

TECHNICAL DATA SHEETS

1. SELF SUPPORTING LATTICE STEEL TOWERS

1.8 TOWER TYPE TEE OFF-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Estimated weight of extensions		
E+2M	(KG)	
E+4M	(KG)	
E+6M	(KG)	
E+8M	(KG)	

TENDERER'S STAMP & SIGNATURE

1. SELF SUPPORTING LATTICE STEEL TOWERS

1.9 TOWER TYPE GANTRY - 132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
1.9.1 General Data		
Designer	Name & Address	
Origin of steels	Maker's	
	Name & Address	
Manufacturer	Name & Address	
Materials		
Load bearing members		
Material		
Standard	JIS G3101	
Minimum Size	mmxmm	
Nuts & bolts		
Material		
Standard	JIS B1051	
Size	(Dia. mm)	
Galvanizing		
Type		
Standard	ASTM A123 & A153	
Thickness	Gram/m^2	
Painting		
Primer		

TENDERER'S STAMP & SIGNATURE

1. SELF SUPPORTING LATTICE STEEL TOWERS

1.9 TOWER TYPE GANTRY - 132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
* Manufacturer		
* Material		
* Application method		
Paint		
* Manufacturer		
* Material		
* Application method		
Cleaning method		
Dry film thickness of each coat	Microns	
Permissible stresses of structural members, bolts, and nuts	kg/cm^2	
Whether all bolt connections secured with helical spring lock washers		
Method for tower assembly / erection		
1.9.2 Specific Data		
Dimensions		
Total height of tower above ground	(m)	
Height of lower crossarm above ground	(m)	
Spacing between crossarms		
Top-middle	(m)	

TENDERER'S STAMP & SIGNATURE

1. SELF SUPPORTING LATTICE STEEL TOWERS

1.9 TOWER TYPE GANTRY - 132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Middle-bottom	(m)	
Length of crossarm (tip to tip)		
Bottom	(m)	
Middle	(m)	
Top	(m)	
Heights of extensions		
Height of lower conductor above ground level for normal height	(m)	
Height of tower footing stubs	(m)	
Width between tower stubs for normal height	(cm)	
Increase in width between tower stubs for each tower extension		
	(m)	
	(m)	
	(m)	
	(m)	
Minimum clearance between live part and steel structure (under consideration of wind load as per specification)	(cm)	
1.9.3 Design Data		
Angle limits (from deg. To deg.)		
Wind span	(m)	
Weight span	(m)	

TENDERER'S STAMP & SIGNATURE

1. SELF SUPPORTING LATTICE STEEL TOWERS

1.9 TOWER TYPE GANTRY - 132/220 kV

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Max. span	(m)	
Whether following data submitted with the bid	(give reference)	
Outline drawing and dimensions		
Loading diagrams for all loading conditions		
Technical data for structural and high tensile steel and nut, bolts and washers		
Stress analysis of tower members and calculations of typical foundation		
Max. admissible forces		
Tension	kg	
Compression	kg	
Over turning	kg.m	
Shear	kg	
Bearing stress on bolts	kg/cm^2	
Factor of safety		
Forces per tower stub to be carried by foundation at maximum simultaneous acting load		
Max. stub tension	kg	
Max. stub compression	kg	
Estimated weight of basic tower	(KG)	
Estimated weight of extensions		

TENDERER'S STAMP & SIGNATURE

TECHNICAL DATA SHEETS

1. SELF SUPPORTING LATTICE STEEL TOWERS

1.9 TOWER TYPE GANTRY - 132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
	(KG)	
	(KG)	
	(KG)	
	(KG)	

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.7 TUBULAR POLE TYPE PT-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
2.7.1 General Data		
Designer	Name & Address	
Origin of steels	Maker's	
	Name & Address	
Manufacturer	Name & Address	
Materials		
Main body		
Material		
Standard	ASTM A572	
Minimum Size	(mm thickness)	
Cross arms		
Material		
Standard	ASTM A572	
Minimum size	(mm thickness)	
Nuts & bolts		
Material		
Standard	ASTM A325	
Size	(Dia. mm)	
Galvanizing		
Type		

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.7 TUBULAR POLE TYPE PT-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Standard	ASTM A123& A153	
Thickness	(Micro meter)	
	(Gram/m²)	
Painting		
Inner surface		
* Manufacturer		
* Material		
* Application method		
* Dry film thickness	Microns	
Outer surface		
* Manufacturer		
* Material		
* Primer		
* Paint		
Application method		
Dry film thickness of each coat	Microns	
Permissible stresses of structural members, bolts, and nuts	kg/cm^2	
Walding process		
Method of pole erection		
2.7.2 Specific Data		

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.7 TUBULAR POLE TYPE PT-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Dimensions		
Total height of pole above ground	(m)	
Height of lower crossam above ground	(m)	
Spacing between crossarms		
Top-middle	(m)	
Middle-bottom	(m)	
Length of crossarm (trip to trip)		
Bottom	(m)	
Middel	(m)	
Top	(m)	
Heights of extensions		
	(m)	
	(m)	
	(m)	
	(m)	
Height of lower conductor above ground level for normal height	(m)	
Minimum clearance between live part and steel pole (under consideration of wind load as per specification)	(cm)	
2.7.3 Design Data		

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.7 TUBULAR POLE TYPE PT-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Angle limits (from deg. To deg.)		
Wind span	(m)	
Weight span	(m)	
Max. span	(m)	
Whether following data submitted with the bid		
Outline drawing and dimensions		
Loading diagrams for all loading conditions		
Technical data for high tensile steel and nut, bolts and washers		
Stress analysis of pole section and calculations of typical foundation		
Max. admissible forces		
Tension	kg	
Compression	kg	
Over turning	kg.m	
Shear	kg	
Factor of safety		
Forces to be carried by foundation at maximum simultaneous acting load		
Max. tension	kg	
Max. compression	kg	
Estimated weight of basic pole	kg	

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.7 TUBULAR POLE TYPE PT-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Estimated weight of basic extensions		
	(KG)	
	(KG)	
	(KG)	
	(KG)	

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.8 TUBULAR POLE TYPE PS-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
2.8.1 General Data		
Designer	Name & Address	
Origin of steels	Maker's	
	Name & Address	
Manufacturer	Name & Address	
Materials		
Main body		
Materials		
Standard	ASTM A572	
Minimum size	(mm thickness)	
Cross arms		
Materials		
Standards	ASTM A572	
Minimum size	(mm thickness)	
Nuts and bolts		
Materials		
Standard	ASTM A325	
Size	(Dia. mm)	
Galvanizing		
Type		

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.8 TUBULAR POLE TYPE PS-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Standard	ASTM A123 & A153	
Thickness	(Micro meter)	
	$(Gram/m^2)$	
Painting		
Inner surfaces		
* Manufacturer		
* Material		
* Application method		
* Dry film thickness	Microns	
Outer surface		
* Manufacturer		
* Material		
* Primer		
* Paint		
Application method		
Dry film thickness of each coat	Microns	
Permissible stresses of structural members, bolts, and nuts	kg/cm^2	
Walding process		
Method of pole erection		
2.8.2 Specific Data		

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.8 TUBULAR POLE TYPE PS-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Dimensions		
Total height of pole above ground	(m)	
Height of lower crossarm above ground	(m)	
Spacing between crossarms		
Top-middle	(m)	
Middle-bottom	(m)	
Length of crossarm (tip to tip)		
Bottom	(m)	
Middle	(m)	
Top	(m)	
Heights of extensions		
	(m)	
	(m)	
	(m)	
	(m)	
Height of lower conductor above ground level for normal height	(m)	
Minimum clearance between live part and steel pole (under consideration of wind load as per specification)	(cm)	
2.8.3 Design Data		

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.8 TUBULAR POLE TYPE PS-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Angle limits (from deg. To deg.)		
Wind span	(m)	
Weight span	(m)	
Max. span	(m)	
Whether following data submitted with the bid		
Outline drawing and dimensions		
Loading diagrams for all loading conditions		
Technical data for high tensile steel and nut, bolts and washers		
Stress analysis of pole section and calculations of typical foundation		
Max. admissible forces		
Tension	kg	
Compression	kg	
Over turning	kg.m	
Shear	kg	
Factor of safety		
Forces to be carried by foundation at maximum simultaneous acting load		
Max. tension	kg	
Max. compression	kg	
Estimated weight of basic pole		

