# EASTERN AFRICA POWER POOL

**TANZANIA-ZAMBIA TRANSMISSION INTERCONNECTOR PROJECT (P163752)**

**TECHNICAL ASSISTANCE TO THE EAPP, GRANT NUMBER: D350**

## TERMS OF REFERENCE

## FOR

# CONSULTANCY SERVICES FOR THE FEASIBILITY STUDY UPDATE FOR 400kV TANZANIA (NYAKANAZI) – UGANDA (MASAKA) TRANSMISSION LINE

**REF. NO.: ET-EAPP-165640-CS-QCBS**

**EASTERN AFRICA POWER POOL**
**HOUSE 059, WEREDA 02, BOLE SUB CITY**
**P.O BOX 100644**
**ADDIS-ABABA, ETHIOPIA**

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**Acronyms**

| | |
|---|---|
| AAAC | All Aluminum Alloy Conductor |
| ACSR | Aluminum Conductor Steel Reinforced |
| AFD | "Agence Francaise de Developpement" equivalent to French Development Agency; |
| AfDB | African Development Bank |
| EAC | East African Community |
| EAPP | Eastern Africa Power Pool |
| ESIA | Environmental and Social Impact Assessment |
| ESMP | Environmental and Social Management Plan |
| ERA | Electricity Regulatory Authority, Kampala, http://www.era.or.ug/ |
| GoT | Government of Tanzania |
| GoU | Government of Uganda |
| GWh | Gigawatt hour |
| HEP | Hydro Electric Plant |
| IFI | International Finance Organizations |
| IPP | Independent Power Producer |
| km | Kilometer |
| kV | Kilovolt |
| kW | Kilo Watt |
| kWh | Kilowatt-hour |
| LV | Low Voltage |
| Mio | Million |
| MV | Medium Voltage |
| MW | Mega Watt |
| NBI | Nile Basin Initiative |
| NEL | Nile Equatorial Lakes |
| NELSAP | Nile Equatorial Lakes Subsidiary Action Program |
| NEMA | National Environment Management Authority, Uganda http://www.nemaug.org/index.php |

| | |
|---|---|
| OHL | Overhead Line |
| OPGW | Optical Ground Wire |
| PAP | Project Affected People |
| PEA | Project Executing Agency |
| PPA | Power Purchase Agreement |
| (A)RAP | (Abbreviated) Resettlement Action Plan |
| RFT | Request for Tender |
| REA | Rural Electrification Agency, (Tanzania and Uganda)<br>http://www.rea.go.tz/<br>http://www.rea.or.ug/ |
| RoW | Right of Way |
| S/S | Substation |
| SAPP | Southern African Power Pool |
| UETCL | Uganda Electricity Transmission Company Limited |
| TANESCO | Tanzania Electric Supply Company Ltd. |
| T/L | transmission lines |
| ToR | Terms of Reference |

# Terms of Reference (TOR)

## 1.0 BACKGROUND

The Governments of the East Africa Community (EAC) Member States agreed to interconnect their power systems by constructing a high voltage transmission line system. The main objectives of the project are to: (i) enhance electricity trade; (ii) improve security and reliability of electricity supply; (iii) foster economic development and regional integration.

Previously, a number of technical feasibility studies, environmental and social studies were undertaken on the national, regional and sub-regional level and the voltage levels considered and recommended included 220kV, 330kV and 400kV. Most recently, the bulk-transmission line Interconnectors, such as Zambia-Tanzania-Kenya (ZTK)- interconnector, are being considered at 400kV double circuit.

Traditionally, countries in the region have planned and implemented their power systems in an isolated manner with a view to satisfy their national demand growth. Bilateral power exchange agreements exist between some countries in the region including Uganda and Tanzania. Currently, there is cross border electrification between Uganda and Tanzania via a 132kV transmission line from Uganda to Kagera region in Tanzania.

Over the last decade considerable efforts have been undertaken to allocate a stronger importance to power trade among East African countries. The EAC Master Plan (2003, ACRES), EAPP Masterplan of 2011 (SNC Lavalin) (update concluded in 2014), NELSAP power trade studies considered power trade among member countries. The overall objective of the studies was to determine whether further interconnection of the power systems of Uganda, Kenya, Tanzania and the Great Lake Countries is technically feasible and economically viable as growth in electricity demand has occurred since the early 2000 which is expected to last over the next 20 years.

One of the priority projects has been the transmission interconnection between Uganda and Tanzania along the Lake Victoria. Hydropower potential in that area (i.e. 80MW Rusumo Falls, 87MW Kakono HPP, 35MW Nsongezi HPP, 14MW Kikagati HPP) as well as low access to power services by the population have underscored the interest for such power transmission facilities which would also cover power distribution services.

Uganda and Tanzania are currently implementing various programmes to increase their generation resources and transmission networks. Following the recent discovery of gas reserves in Tanzania, the country is at various stages of implementing about 3305MW from various sources up to year 2025. Uganda is currently implementing up to about 2,750MW of hydro based generation by 2035. In addition, potential sites for power generation in the region will open up opportunities for power trade between the two countries and other neighboring countries in the region. Therefore, the need for an interconnector between the two countries is of paramount importance in sharing the produced electricity.

## 2.0 THE PROPOSED STUDY

The aim of the proposed study is to support the development of the East African interconnected power transmission grid for increased regional power trade and improved supply reliability and affordability.

The study is expected to last for 12 calendar months.

### Objectives

The objectives of the study are to:

(i) Carry out a technical feasibility and economic viability of the proposed Uganda-Tanzania Interconnector Project (UTIP) in the context of the existing and expected future power system

development in both Uganda and Tanzania and potential to enable power trade between the East Africa Power Pool (EAPP) and the Southern Africa Power Pool (SAPP) .

(ii) Assess and recommend appropriate organizational, institutional, commercial, and operational frameworks for the financing, construction, ownership, and operation of the interconnection;

The leading Project Executing Agency (PEA) will be Eastern Africa Power Pool (EAPP) as ‘’Project Coordinator’’. The supervision of the implementation of the feasibility study shall be carried out in collaboration with the beneficiary partner power utilities in Tanzania (TANESCO) and Uganda (UETCL).

## 3.0 THE TECHNICAL FEASIBILIITY STUDY

The Consultant will carry out the Feasibility Study for the proposed UTIP taking into consideration the opportunities for power trade between the two countries and reflecting the trade options within the broader region of the EAPP and SAPP.

The Consultant shall identify and examine various line routing alternatives and technical options of interest (e.g.; voltage levels; technical configurations; interconnection points etc.), taking into account future developments of the power systems in Uganda, Tanzania and neighboring countries, the role of the interconnector in supporting electrification initiatives in both countries (Uganda and Tanzania), the potential environmental and social impacts, and other relevant factors. As required, the Consultant shall identify and include any strengthening of the transmission infrastructure in Uganda and Tanzania needed to integrate the interconnector in the respective power systems and to operate the two systems synchronously, with adequate security, reliability, and efficiency.

The Consultant shall then select the most appropriate technical solution, assess the technical, economic, and financial feasibility and prepare technical specifications, conceptual designs and tender documents for the interconnector. Separate bid documents will be prepared for the Ugandan and Tanzanian sections of the interconnector.

Finally, the Consultant shall assess and recommend organizational, operational, institutional, and commercial frameworks for the financing, construction, and operation of the interconnection.

This assignment shall be undertaken in a two-phase approach:

- First phase: Undertake the full feasibility study including demand forecast, line route selection, voltage selection, network update and analysis, financial and economic analysis, recommendation for appropriate organizational, institutional, commercial, and operational frameworks for the financing, construction, ownership, and operation of the interconnector
- Second phase: Preparation of separate tender documents for the Tanzania and Uganda sections of the line including technical specifications, conceptual design and bill of quantities (BoQ).

The main sub-tasks are summarized in the following sections.