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.8 TUBULAR POLE TYPE PS-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Estimated weight of extensions		
	(KG)	
	(KG)	
	(KG)	
	(KG)	

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.9 TUBULAR POLE TYPE PLA-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
2.9.1 General Data		
Designer	Name & Address	
Origin of steels	Maker's	
	Name & Address	
Manufacturer		
Materials		
Main body		
Material		
Standard	ASTM A572	
Minimum Size	(mm thickness)	
Cross arms		
Material		
Standard	ASTM A572	
Minimum Size	(mm thickness)	
Nuts & bolts		
Material		
Standard	ASTM A325	
Size	(Dia. mm)	
Galvanizing		
Type		

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.9 TUBULAR POLE TYPE PLA-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Standard	ASTM A123& A153	
Thickness	(Micro meter)	
	($Gram/m^2$)	
Painting		
Inner surfaces		
* Manufacturer		
* Material		
* Application method		
* Dry film thickness	Microns	
Outer surface		
* Manufacturer		
* Material		
* Primer		
* Paint		
Application method		
Dry film thickness of each coat	Microns	
Permissible stresses of each pole section, bolts, and nuts	kg/cm^2	
Walding process		
Method for pole erection		
2.9.2 Specific Data		

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.9 TUBULAR POLE TYPE PLA-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Dimensions		
Total height of pole above ground	(m)	
Height of lower crossam above ground	(m)	
Spacing between crossarms		
Top-middle	(m)	
Middle-bottom	(m)	
Length of crossarm (trip to trip)		
Bottom	(m)	
Middel	(m)	
Top	(m)	
Heights of extensions		
	(m)	
	(m)	
	(m)	
	(m)	
Height of lower conductor above ground level for normal height	(m)	
Minimum clearance between live part and steel pole (under consideration of wind load as per specification)	(cm)	
2.9.3 Design Data		
Angle limits (from deg. to deg.)		

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.9 TUBULAR POLE TYPE PLA-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Wind span	(m)	
Weight span	(m)	
Max. span	(m)	
Whether following data submitted with the bid		
Outline drawing and dimensions		
Loading diagrams for all loading conditions		
Technical data for high tensile steel and nut, bolts and washers		
Stress analysis of pole section and calculations of typical foundation		
Max. admissible forces		
Tension	kg	
Compression	kg	
Over turning	kg.m	
Shear	kg	
Factor of safety		
Forces to be carried by foundation at maximum simultaneous acting load		
Max. tension	kg	
Max. compression	kg	
Estimated weight of basic pole		

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.9 TUBULAR POLE TYPE PLA-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Estimated weight of extensions		
	(KG)	
	(KG)	
	(KG)	
	(KG)	

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.10 TUBULAR POLE TYPE PLB-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
2.10.1 General Data		
Designer	Name & Address	
Origin of steels	Maker's	
	Name & Address	
Manufacturer	Name & Address	
Materials		
Main body		
Material	ASTM A572	
Standard		
Minimum Size	(mm thickness)	
Cross arms		
Material		
Standards	ASTM A572	
Minimum Size	(mm thickness)	
Nuts & bolts		
Material		
Standard	ASTM A325	
Size	(Dia. mm)	
Galvanizing		
Type		

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.10 TUBULAR POLE TYPE PLB-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Standard	ASTM A123 & A153	
Thickness	(Micro meter)	
	(Gram/m²)	
Painting		
Inner surfaces		
* Manufacturer		
* Material		
* Application method		
* Dry flim thickness	Microns	
Outer surfaces		
* Manufacturer		
* Material		
* Primer		
* Paint		
Application method		
Dry film thickness of each coat	Microns	
Permissible stresses of each pole section, bolts, and nuts	kg/cm^2	
Walding process		
Method of pole erection		
2.10.2 Specific Data		

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.10 TUBULAR POLE TYPE PLB-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Dimensions		
Total height of pole above ground	(m)	
Height of lower crossam above ground	(m)	
Spacing between crossarms		
Top-middle	(m)	
Middle-bottom	(m)	
Length of crossarm (trip to trip)		
Bottom	(m)	
Middel	(m)	
Top	(m)	
Heights of extensions		
	(m)	
	(m)	
	(m)	
	(m)	
Height of lower conductor above ground level for normal height	(m)	
Minimum clearance between live part and steel pole (under consideration of wind load as per specification)	(cm)	
2.10.3 Design Data		
Angle limits (from deg. to deg.)		

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.10 TUBULAR POLE TYPE PLB-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Wind span	(m)	
Weight span	(m)	
Max. span	(m)	
Whether following data submitted with the bid		
Outline drawing and dimensions		
Loading diagrams for all loading conditions		
Technical data for high tensile steel and nut, bolts and washers		
Stress analysis of pole section and calculations of typical foundation		
Max. admissible forces		
Tension	kg	
Compression	kg	
Over turning	kg.m	
Shear	kg	
Factor of safety		
Forces to be carried by foundation at maximum simultaneous acting load		
Max. tension	kg	
Max. compression	kg	
Estimated weight of basic pole		

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.10 TUBULAR POLE TYPE PLB-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Estimated weight of extensions		
	(KG)	
	(KG)	
	(KG)	
	(KG)	

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.11 TUBULAR POLE TYPE PLT-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
2.11.1 General Data		
Designer	Name & Address	
Origin of steels	Maker's	
	Name & Address	
Manufacturer	Name & Address	
Materials		
Main body		
Material		
Standard	ASTM A572	
Minimum Size	(mm thickness)	
Cross arms		
Material		
Standards	ASTM A572	
Minimum Size	(mm thickness)	
Nuts & bolts		
Material		
Standard	ASTM A325	
Size	(Dia. mm)	
Galvanizing		
Type		

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.11 TUBULAR POLE TYPE PLT-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Standard	ASTM A123 & A153	
Thickness	(Micro meter)	
	(Gram/m²)	
Painting		
Inner surfaces		
* Manufacturer		
* Material		
* Application method		
* Dry flim thickness	Microns	
Outer surfaces		
* Manufacturer		
* Material		
* Primer		
* Paint		
Application method		
Dry film thickness of each coat	Microns	
Permissible stresses of each pole section, bolts, and nuts	kg/cm^2	
Walding process		
Method of pole erection		
2.11.2 Specific Data		

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.11 TUBULAR POLE TYPE PLT-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Dimensions		
Total height of pole above ground	(m)	
Height of lower crossam above ground	(m)	
Spacing between crossarms		
Top-middle	(m)	
Middle-bottom	(m)	
Length of crossarm (trip to trip)		
Bottom	(m)	
Middel	(m)	
Top	(m)	
Heights of extensions		
	(m)	
	(m)	
	(m)	
	(m)	
Height of lower conductor above ground level for normal height	(m)	
Minimum clearance between live part and steel pole (under consideration of wind load as per specification)	(cm)	
2.11.3 Design Data		

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.11 TUBULAR POLE TYPE PLT-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Angle limits (from deg. To deg.)		
Wind span	(m)	
Weight span	(m)	
Max. span	(m)	
Whether following data submitted with the bid		
Outline drawing and dimensions		
Loading diagrams for all loading conditions		
Technical data for high tensile steel and nut, bolts and washers		
Stress analysis of pole section and calculations of typical foundation		
Max. admissible forces		
Tension	kg	
Compression	kg	
Over turning	kg.m	
Shear	kg	
Factor of safety		
Forces to be carried by foundation at maximum simultaneous acting load		
Max. tension	kg	
Max. compression	kg	
Estimated weight of basic pole		

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.11 TUBULAR POLE TYPE PLT-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Estimated weight of extensions		
	(KG)	
	(KG)	
	(KG)	
	(KG)	

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.12 TUBULAR POLE TYPE PLDP-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
2.12.1 General Data		
Designer	Name & Address	
Origin of steels	Maker's	
	Name & Address	
Manufacturer	Name & Address	
Materials		
Main body		
Material		
Standard	ASTM A572	
Minimum Size	(mm thickness)	
Cross arms		
Material		
Standards	ASTM A572	
Minimum Size	(mm thickness)	
Nuts & bolts		
Material		
Standard	ASTM A325	
Size	(Dia. mm)	
Galvanizing		
Type		