## 3.1 DATA COLLECTION AND REVIEW

The Consultant shall visit the two countries for the purposes of collecting all previous study reports for reference pertaining to the project and data on existing facilities, unit costs, power demand and power system expansion plans.

The Consultant shall review the data and studies collected, identify any inconsistencies and gaps, and perform the necessary additional analyses to deal with these inconsistencies and gaps.

As required, the Consultant shall establish reasonable assumptions for data gaps that cannot be provided by the counterparts (, e.g. the cost for un-served energy and applicable discount rate).

## 3.2 GENERATION AND TRANSMISSION EXPANSION PLANS AND SUPPLY-DEMAND ANALYSIS FOR UGANDA AND TANZANIA

The Study shall review the available: (a) long-term load forecast; (b) generation expansion plan; and (c) transmission expansion plan for Uganda and Tanzania. The Consultant should use its best technical judgment to fill any gaps in the existing expansion plans, if and as needed, to match the Planning Horizon for the study. The Study should establish the ability of both power systems to export and import electricity and provide wheeling through the proposed interconnector for regional trade over the Planning Horizon twenty (20) years in steps of five (5) years, taking into account domestic demand, export and import opportunities and existing commitments to other countries. The consultant shall also conduct its assessments for Uganda and Tanzania in the context of the EAPP developments (EAPP Master Plan) over the Planning Horizon.

## 3.3 SELECTION OF INTERCONNECTOR

### (a) Identification of interconnection options

The Consultant will identify and analyze interconnection options for the proposed UTIP with respect to terminal substations and general routing of the line, technology, voltage levels, configurations (single or double circuit), and operating requirements and options (e.g., consider operating the line at lower voltage than designed for some period). The analysis should narrow down the options to be further examined and optimized for their suitability through network analysis and cost optimization. The Consultant will set the design criteria acceptable to both countries, taking into account technical standards being discussed at EAPP level. These options should also serve the purpose of project alternatives in the high-level assessment of environmental and social impacts[1].

### (b) Network Analysis

The Consultant will undertake network analysis and optimization studies (load-flow analysis, contingency analysis including Net Transfer Capacity calculations, short circuit analysis, and stability analysis) for the identified interconnection options as needed in order to confirm technical feasibility and select the best scheme from a technical and economic point of view as well as from a preliminary environmental and social (E&S) standpoint. Sensitivity analysis of selection of best scheme will be performed for various scenario as agreed upon with both Utilities (UETCL & TANESCO).

The Consultant shall carry out a detailed system study for the selected scheme. Analyses shall be carried out for the Ugandan and Tanzanian power systems at the year of interconnection in order to check the performance of the two systems and identify any strengthening of the internal transmission systems that may be needed to accommodate the interconnection. Such investments, to the extent that they are needed exclusively for the reason of the interconnection, should be included in the costs of the interconnector.

The analysis of the interconnected system shall then be carried out at every five-year interval over the Planning Horizon, for the peak and low-load conditions. The system studies will include:

- **Load Flow Analysis:** Load flow studies shall be performed in order to determine the performance of the interconnected systems and determine the feasibility of operating conditions of the interconnector and the interconnected systems.

[1] Separate detailed environmental and social impact assessments will be undertaken within other consultancies in parallel with this assignment.

- **Contingency Analysis:** This analysis should examine the operation of the interconnector under the various contingency situation (outages of the various relevant elements of the interconnected systems). Net Transfer Capacity Calculations shall be performed to determine the maximum power that can be exchanged on the interconnector without violating the N-1 contingency requirements in either systems.
- **Short Circuit Analysis:** Short circuits analysis shall be carried out to assist with design of an appropriate protection system (including circuit breakers and other elements) for the interconnected system.
- **Switching Surges Study**: Energization procedure and switching surges along the new interconnection lines shall be studied to determine the appropriate equipment to control the surges.
- **Stability Analysis:** Stability analysis shall be performed that covers the static, dynamic, and transient stability (including voltage stability and system frequency control and stability) in order to determine the mitigation measures to ensure system stability under various operating conditions and contingency events.

**(c) Design of the Interconnector**

The Consultant will use the network analysis to determine the final choice for the interconnector and its technical design, including the terminal substations (and in-between substations, if any), the approximate routing of the transmission line, the associated systems for reactive power compensation and voltage control, system frequency control, system stability, etc. Importantly, as mentioned above, the network analysis should also identify any strengthening investments needed in the Ugandan and Tanzanian power systems to accommodate the interconnector. The Study should determine the technical and functional power transfer limits of the interconnector. The design of the interconnector and all associated infrastructure and systems (including those detailed in the subsequent sections below) should be given with sufficient details to prepare technical specifications for tender documents for contracting the work.

**(d) Route Selection**

The Consultant shall assess the line route options and recommend optimum line route selection between the interconnector's terminal points, based on technical, economic and financial analyses and the preliminary environmental and social impact considerations.

Transmission line sections of particular interest are:

| S/Nn | Transmission line sections | Approx. Line length in km |
|---|---|---|
| 1.0 | Section Masaka – Kyaka | |
| 1.1 | Masaka - Mutukula, Uganda | 82 |
| 1.2 | Mutukula – Kyaka, Tanzania | 19 |
| 2.0 | Section Kyaka – Nyakanazi | |
| 2.1 | Kyaka – Nyakanazi | Aprox. 240 |

**(e) Geotechnical investigations**

Once the optimal transmission line route alignment has been determined, the Consultant shall carry out geotechnical investigations of angle points so as (i) to determine soil features relating to their

capacity of serving as the foundation for line towers and (ii) to assess the stability of the towers. Geotechnical investigations at the substation sites shall be included as appropriate. Existing information where available shall be used (Nyakanazi – Kyaka - Masaka). The Consultant will collect all the geotechnical information necessary for the construction of the transmission line and substations.

**(f) Grid Code/Operational Rules**

The Consultant will examine the applicable Grid Codes and system operating rules in Uganda and Tanzania to ensure their compatibility in operating the interconnection. The Consultant should take into account the EAPP Interconnection Codes, which will be made available to the Consultant by EAPP. Should the Grid Codes of Uganda and Tanzania require some improvements, the Consultant will propose the needed changes.

**(g) Protection, control, and communications**

The Study should determine requirements for system protection, operational control and communications needed to operate the interconnector.

**(h) Cost Estimates**

The Consultant shall prepare detailed cost estimates for the interconnector and all associated investments to accommodate the interconnector. Cost estimates should be presented separately for investments within Uganda and Tanzania and organized by the technical subsystems (substation works and associated protection, control and communication equipment and transmission line works). The cost estimates should be further disaggregated into the cost of goods, equipment and materials (and components of each category), and construction costs. Physical contingency, price contingency, and applicable taxes and duties in each country should also be presented. The Study should estimate the engineering, project management & implementation, operation and maintenance costs.

**(i) Benefits**

The study will identify and quantify, wherever possible, the benefits expected to accrue due to the proposed interconnector project, such as: reduced cost of supply and losses, increased export revenues, improved reliability, reduced investment requirements in generation, reduced carbon emission, and others.

**(j) Economic and Financial Evaluation**

The Consultant shall carry out the economic and financial evaluation of the project and calculate the economic and financial internal rate of return (EIRR and FIRR) and the Net Present Value (NPV). The Economic and Financial Evaluation shall include the both costs and benefits related to social and environment aspects of the proposed projects including line route acquisition costs and the associated management actions. Sensitivity analysis will be performed for various scenarios as will be agreed on with the Utilities including but not limited to the following:

- with and without the interconnector;
- delayed implementation; and
- discount rates.