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.12 TUBULAR POLE TYPE PLDP-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Standard	ASTM A123 & A153	
Thickness	(Micro meter)	
	(Gram/m²)	
Painting		
Inner surfaces		
* Manufacturer		
* Material		
* Application method		
* Dry flim thickness	Microns	
Outer surfaces		
* Manufacturer		
* Material		
* Primer		
* Paint		
Application method		
Dry film thickness of each coat	Microns	
Permissible stresses of each pole section, bolts, and nuts	kg/cm^2	
Walding process		
Method of pole erection		
2.12.2 Specific Data		

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.12 TUBULAR POLE TYPE PLDP-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Dimensions		
Total height of pole above ground	(m)	
Height of lower crossam above ground	(m)	
Spacing between crossarms		
Top-middle	(m)	
Middle-bottom	(m)	
Length of crossarm (trip to trip)		
Bottom	(m)	
Middel	(m)	
Top	(m)	
Heights of extensions		
	(m)	
	(m)	
	(m)	
	(m)	
Height of lower conductor above ground level for normal height	(m)	
Minimum clearance between live part and steel pole (under consideration of wind load as per specification)	(cm)	
2.12.3 Design Data		

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.12 TUBULAR POLE TYPE PLDP-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Angle limits (from deg. To deg.)		
Wind span	(m)	
Weight span	(m)	
Max. span	(m)	
Whether following data submitted with the bid		
Outline drawing and dimensions		
Loading diagrams for all loading conditions		
Technical data for high tensile steel and nut, bolts and washers		
Stress analysis of pole section and calculations of typical foundation		
Max. admissible forces		
Tension	kg	
Compression	kg	
Over turning	kg.m	
Shear	kg	
Factor of safety		
Forces to be carried by foundation at maximum simultaneous acting load		
Max. tension	kg	
Max. compression	kg	

TENDERER'S STAMP & SIGNATURE

2. SELF SUPPORTING TUBULAR STEEL POLES

2.12 TUBULAR POLE TYPE PLDP-132/220

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Estimated weight of basic pole		
Estimated weight of extensions		
	(KG)	
	(KG)	
	(KG)	
	(KG)	

TENDERER'S STAMP & SIGNATURE

3. LONG ROD/ 220/132kV DISC INSULATORS (PORCELAIN)

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
3.1 General Data		
Manufacturer		
Standard	IEC 575/VDE 212 IEC 437/VDE 0446	
Type of coupling		
Material		
3.2 Individual Unit		
Dimensions		
Length of unit	(mm)	
Spacing of sheds	(mm)	
Dia of trunk	(mm)	
Dia of sheds	(mm)	
* Large	(mm)	
* Small	(mm)	
Creepage distance	mm/kV	
Min. 50 Hz withstand voltage		
Dry	(kV)	
Wet	(kV)	
Impulse withstand voltage		
Positive	(kV)	
Negative	(kV)	
Loading capacity	(kN)	

TENDERER'S STAMP & SIGNATURE

3. LONG ROD/ DISC INSULATORS (PORCELAIN)

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Failing load	(kN)	
Mass of one LONG ROD/ DISC unit	(KG)	
3.3 132 kV String		
No. of insulator units in 132 kV string		
Minimum 50 Hz withstand voltage for string of two units with all fittings		
Dry	(kV)	
Wet	(kV)	
Impulse withstand voltage for string of two units with all fittings		
Positive	(kV)	
Negative	(kV)	
Creepage distance of 132 kV string	(mm)	
Total length of 132 kV string	(mm)	
Total mass of 132 kV string	(KG)	
Loading capacity of 132 kV string	(kN)	
Failing load of 132 kV string	(kN)	
3.4 220 kV String		
No. of insulator units in 132 kV string		
Minimum 50 Hz withstand voltage for string of three units with all fittings		
Dry	(kV)	

TENDERER'S STAMP & SIGNATURE

3. LONG ROD/ DISC INSULATORS (PORCELAIN)

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Wet	(kV)	
Minimum 50 Hz withstand voltage for string of three units with all fittings		
Positive	(kV)	
Negative	(kV)	
Creepage distance of 220 kV string	(mm)	
Total length of 220 kV string	(mm)	
Total mass of 220 kV string	(KG)	
Loading capacity of 220 kV string	(KN)	
Failing load of 220 kV string	(KN)	
3.5 Arcing Device		
Manufacturer		
Standard	IEC 471 - 19L	
Type of coupling		
Material		
Galvanizing		
Dimensions		
3.6 Fittings		
Manufacturer		
Standard	IEC 471-19L	

TENDERER'S STAMP & SIGNATURE

TECHNICAL DATA SHEETS

3. LONG ROD/ DISC INSULATORS (PORCELAIN)

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Material		
D/S	kg	
S/S	kg	
D/T	kg	
J/S	kg	
Method and thickness of galvanizing for ferrous parts		
Whether provision for hot line maintenance available		
Corona extinction voltage	(kV)	
Minimum failing loads of various components		
*	(KN)	
*	(KN)	
*	(KN)	
*	(KN)	

TENDERER'S STAMP & SIGNATURE

4. CONDUCTOR, EARTHING AND ACCESSORIES

4.1 400mm² COPPER CONDUCTOR

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
4.1.1 General Data		
Manufacturer		
Standard	IEC 208, 209 ASTM B1&B8	
Design	DIN 48201	
Material / Construction	DIN 48201	
Material		
Cross section of complete conductor	(mm²)	
No. of strands		
Dia of strand	(mm)	
Dia of complete conductor	(mm)	
Mass of conductor per km	(KG)	
Lay ratio of each layer		
Direction of lay for outermost layer of conductor		
Standard unjointed length of conductor per drum	(m)	
Overall drum dimensions		
Dia of complete conductor	(cm)	
Width	(cm)	
Approx. gross mass per drum (including conductor)	(KG)	
4.1.2 Mechanical Data		
Continuous tensile stress	(N/mm²)	

TENDERER'S STAMP & SIGNATURE

4. CONDUCTOR, EARTHING AND ACCESSORIES

4.1 400mm² COPPER CONDUCTOR

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Ultimate strength	(KN)	
Modules of elasticity	(KN/mm²)	
Co-efficient of linear expansion	(1/K)	
4.1.3 Electrical Data		
Constant current carrying capacity for 35#C ambient temperture and wind velocity for conductor cooling of 0.8 ft./sec., under effect of sunshine and for 80#C conductor and temperature		
Short time current (1 sec.)	(kA)	
D.C. Resistance at 20#C	(Ohm/km)	
Corona losses per km	(kW)	

TENDERER'S STAMP & SIGNATURE

4. CONDUCTOR, EARTHING AND ACCESSORIES

4.2 ACCESSORIES AND DAMPERS FOR 400mm² COPPER CONDUCTOR

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
4.2.1 General Data		
Manufacturer		
Type		
Material		
*		
*		
*		
Corrosion protection		
Breaking load	(KN)	
4.2.2 Tension Clamp		
Manufacturer		
Type		
Material		
*		
*		
*		
Corrosion protection		
Breaking load	(KN)	
Slipping strengths		
Conductivity	(%of conductor's conductivity)	

TENDERER'S STAMP & SIGNATURE

4. CONDUCTOR, EARTHING AND ACCESSORIES

4.2 ACCESSORIES AND DAMPERS FOR 400mm² COPPER CONDUCTOR

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
4.2.3 Compression Joint		
Manufacturer		
Material		
Breaking load	(KN)	
Slipping strength	(KN)	
Conductivity	(%of conductor's conductivity)	
4.2.4 Repair Sleeves		
Manufacturer		
Type		
Material		
Breaking load	(KN)	
4.2.5 Dampers		
Manufacturer		
Type		
Material		

TENDERER'S STAMP & SIGNATURE

4. CONDUCTOR, EARTHING AND ACCESSORIES

4.2 ACCESSORIES AND DAMPERS FOR 400mm² COPPER CONDUCTOR

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Type of bolts		
Whether provision made to remove/install the dampers by us of hot line tools		
Whether spacing data submitted	give reference	
Damper designed and spacing data calculated for	I/m bending strain in conductor	