**(k) Climate Risk Assessment**

The Consultant shall conduct a desktop assessment of historical and projected extreme weather events and weather conditions and anticipated impact of climate change in the proposed project areas. Detailed tasks include:

a. Identification of weather and climate change parameters to be assessed and the modeling scale (temporal and spatial) to be used in the risk assessment of the project infrastructure (transmission line and associated substations).
b. Surveying existing data on climate change projections and local historical climate trends (focusing on the weather and climate change parameters identified for the assessment). For historical climate data, the consultant should explore ground climate and hydrology data from national weather stations through local hydrological and meteorological ('hydromet') agencies and remote sensing information from Copernicus and EO4SD CR Platform, which generally provide high-resolution observational data.
c. Developing a summary list of original data sources surveyed, noting the reliability of existing climate change projections based on the underlying models' ability to represent past/present climate conditions. The Consultant should identify any need for further climate data and modeling where there is a gap.
d. Identification of probabilities of occurrence of specific climate changes taking place, and of assumptions and limitations in terms of the use of the projections for influencing project design.

**(l) Site Assessment and Project Vulnerability Analysis**

Based on the climate risk assessment and field visit of vulnerable areas that could impact project (within or outside project boundary), identify the project's vulnerability to climate changes and trends. Detailed tasks include:

e. Conducting site assessment of high-risk project areas identified to collect environmental data, including land cover/vegetation, topography/slopes, high-temperature areas, landslide hazard areas, and flood zones. The area for the site assessment will be determined based on risk levels and potential impact to the project.
f. Preparation of climate risk map of project site based on climate and environmental data, including geological hazards, high-temperature areas, precipitation distribution, and flood risk; and identification of areas with high climate risks. If applicable and available, overlay environmental data, such as land cover/vegetation and topography/slopes (verified by site assessment) on the climate risk map.
g. Conducting a climate impact assessment for the project and outlining key vulnerabilities of the planned infrastructure based on the relevant climate risks identified.
h. Preparation of a draft assessment report containing a summary of key observable climate and environmental vulnerabilities and sensitivities of the planned infrastructure.

**(m) Identification of Climate Resilience Measures**

The Consultant shall synthesize the results from climate risk and project vulnerability assessments and identify and prioritize adaptation and resilience measures to be reflected in the project design, technical specifications, and maintenance and operation guidelines of project infrastructure

**(n) Project risks**

The Consultant shall identify, classify, assess, and rate the risks involved in the development and operation of the proposed interconnector project and discuss and advise on risk minimization and mitigation measures and risk allocation among the various parties involved in project development, financing, and operations. The analysis of risks should be comprehensive and cover the following risk categories (the list is not meant to be exhaustive): political, macroeconomic, sectoral strategies and policies, market (domestic and regional), institutional (including institutional capacity), project financing,

regulatory, commercial, environmental and social (including acquisition of right-of-way), technical, construction, and operations and maintenance.

**(o) Options for project financing and organizational, institutional, commercial, and operational frameworks**

The Consultant will recommend appropriate organizational, institutional, commercial, and operational frameworks for financing, construction, operation, and maintenance of the interconnection at various levels (intergovernmental; inter-utility; the regional (EAPP) policy, regulatory, and commercial frameworks, etc.). The Consultant should reflect the policies of Uganda and Tanzania related to energy security, investments, development of domestic and regional markets and trading models, technical power system requirements, and take into account international and regional experience on cross-border electricity infrastructure and trading. The Study should cover the issues such as risk mitigation, dispute resolution, and maintenance planning, operational notices, etc. The Study should advise on the appropriate regulatory models for covering the capital and operating costs of the interconnector project.

**(p) Project Implementation Arrangements**

The Consultant will recommend appropriate procurement strategy and institutional organization, including staffing and outside assistance (owner's engineer, project management specialists, etc.) for implementing the interconnector project.

**(q) Capacity Building Program**

The Consultant will recommend appropriate capacity building program/knowledge transfer activities to equip the two utilities to construct, manage, operate and maintain the interconnection appropriately.

**(r) Training and knowledge transfer**

The Consultant shall provide training to UETCL, TANESCO and EAPP on conducting feasibility studies, conceptual designs, and tender documents preparation of transmission line projects. The training will be for at least six staff (2 minimum from each institution). The Consultant will be responsible for the preparation and supply of the relevant presentations and other training materials.