TENDERER'S STAMP & SIGNATURE

4. CONDUCTOR, EARTHING AND ACCESSORIES

4.3 500mm² ALUMINIUM CONDUCTOR

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
4.3.1 General Data		
Manufacturer		
Standard for	IEC 208, 209 ASTM B1&B8	
Design	DIN48201	
Material / Construction	DIN48201	
Material		
Cross section of complete conductor	(mm^2)	
No. of strands		
Dia of strand	(mm)	
Dia of complete conductor	(mm)	
Mass of conductor per km	(KG)	
Lay ratio of each layer		
Direction of lay for outermost layer of conductor		
Standard unjointed length of conductor per drum	(m)	
Overall drum dimensions		
Dia	(cm)	
Width	(cm)	
Approx. gross mass per drum (including conductor)	(KG)	
4.3.2 Mechanical Data		
Continuous tensile stress	(N/mm^2)	

TENDERER'S STAMP & SIGNATURE

4. CONDUCTOR, EARTHING AND ACCESSORIES

4.3 500mm² ALUMINIUM CONDUCTOR

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Utimate strength	(KN)	
Modules of elasticity	(KN/mm²)	
Co-efficient of linear expansion	(1/K)	
4.3.3 Electrical Data		
Constant current carrying capacity for 35#C ambient temperture and wind velocity for conductor cooling of 0.8 ft./sec., under effect of sunshine and for 80#C conductor and temperature		
Short time current (1 sec.)	(kA)	
D.C. Resistance at 20#C	(Ohm/km)	
Corona losses per km	(kW)	

TENDERER'S STAMP & SIGNATURE

4. CONDUCTOR, EARTHING AND ACCESSORIES

4.4 ACCESSORIES AND DAMPERS FOR 500mm² ALUMINIUM CONDUCTOR

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
4.4.1 Suspension Clamps		
Manufacturer		
Type		
Material		
*		
*		
*		
Corrosion protection		
Breaking load	(KN)	
4.4.2 Tension Clamp		
Manufacturer		
Type		
Material		
*		
*		
*		
Corrosion protection		
Breaking load	(KN)	
Slipping strengths		
Conductivity	(%of conductor's conductivity)	

TENDERER'S STAMP & SIGNATURE

4. CONDUCTOR, EARTHING AND ACCESSORIES

4.4 ACCESSORIES AND DAMPERS FOR 500mm² ALUMINIUM CONDUCTOR

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
9.4.4.3 Compression Joint		
Manufacturer		
Material		
Breaking load	(KN)	
Slipping strength	(KN)	
Conductivity	(%of conductor's conductivity)	
4.4.4 Repair Sleeves		
Manufacturer		
Type		
Material		
Breaking load	(KN)	
4.4.5 Dampers		
Manufacturer		
Type		
Material		

TENDERER'S STAMP & SIGNATURE

4. CONDUCTOR, EARTHING AND ACCESSORIES

4.4 ACCESSORIES AND DAMPERS FOR 500mm² ALUMINIUM CONDUCTOR

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Type of bolts		
Whether provision made to remove / install the dampers by use of hot line tools		
Whether spacing data submitted	give reference	
Dampers designed and spacing data calculated for	I/m bending strain in conductor	

TENDERER'S STAMP & SIGNATURE

4. CONDUCTOR, EARTHING AND ACCESSORIES

4.5 OPGW

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
4.3.1 General Data		
Manufacturer		
Standard for	IEC-61232,IEC-60794,IEEE-1138	
Design	ASTM B 416-93	
Material / Construction	ASTM B 415-92	
Material		
Cross section of complete earthwire	(mm^2)	
No. of strands		
Dia of strand	(mm)	
Dia of complete earthwire		
Mass of earthwire per km	(KG)	
Lay ratio of each layer		
Direction of lay for outermost layer of earthwire		
Standard unjointed length of earthwire per drum	(m)	
Overall drum dimensions		
Dia	(cm)	
Width	(cm)	
Approx. gross mass per drum (including earthwire)	(KG)	
4.3.2 Mechanical Data		
Continuous tensile stress	(N/mm^2)	

TENDERER'S STAMP & SIGNATURE

4. CONDUCTOR, EARTHING AND ACCESSORIES

4.5 OPGW

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
Ultimate strength	(KN)	
Modules of elasticity	(KN/mm^2)	
Co-efficient of linear expansion	(1/K)	
4.5.3 Electrical Data		
Max. earth fault current	(kA)	
D.C. Resistance at 20#C	(Ohm/km)	
4.5.4 Fiber Data		
Number of optical fibers	(Nos.)	
Mode		
Operation wave length	(nm)	
Cut off wave length	(nm)	
Attenuation at 1310nm.	(dB/km)	
Optical loss variation between - 25^o to 80^o	(dB/km)	
Chromatic dispersion at 1285 - 1330nm	(ps/nm.km)	
Standards		

TENDERER'S STAMP & SIGNATURE

4. CONDUCTOR, EARTHING AND ACCESSORIES

4.6 ACCESSORIES AND DAMPERS FOR OPGW

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
4.6.1 Suspension Clamps		
Manufacturer		
Type		
Material		
*		
*		
*		
Corrosion protection		
Breaking load	(KN)	
4.6.2 Tension Clamp		
Manufacturer		
Type		
Material		
*		
*		
*		
Corrosion protection		
Breaking load	(KN)	
Slipping strengths	(KN)	
Conductivity	(% of earthwire conductivity)	

TENDERER'S STAMP & SIGNATURE

4. CONDUCTOR, EARTHING AND ACCESSORIES

4.6 ACCESSORIES AND DAMPERS FOR OPGW

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
4.6.3 Joint Boxes		
Manufacturer		
Material		
4.6.4 Dampers		
Manufacturer		
Type		
Material		
Type of bolts		
Whether provision made to remove / install the dampers by use of hot line tools		
whether spacing data submitted	give reference	
Dampers designed and spacing data calculated for	I/m bending strain in earthwire	

TENDERER'S STAMP & SIGNATURE

SPECIFIC WORKS DATA

4.1 OPGW

SR. NO.	DESCRIPTION OF DATA	UNIT	REQUIRED	OFFERED BY BIDDER
1	**GENERAL**			
1.1	Manufacturer:			
1.1.1	OPGW cable			
1.1.2	Optical fiber			
1.2	Model number:			
1.2.1	OPGW cable			
1.2.2	Optical fiber			
1.3	Applicable standards for:			
1.3.1	Metallic part		ASTM	
1.3.2	Optical fiber		ITU-T G.652	
1.3.3	Tests		IEEE 1138	
1.4	Type tests costs included in tender price		yes	
2	**TECHNICAL DETAILS**			
2.1	**Cable Construction:**			
2.1.1	<u>Fiber optic unit</u>			
2.1.1.1	Type of fiber optic unit			
2.1.1.2	Material of buffer tube			
2.1.1.3	Number of buffer tubes	No.	3	
2.1.1.4	Number of fibers	No.	24	
2.1.1.5	Fibers loosely housed in buffer tube		yes	
2.1.1.6	Type of waterproof gel within buffer tube		thixotropic jelly	
2.1.1.7	Plastic buffer tube, if applicable, housed in metallic tube/slotted metallic strength member			
2.1.1.8	Structural details of fibre optic unit included		yes	
2.1.2	<u>Stranded metallic wires (armor)</u>			
2.1.2.1	Number of stranded layers			
2.1.2.2	Material of strands:			
	(a) First layer		ACS	
	(b) Second layer (if applicable)		ACS/AA	
2.1.2.3	Number of strands:			
	(a) First layer			
	(b) Second layer (if applicable)			
2.1.2.4	Strand diameter	mm		

BIDDER'S STAMP AND SIGNATURE

SPECIFIC WORKS DATA

4.1 OPGW

SR. NO.	DESCRIPTION OF DATA	UNIT	REQUIRED	OFFERED BY BIDDER
2.2	**Cable Characteristics:**			
2.2.1	Overall diameter	mm	≤ 12	
2.2.2	Nominal cross section	mm²		
2.2.3	Maximum permissible pulling force	kg		
2.2.4	Ultimate breaking force	kg	≤ 7000	
2.2.5	Minimum bending radius (without fiber damage	mm	≤ 200	
2.2.6	Nominal DC resistance at 20°C	ohm/km	≤ 0.75	
2.2.7	Thermally efficient rated short circuit current (Maximum 1 sec. current for temperature rise from 20 to 200 deg. C).	kA	≥ 5	
2.2.8	Modulus of elasticity	kg/mm²		
2.2.9	Coefficient of linear expansion/°C			
2.2.10	Nominal weight	kg/km	≤ 460	
2.2.11	Delivery length per drum:			
2.2.11.1	standard length	m		
2.2.11.2	maximum length	m		
2.2.11.3	tolerance on length of cable per drum			
2.2.12	Climatic requirements:			
2.2.12.1	operation temperature:			
	- maximum	°C	70	
	- minimum	°C	0	
2.2.12.2	relative humidity:			
	- maximum	%	95	
	- minimum	%	5	
2.3	**Fiber characteristics:**			
2.3.1	Single mode		yes	
2.3.2	Material		glass	
2.3.3	Wavelength	nm	1310 & 1550	
2.3.4	Core diameter	µm	9-10 um ± 0.5	
2.3.5	Core concentricity error	µm	<1	
2.3.6	Cladding diameter	µm	125 +/- 2	
2.3.7	Maximum cladding non-circularity	%	2	
2.3.8	Mode field diameter	µm	8.1-9.7	
2.3.9	Cut-off wavelength	nm	≤ 1270	

SPECIFIC WORKS DATA

4.1 OPGW

SR. NO.	DESCRIPTION OF DATA	UNIT	REQUIRED	OFFERED BY BIDDER
2.3.10	Chromatic dispersion:			
2.3.10.1	At 1310 nm	ps/nm.km	<4	
2.3.10.1	At 1550 nm	ps/nm.km	<20	
2.3.11	Maximum attenuation:			
2.3.11.1	At 1310 nm	dB/km	<0.4	
2.3.11.2	At 1550 nm	dB/km	<0.25	
2.3.12	Difference in attenuation coefficient when measured from both ends	dB	0.05	
2.3.13	Maximum splicing loss	dB	0.2	
2.3.14	Fibre colour coded according to EIA-598A		yes	
2.3.15	Fibre reserve length	%	$\geq$ 0.45	
2.3.16	Operational temperature range	ºC	-10 to 80	
3	**OTHER PERFORMANCE DATA**			
3.1	Date of first commercial operation of the offered OPGW	dd-mm-yy		
3.2	Reference list attached		yes	
4	**SUPPORTING DOCUMENTS**			
4.1	Cable cross-section drawing enclosed		yes	
4.2	Technical literature enclosed		yes	
4.3	Type test reports enclosed			

BIDDER'S STAMP AND SIGNATURE

SPECIFIC WORKS DATA

4.2 JOINT BOX

SR. NO.	DESCRIPTION OF DATA	UNIT	REQUIRED	OFFERED BY BIDDER
1	**GENERAL**			
1.1	Manufacturer			
1.2	Model number			
1.3	Applicable standards		ITU-T & IEC 529	
1.4	Type tests carried out		yes	
2	**DESIGN DATA**			
2.1	Material of housing			
2.2	Protection class		≥ IP65	
2.3	Number of cable entries		≥ 4	
2.4	Hardware and metallic parts treated with anti-corrosion element		yes	
2.5	Paint thickness	mm		
2.6	Dimensions:			
2.6.1	width	mm		
2.6.2	height	mm		
2.6.3	depth	mm		
2.7	Weight	kg		
2.7.1	Climatic requirements:			
2.7.2	operation temperature:			
2.7.2.1	maximum	°C	80	
2.7.2.2	minimum	°C	-10	
2.7.3	relative humidity:			
2.7.3.1	maximum	%	95	
2.7.3.2	minimum	%	5	
3	**OTHER PERFORMANCE DATA**			
3.1	Date of first commercial operation of the offered Joint Box	dd-mm-yy		
3.2	Reference list attached		yes	
4	**SUPPORTING DOCUMENTS**			
4.1	Technical literature enclosed		yes	
4.2	Type test reports enclosed			

BIDDER'S STAMP AND SIGNATURE

SPECIFIC WORKS DATA

4.3 HARDWARE

SR. NO.	DESCRIPTION OF DATA		REQUIRED	OFFERED BY BIDDER
1	**GENERAL**			
1.1	Manufacturer:			
1.1.1	Hardware fittings			
1.1.2	Stockbridge damper			
1.2	Model number:			
1.2.1	Hardware fittings			
1.2.2	Stockbridge damper			
1.3	Applicable standards:			
1.3.1	Hardware fittings		ASTM	
1.3.2	Tests		IEEE	
1.4	Type tests costs included in tender price		yes	
2	**TECHNICAL DETAILS**			
2.1	**Hardware Fittings**			
2.1.1	Resistance to OPGW slippage test:			
2.1.1.1	OPGW suspension clamps			
2.1.1.2	OPGW tension clamps			
2.1.2	Type of galvanizing			
2.1.3	Production capability			
2.1.4	Whether hardware suitable for hot line maintenance			
2.1.4.1	Packing:			
2.1.4.1.1	Number of crates	No.		
2.1.4.1.2	Net weight of each crate	kg		
2.1.4.1.3	Gross weight of each crate	kg		
2.2	**Stockbridge Type Vibration Damper**			
2.2.1	Manufacturer			
2.2.2	Model number			
2.2.3	Weight	kg		
2.2.4	Type of attachment to OPGW			
2.2.5	Whether performance requirements as called in the Specifications submitted.		yes	
2.2.6	Dynamic strain caused by vibration at suspension point in vertical direction, micro-strain		$\pm$250 micro m/m (peak to peak)	

SPECIFIC WORKS DATA

4.3 HARDWARE

SR. NO.	DESCRIPTION OF DATA		REQUIRED	OFFERED BY BIDDER
2.2.7	No. of vibration dampers required for OPGW for following span lengths:			
	0 m - 50 m	No.		
	51 m - 100 m	No.		
	101 m -150 m	No.		
	151 m - 200 m	No.		
	201 m - 250 m	No.		
	251 m - 300 m	No.		
	301 m - 350 m	No.		
	351 m - 400 m	No.		
2.2.8	Climatic requirements:			
2.2.8.1	operation temperature:			
2.2.8.2	maximum	ºC	70	
2.2.8.3	minimum	ºC	0	
2.2.9	relative humidity:			
2.2.9.1	maximum	%	95	
2.2.9.2	minimum	%	5	
3	**OTHER PERFORMANCE DATA**			
3.1	Date of first commercial operation of the offered Hardware Fittings	dd-mm-yy		
3.2	Reference list attached		yes	
4	**SUPPORTING DOCUMENTS**			
4.1	Relevant drawings enclosed		yes	
4.2	Technical literature enclosed		yes	
4.3	Type test reports enclosed			

5. EARTHING

5.1 TOWER / POLE EARTHING

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
5.1.1 Grounding Conductor		
Manufacturer		
Material		
Cross-section	(mm^2)	
5.1.2 Earthing Rods		
Manufacturer		
Material		
Cross-section	(mm^2)	
5.1.3 Connector		
Manufacturer		
Type and material of connectors for connection with		
Steel structure		
Steel poles		
Type and material of connectors for connection with ground rods		
5.1.4 Ground Strips		
Manufacturer		
Material		
Cross-section	(mm x mm)	

TENDERER'S STAMP & SIGNATURE

5. EARTHING

5.1 TOWER / POLE EARTHING

DESCRIPTION OF DATA	UNITS	OFFERED BY BIDDER
5.2.1 Grounding System		
Standard for designing grounding system	IEEE-80	
Max. resistance of grounding system to earth at any point		
5.2.2 Grounding Conductor		
Manufacturer		
Material		
Cross-section	(mm^2)	
5.2.3 Grounding Grid		
Manufacturer		
Material		
Cross-section	(mm)	

TENDERER'S STAMP & SIGNATURE

ANNEXURE-3

HSEQ Policy

Energy That Moves Life

CORPORATE HSEQ POLICY				
TITLE				
KE - HSEQ POLICY-001	05	1st December 2014	1 of 1	CORPORATE HSEQ
DOCUMENT NO.	VERSION	DATE OF VERSION	PAGE	ISSUING DEPARTMENT

HSEQ POLICY

We at KE are committed to surpassing the requirements and expectations of our customers, improving our Health, Safety, Environment and Quality performance and minimising the impact of our activities on the environment by:

- Complying with applicable legal and other requirements to which our company subscribes.
- Embedding the Health, Safety, Environment and Quality requirements in our routine and non-routine activities.
- Preventing injuries and ill health to personnel affected by our activities through a proactive system of risk management.
- Conserving natural resources and reducing the carbon footprint of activities by proactively assessing their environmental impact and mitigating their adverse effects.
- Ensuring competency of employees by providing them with adequate training, information, instructions and supervision.
- Communicating with stakeholders to ensure better understanding of our HSEQ policies, standards, programmes and performance.
- Ensuring continual improvement through a system of performance planning, measurement and reviews.