**(s) Workshops**

The Consultant will conduct workshops organized around the main deliverables of the Feasibility Study. The workshops will be attended by representatives of the EAPP, TANESCO, UETCL, the project financier/s and relevant stakeholders from Tanzania and Uganda. The workshop shall be planned and facilitated by the Consultant and the Consultant's related costs should be reflected in their financial proposal. The EAPP shall be responsible for organizing the workshop venues (conference room package), any cost of participants, audio-visual and other related services for the workshops.

The workshops will be held either in Tanzania, Uganda or Ethiopia and tentative number of participants from TANESCO, UETCL, EAPP and other stakeholders will be as follows:

| Workshop | Number of days | Expected number of participants |
|---|---|---|
| Workshop 1: Inception Workshop | 1 | 9 |

| Workshop | Number of days | Expected number of participants |
|---|---|---|
| Workshop 2: Interim Report | 2 | 15 |
| Workshop 3: Draft Feasibility Study and Draft Tender documents | 2 | 15 |
| Workshop 4: Final Feasibility Study and Final Tender documents | 2 | 15 |

**(t) Preparation of project conceptual designs, specifications and tender documents.**

Based on the findings and recommendations from the feasibility study, the Consultant will:

- Prepare all the necessary Technical Specifications and Conceptual Designs for the proposed transmission line interconnector; and
- Prepare two separate sets of Tender Documents for Uganda (UETCL) and Tanzania (TANESCO) sections of the transmission interconnector using an agreed format of standard bidding documents for plant, design, supply, and installation.

## 4.0 RESPONSIBILITIES OF THE CONSULTANT.

The Consultant shall provide all the input in terms of staff, facilities and support from the main office in relation with the Project whether explicitly mentioned in the present document or not, in order to ensure successful accomplishment of the assignment.

## 5.0 CONTRIBUTION BY THE EAPP AND BENEFICIARY UTILITIES

TANESCO and UETCL will provide information, data, reports and maps as far as available and will assist the Consultant in obtaining any other relevant information and materials from Governmental Institutions and State Authorities as far as possible. Both entities shall furnish studies such as the Energy Sector Master Plan which focuses on power generation, transmission expansion as well as other available system studies.

EAPP and the beneficiary utilities will make available existing reports to the Consultant including but not limited to the following:

- Feasibility Study for Masaka-Mwanza 220kV Transmission Line (2011, SWECO).
- 400kV Nyakanazi - Kyaka pre-feasibility study (2015, USAID).

## 6.0 REPORTS AND OTHER DELIVERABLES

The Consultant will prepare the following reports/documents under the proposed assignment:

| Type of Report | Narrative description | Expected Date from Contract Start(M) |
|---|---|---|
| 1. Draft Inception Report | The Inception Report shall include: (i) review the tasks to be carried out and the associated methodologies, and agree with the client on any modifications and additions that may be require; (ii) prepare a scoping exercise for each task, that will provide the basis for the scope of the analytical work and detailed work plan; (iii) set out detailed work plan indicating schedules, data and other inputs required to complete the tasks, describe methodology for carrying out the various technical analyses and tasks, define the study implementation schedule by task, and assign the key personnel to each task. The proposed project schedule shall be broken down by tasks and sub-tasks and presented in Gantt chart form. | M+1 |
| 2. Draft Interim Report | It shall describe the findings of the Demand Forecast, the Network Analysis, Technical conceptual design report for transmission lines &substations and a Line Route Selection Report (incl. preliminary environmental and social impacts). The draft interim report shall be submitted 5 months after the commencement of the study followed by a review workshop and submission of the final interim report 6 months after commencement. | M+5 |
| 3. Draft Feasibility Study and draft tender documents | The draft feasibility study shall be in compliance with good engineering and utility standards. The report will consider the remarks and proposals on all investigated aspects with conclusion and suggestions concerning the reviewed material and the proposed purpose of the study. Cost estimates, financial and economic analysis, geotechnical investigation results shall be included in the report. The report will also include the recommendation for appropriate organization, institutional, commercial, and operational frameworks for the financing, construction, ownership, and operation of the interconnection. | M+9 |
| 4. Final Feasibility Study and Final Tender | The Final Feasibility Study and Final Documents will incorporate all comments of the draft versions. | M+12 |

The consultant shall submit three hard copies and soft copies (preferably in USBs) of the final report/tender document to each of the study lead institutions (EAPP, UETCL and TANESCO). Additionally, the consultant shall make available to the Client all power system models used for their analysis.