KE employees are at the forefront of this policy; for its successful implementation they shall demonstrate their HSEQ consciousness by practicing their assigned safety roles and responsibilities. The policy shall also reinforce our standards of nurturing and developing our substantial talent pool, building shareholder value through performance excellence & improved financial results and measuring customer satisfaction by providing reliable, safe and cost effective services.

It is my firm belief and a core business value that all accidents and work related ill health is preventable. To achieve this, I shall ensure that timely decisions are taken and resources provided to demonstrate our commitment on implementing our HSEQ vision and strategy.

TAYYAB TAREEN
CHIEF EXECUTIVE OFFICER
Date: 1st December'14

ANNEXURE-4

Contractors and Suppliers HSEQ Management Procedure

1.0 Purpose:

The purpose of this procedure is to describe the process required to be adopted with respect to Health, Safety, Environment and Quality (HSEQ) management during implementation of Contracts and Procurement process for acquisition of goods and/or services. The main objectives are to;

- Define the minimum HSEQ objectives to be met at each stage of a contract.
- Develop a strategy for proactive management of Contractor & Supplier HSEQ.
- Highlight the benefit of effective proactive approaches, particularly prior to tendering and mobilization.
- Describe a planned approach to Management of Contractor and Supplier HSEQ that will ensure a continuing improvement in HSEQ performance for all contractor activities.
- Describe the role and responsibilities of key personnel in contractor and supplier HSEQ management.

2.0 Scope:

This procedure applies to KESC employees, contractors and suppliers.

3.0 Distribution:

All employees at KESC, Contractors and Suppliers.

4.0 Definitions:

Company: Karachi Electric Supply Company.

Contract: A formal business agreement detailing the terms and conditions for the supply of products or the provision of services.

HSEQ Plan: A formal document showing how it is intended to manage the hazards determined. It should be recognized that in many situations, particularly for larger contracts, this HSEQ Plan will effectively form a significant part of the contract.

Contractor: A Supplier holding a Contract with Company for the supply of goods or services.

Contract Sponsor: The department, BU or function that has budget and management authority to execute the Contract.

Contract Manager: The person named in the contract to represent the Contractor in respect of the contract and to be responsible for the management of the contract or supplies.

Contractor Representative: The person appointed in writing by the Contract Manager to supervise the execution of the contract activities or supplies.

Scope of Work: The objective and extent of work to be accomplished by a Contractor or Supplier.

Services: Reflect work done in which people play a prominent role in delivery. A service is an intangible product. Work performed for pay.

5.0 HSEQ Requirements:

5.1 Corporate HSEQ Policy:

- Embedding the Health, Safety, Environment and Quality requirements in our routine and non-routine activities.
- Preventing injuries and ill health to personnel affected by our activities through a proactive system of risk management.
- Improving competence and skill through training and awareness.
- Ensuring continual improvement through a system of performance planning, measurement and reviews.

5.2 ISO 14001:2004 Specifications (Section 4.4.2) - Training Awareness and Competence:

The organization shall ensure that any person(s) performing tasks for it or on its behalf that have the potential to cause a significant environmental impact(s) identified by the organization is (are) competent on the basis of appropriate education, training or experience, and shall retain associated records.

5.3 OHSAS 18001 Specifications (Section 4.4.2) - Training Awareness and Competence:

Personnel shall be competent to perform task that may impact on OH & S in the work place. Competence shall be defined in terms of appropriate education, training and or experience.

6.0 Objectives:

The overall objectives of this procedure are:

- Ensure that contractors / supplier meet or exceed KESC HSEQ standards.

6.1 Adherence to Hazards and Effects Management Process:

All hazards to contractor's personnel, KESC staff, public and to the environment shall be:

- Identified, assessed systematically and eliminated where possible
- Controlled through formal procedures and planning methods
- Covered by contingency plans in place to deal with identified consequences of potential loss of control.

6.2 Mutual HSEQ awareness:

The contractor / supplier and the Contract Sponsor shall be mutually aware of both parties' minimum obligations to manage HSEQ and these obligations shall be within mutually agreed contractual terms.

6.3 Means to monitor the contract HSEQ management:

The means to monitor the contract HSEQ management system (HSEQMS) shall be mutually defined, understood, accepted and agreed by both parties as contractually binding.

6.4 Equal attention to Health, Safety, Environment and Quality:

6.5 Controls in place for hazards and effects management

The controls necessary for the management of hazards and effects shall be in place and working. Where they are not, this shall be speedily remedied or in extreme cases, work should be stopped.

6.6 Ensure clarity between Contract Sponsor and Contractor regarding responsibilities:

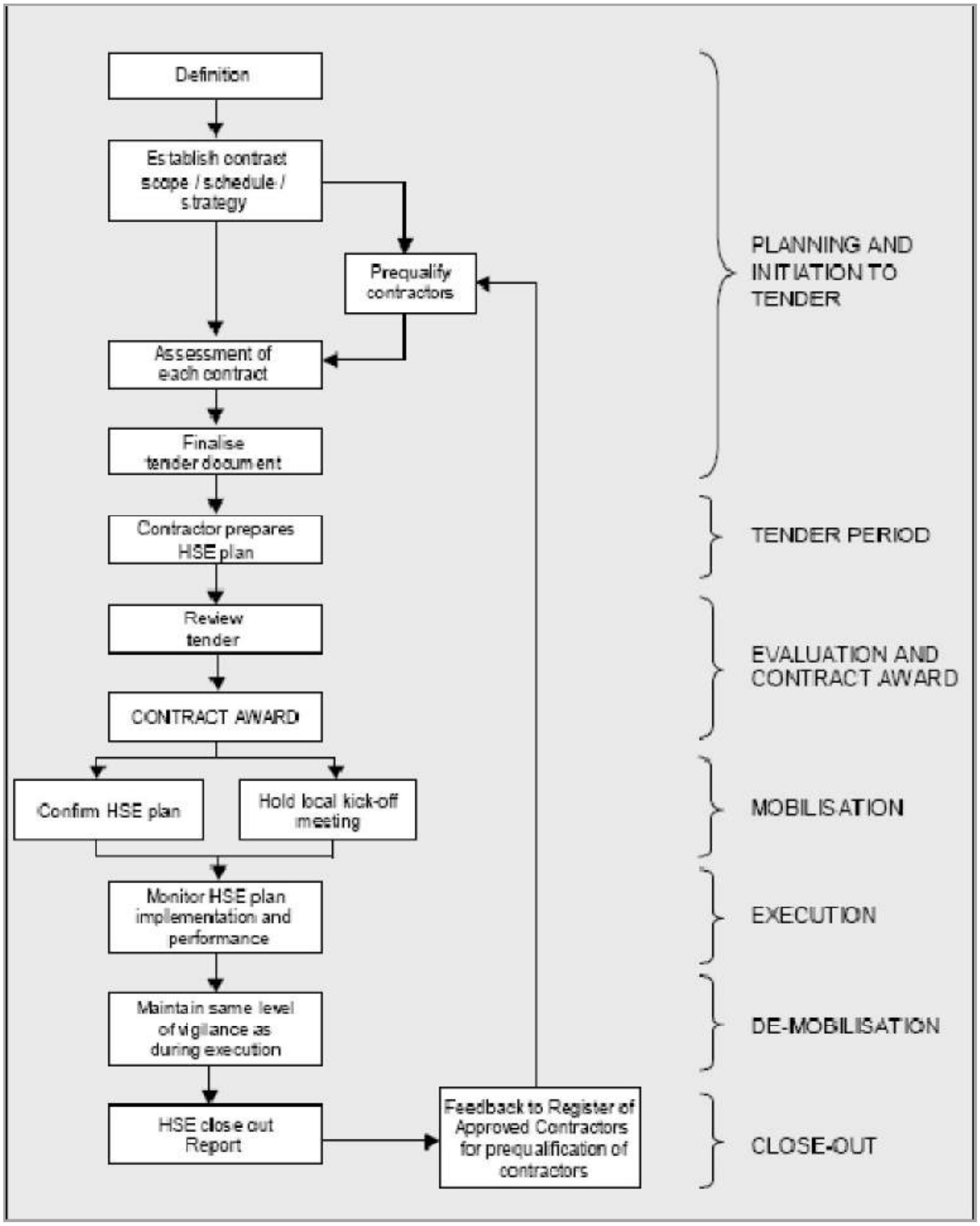
7.0 Procedure:

7.1 Contract Phases and HSEQ Planning:

The influence and inclusion of HSEQ issues in the preparation of tender and contract documents and the subsequent HSEQ management of a contractor shall be described within the context of an identifiable series of phases:

- Planning and invitation to tender.
- Tender period.
- Bid evaluation and contract award.
- Mobilization.
- Execution
- Demobilization
- Close-out.

More details are in the below table



7.2 Pre-Qualification and Tender Process:

Pre-Qualification is a process that shall be conducted preferably in advance of, but may be in parallel with, Tendering, to determine if a Contractor has the capacity to deliver a specific service. In all cases, pre-qualification shall include an HSEQ assessment component.

HSEQ prequalification pack shall include but not be limited to the requirement for potential Tenderers to submit the following:

- Contractor Self Evaluation Form (KESC-SP-022-F01).
- HSEQ policy.
- Contractor HSEQ Management plan.
- HSEQ Organizational structure.
- Details of Contractor HSEQ training and audit systems.
- Overview of the Contractor's recent HSEQ performance.

In addition, any specific HSEQ requirements of the Contractor/Supplier should be defined based on the control measure outcomes of identified in the Risk Evaluation process and included in the Pre-Qualification package.

7.3 HSEQ Tender Package:

The Tender package shall clearly present all HSEQ requirements applicable to the Scope of Work. HSEQ documentation to be included in the HSEQ Tender package and must include but not be limited to the following HSEQ documentation:

- KESC Corporate HSEQ Policy.
- KESC Corporate HSEQ Manual.
- KESC-SP-022 – Contractor / Supplier HSEQ Management Procedure.
- All relevant KESC Corporate HSEQ Procedures (If required by the contractor).

These requirements are mandatory for all Contracts with the Company – irrespective of their jurisdiction. The applicability of all Company HSEQ requirements must be assessed on a case by case basis for each contract.

7.4 Tender Schedule:

A specific HSEQ Tender Schedule shall be prepared that lists all HSEQ related information to be provided by the Tenderer in their submission. It is used as a formal basis for evaluation of the Tender.

The Tender Schedule should require a response to be submitted by the Tenderer for all key HSEQ issues that must be addressed by the Contractor in performing the Scope of Work.

For simple procurement contracts, the HSEQ Tender Schedule may be limited to a request for basic information repeating to the Tenderers internal HSEQ policies and systems. However, for controlled Site based activities, more detailed information shall be requested of the Tenderer including specific responses to HSEQ related issues pertinent to the Scope of Work (e.g. outline of method statements, etc.).

7.5 HSEQ Evaluation of Tender Submissions:

A weighted evaluation of Tenderers final submissions shall be prepared as a basis determining a preferred Tenderer from an HSEQ perspective. The relative weighting assigned to each component of the Tender Schedule shall be based on the risk exposure associated with each aspect of the Scope of Work.

8.0 Contract Award:

8.1 Pre-award HSEQ alignment meeting:

A Pre-Award HSEQ alignment meeting is mandatory for all high risk contracts. The Contract Sponsor shall arrange a pre-award HSEQ alignment meeting with the preferred Tenderer to ensure that the Tenderer is fully cognizant and aligned with all HSEQ requirements applicable to the Scope of Work. Any discrepancies shall be identified at this meeting, if possible resolved, and outcomes minuted by the Contract Sponsor.

8.2 Finalize HSEQ Contract Documentation:

Should any HSEQ amendments to the Tender documentation be necessary as identified in the Pre-Award HSEQ alignment process, these amendments shall be translated into a revision of Contract documentation prior to Contract award.

Any additions, changes or deletions to the standard HSEQ pro-forma clauses shall be approved by the HSEQ and/or Legal functions.

9.0 Contract Pre-Execution:

9.1 Contractor / Supplier HSEQ Plan:

The purpose of the Contractor/Suppliers HSEQ Plan is to define how the Scope of Work shall be implemented by the Contractor/Supplier in accordance with Company (Contractual) HSEQ requirements.

Although a specific Contractors/Suppliers HSEQ Plan shall be required for all Contracts, the content and format of the plan shall be commensurate with the risk associated with executing each aspect of the Scope of Work as determined by risk assessment as well as the necessary control measures.

The Contractors HSEQ Plan shall address any bridging or interfacing requirements necessary to ensure the effective management of HSEQ related issues.

The Plan shall be approved by the Company prior to commencing execution of the Scope of Work.

9.2 Establish Specific HSEQ Systems and Processes:

Specific HSEQ systems and processes shall be established prior to commencing the Scope of Work shall be defined in the HSEQ Plan for the activity and/or the Contractors HSEQ Plan. Following presents a guide to Company expectations regarding HSEQ processes and systems to be established across a range of activities.

The level of inspection and assessment required will be a function of the Scope of Work, work environment and jurisdiction classification of planned activities.

Process	Controlled site activities	Supply/Procurement contract only
Plan	Equipment (Inspections, Checklists, Certifications, Tagging) as per KESC-SP-022-F02	Inspections
	Procedures (Permit systems and certificates)	
	Personnel (Induction, training, certifications)	
Do	Maintain hazard register	
	Inspections	
	Actions register maintenance	
	Contractor coordination meetings	Contractor coordination meetings
	Workforce communications meetings Tool Box Talk	
	Behavioral observation systems	
	Incentive scheme implementation	
	Knowledge sharing initiatives	Knowledge sharing initiatives
Check	Compliance auditing	Compliance auditing
Act	Monthly HSE Reporting	
	Incident and event	

9.3 Complete Pre-Start HSEQ Inspections and Review:

Assessment of key plant, equipment and personnel should be undertaken prior to site mobilization. For example, equipment to be evaluated may include the following:

Fixed and mobile plant (cranes, elevated work platforms, generators, air compressors, etc.). Other specific equipment (scaffolding, ladders, harnesses, rigging, tools, PPE, etc.)

Inspections, audits and third party compliances are mandatory for all activities.

All Personnel working in activities shall have the minimum training, competency and qualifications:

Certificates verifying competency, training and qualifications shall be up to date and made available to upon request.

In addition, short service personnel shall complete a minimum of:

- Site specific HSEQ Induction.

All other personnel shall complete;

- Site specific HSEQ Induction.
- Specific training and competency topics as identified by the site.

10.0 Contract Execution:

10.1 Implement HSEQ Systems and Processes:

The Contract Sponsor and HSEQ Support shall be responsible for monitoring and review of Contractor compliance with all HSEQ requirements defined in the Contract.

A process of continuous review shall be maintained to track HSEQ performance throughout Contract execution. Opportunities for improvement and enhancement of HSEQ systems and processes shall also be identified and implemented. Tools to assist in this process include the following:

- Regular reviews and inspections
- Audit compliance with the HSEQ Plan
- Audit HSEQ performance against the KESC requirements
- Contractor coordination meetings.
- Other feedback mechanisms.

HSEQ performance reviews shall be conducted on a quarterly basis for all high risk contracts.

An HSEQ Action Register shall be established to ensure HSEQ issues are followed up in a timely manner.

10.2 Reporting and Auditing:

Reporting: The Contractor shall be responsible for providing monthly HSEQ performance data to the Company as defined in the Contract and aligned with Company reporting requirements.

Reporting shall be done of the following as minimum;

- HSEQ Incidents / Accidents

- Near-misses
- Tool Box Talk
- Manning Statistics

Auditing: Auditing shall be undertaken by the Contractor, Contract Sponsor and HSEQ as defined in the Contract and the Contractors HSEQ Plan.

A process of corrective action tracking shall be in place in the event that areas of non-compliance are identified. Depending on the Scope of Work, formal audits and audit reporting may also be required.

10.3 Contract Closeout:

After completion, a Contract HSEQ review shall be prepared that provides a formal record and a concise history of the contractor's HSEQ performance and capture learning’s that can be applied to future contracts. The review should derive the majority of its content from factual documentation collected during the duration of the contract and lodged with Supply and Chain for future reference.

11.0 Responsibilities:

11.1 Contract Sponsor:

- Shall be responsible for ensuring that this Procedure is implemented for their assigned contract.
- Shall be responsible to conduct regular audit, inspections in conjunction with Corporate HSEQ Department.
- Shall gather the relevant HSEQ documents from the contractor as mentioned in the procedure or as and when required basis.

11.2 Corporate HSEQ Department:

- Shall assist the contract sponsor to conduct the inspections, audits.
- Shall analyze the HSEQ Data received from the contract sponsor for the continuous improvement in the HSEQ System.
- Shall analyze the contracts / tenders with respect to HSEQ Management System prior to the award of contracts.

11.3 Contractor:

- Shall be responsible to conduct regular internal audit, inspections, tool box talks, etc as per company policy.
- Shall provide the HSEQ Data on regular basis as mentioned in the procedure.
- Shall be responsible to provide the HSEQ Resources (PPEs, SPEs, training) to all staff involved in the activity.

12.0 APPLICABILITY

- All Management and non-management staff – KESC.
- 3rd Party contractual.

13.0 FORMS / DOCUMENTS

KESC-SP-022-F01 ------------------ Contractor Self Evaluation Form.

KESC-SP-022-F02 ------------------ Equipment Inspection Checklist.

10.8.10 AMIR ZAFAR Director-Corporate HSEQ KESC Ltd.

Prepared By;

HSEQ Department

Tabish Gauhar Chief Executive Officer KESC Ltd.

Approved By;

CEO

ANNEXURE-5

Waste Management Plan

WASTE MANAGEMENT PLAN

The purpose of this waste management plan is to assess, and where possible reduce, the amount of waste produced during the construction phase of the Project. This plan will assess how the waste will be dealt with in the most environmentally sustainable way. This plan describes the procedures, methods and techniques to be adopted for disposal of waste (to be generated from camps, offices, vehicles and construction site) during construction phase of the project. It must:

- Identify the types of waste expected to be produced
- Estimate the quantity of each type of waste
- Identify the planned waste management action proposed for each type of waste generated.

Proper management of waste is important because the risk of improper waste handling and disposal to human health and the environment cannot be ignored.

Types of Waste

The expected types of wastes generated in the Project will be:

- Camp sites waste
- Sewage (waste water)
- Workshop waste (vehicles and heavy equipment oil and parts)
- Chemical waste (spent oil from generators and machinery in work, oil, greese, paints)
- Medical waste
- Packing waste
- Debris from construction sites and excavated material

The wastes mention above can also be generalized into following two categories:

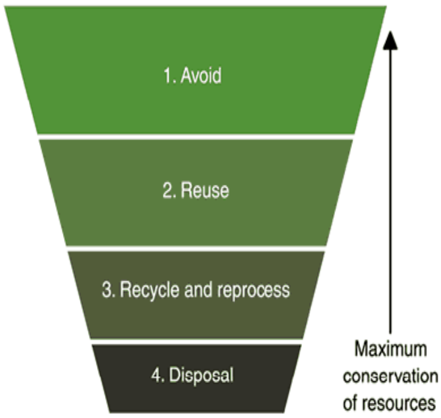
- Biodegradable waste: Mainly organic wastes such as food stuffs, fruit and vegetables, wood grass and other biodegradable items.
- Non-biodegradable waste: It includes polythene bags, excavated material, glass, stone/brick, shoppers, plastic products, process wastes, metal scrap and medical wastes such as used needles, tablets, glass bottles and syringes etc.

Waste Management Plan:

The solid waste management plan for Project is developed to ensure that waste must be dealt with an efficient and environmentally sound manner, starting from collection to disposal. Therefore, waste collection and disposal arrangements will be required separately and independently at camp and working site.

Waste Minimization:

- **Avoid:** Waste avoidance by reducing the quantity of waste being generated. This is the simplest and most cost-effective way to minimize waste. It is the most preferred option in the Waste Management Hierarchy and is therefore ranked first.
- **Reuse:** Reuse occurs when a product is used again for the same or similar use with no reprocessing. Reusing a product more than once in its original form reduces the waste generated and the energy consumed, which would have been required to recycle.



- **Recycle and Reprocess:** Recycle involves the reprocessing waste into in a similar non-waste product consuming less energy than production from raw materials. Recycling spares the environment from further degradation, saves landfill space and resources.
- **Dispose:** Removing wastes from worksites, compounds, offices and dumping in a licensed landfill site or other appropriate authorized disposal facility.

WASTE COLLECTION & SEGREGATION:

The contractor will be responsible for deputing a sanitary staff for daily cleaning and collecting of waste from camp site and placing of waste in the nominated waste bins. It is necessary to sort the waste into various categories. The waste shall be sorted manually or mechanically before applying necessary treatment and disposal arrangement. Waste collection receptacle will have following characteristics:

- Separate receptacles for biodegradable and non-biodegradable wastes (only on sites where non-degradable waste is generated).
- Containment should maintain properly, convenient to handle and environmentally sound.
- Waste bins provided must be suitable for all kinds of wastes generated in project area.
- Distribution of bins will be in way that every person on site can approach without disturbance to work.

WASTE TRANSPORTATION

The waste must be transported from collection points to disposal points in well maintained, designated and covered vehicles. Every transportation vehicle must have fixed routes. Hazardous material must be transported in separate vehicle, should not be mixed with non-hazardous waste.

WASTE TREATMENT

Origin of waste	Description	Treatment/Disposal Method
Camp site waste	Biodegradable: Foodstuffs, fruits and vegetables, wood, Bones, grass etc. Non-Biodegradable: Paper, metals, glass, plastic bottles, shoes, bottles and jars etc	Biodegradables: Dumping on Site (can used for composting process) Non-Biodegradable: Should be disposed off through EPA approved contractor.
Workshop waste Including solid and Fluid	Used oil, ferrous /non ferrous materials, batteries etc.	Handling by the EPA certified recycling Contractor.
Medical Waste	Syringes, glass bottles, bandages, blood sampling tubes, expired drugs, dressing etc.	Sent to EPA approved contractor for incineration.
Excavated and Demolition waste	Rocks, sand, silt/clay, concrete, bricks and other building materials	Almost all excavated, construction and demolition waste is capable of being reused in back filling. The recycled materials should be sold to sub-contractor or vendor.
Excess construction material	Sand, aggregate, cement, bricks, reinforcement steel bars, paints and other construction materials	To be sold back or given to the supplier or other users.

Origin of waste	Description	Treatment/Disposal Method
Hazardous material	Spills of diesel fuel, gasoline, hydraulic fluid, brake fluid, engine oil, lubricants, etc. Spills of generator and vehicle fluids include mobile refueling trucks and construction vehicles and equipment. Vehicle accidents; and natural disasters.	All Containers will be properly labeled and leak proof placed on hard base. Conduct proper maintenance & inspection of vehicle. All machinery found to be a potential source of a future spill and Vehicles with chronic or continuous leaks must be removed from the construction site and repaired before returning to operations. Restrictions will be placed on all equipment refueling, servicing, and maintenance supplies and Activities on working site. A Spill Containment Kit with following provisions will be available on each site (a) Sorbent socks (b) Disposal bags (c) Safety glasses (d) Rubber bags (e) Sorbent pads
Liquid Waste (sewage waste water)	Kitchen, Washing and working site	Septic tanks must be provided for waste water. Waste water to be disposed of after treatment through septic tanks.

TRAINING

All employees, contractors and utility staff working on site will undergo site induction training (which includes environmental due-diligence training) and environmental training in relation to waste management issues. The induction will address:

- This management plan
- Relevant legislation
- Waste minimization
- Waste recognition and recycling
- Available recycling facilities
- Energy and water minimization measures

Records would be kept of all personnel undertaking the site induction and training, including the contents of the training, date and nature of trainers.

Key staff will undertake more comprehensive training relevant to their position and responsibility. This training may be provided as “TOOL BOX” training.

INSPECTION, MONITORING, AUDITING AND REPORTING

Inspections and Monitoring

Regular monitoring will be undertaken to track waste management on site. This will be through a series of formal and informal inspections at regular interval.

Activity	Resources	Responsibility	Frequency
Site Inspection	Site Diary	Contractor	Daily
Environmental Inspection	Environmental site checklist	Contractor	Weekly
Waste removal activities off site	Monthly register for waste materials	Contractor	Monthly

Auditing

Audits both (internal and external) would be undertaken to assess the effectiveness of environmental control and compliance with this plan and EPA guidelines. Any audit of this plan will be part of an overall audit of project activity.

Reporting

Quarterly report will be produced by the contractor through EPA certified firm.