In addition to the above, the Consultant shall note following requirements regarding documentation.

| | |
|---|---|
| Network analysis | System models shall be in PSSE |
| Drawings | Shall be in editable format – AUTO CAD |
| Transmission line design | Shall be in PLS CAD and compatible with GIS |

## 7.0 KEY EXPERTS FOR THE STUDY

The Consultant should have adequate experience with similar international projects in developing countries, with at least three contracts of similar nature, scope, and scale successfully completed during the last five years. The consultant shall have experience in Sub-Saharan Africa region. The Consultant should be financially sound and demonstrate profitability during the most recent three financial years.

The Consultant's team shall have the following key expertise and experience to cover the scope of the Study with requisite competence. All team members should have good proficiency in English, both verbal and written and shall only provide CVs of the lead expert for each of the highlighted key expert positions. The key areas to be covered by the team specialists and team members should have the following qualifications:

- **Project Manager**: The Project Manager should have a professional degree (MSc or higher) in a field directly relevant to the Study – electrical or electro-mechanical engineering -- with at least 15 years of experience, of which at least 10 years in power and transmission system planning/transmission system design and project management. The Project Manager should present evidence on having successfully managed at least 5 (five) projects of similar nature during the last 10 years. -The Project Manager shall have managed a similar assignment in the Sub-Saharan Africa Region.

- **Power System Transmission Planning and Analysis**: BSc. or higher degree in electrical; with at least 10 years of experience in high-voltage power transmission system planning and analysis, with systems comparable to (or larger than) the combined Uganda and Tanzania power system approx. 2000MW demand and up-to 400kV voltage system.

- **SCADA (System Control and Data Acquisition) and Power System Operations:** BSc or higher degree in electrical engineering; with at least 10 years of experience in SCADA for high-voltage power systems.

- **High Voltage Transmission Line Design Engineer: BSc. or higher degree in** electrical engineering; with at least 10 years of experience in high-voltage (220-kV or higher) transmission line electri**cal design.**

- **Transmission lines civil engineering: BS**c or higher degree in civil engineering; with at least 10 years of experience in high-voltage transmission line civil engineering design.

- **High Voltage Substation Design Engineer:** BSc or higher degree in electrical engineering; wit at least 10 years of experience in high-voltage substation electrical design.

- **Surveyor:** BSc or higher degeree in Surveying or Civil Engineering with a minimum ten (10) years of relevant working experience in HV transmission lines survey.

- **Financial and Economic Analyst:** BSc or higher degree in economics or finance; with at least10 years of experience in economic and financial analysis of power sector investment projects, including substantial experience with high-voltage transmission projects.
- **Geotechnical Engineer:** BSc or higher degree in geotechnical/civil engineering; with at least 10 years of experience related to high-voltage transmission lines and substations.

**Other staffing resources**: The Consultant needs to ensure that the team has the expertise not explicitly covered in the above list but needed for successful completion of the Study.

The Consultant may cover more than one area of expertise through a single specialist or assign more than one specialist to cover the areas listed. The Consultant is free to propose a composition of the team that best fits its expert's pool. The Consultant should demonstrate use of local expertise in their personnel assignment.

The Consultant will indicate in its proposal a list of key members, expertise covered, time resource allocated for the execution of the project. The consultant should clearly indicate the man-months to be spent on activities in Uganda, Tanzania, Ethiopia (if applicable) and home office.

**Registration with Engineers Boards:** The Consultant should be aware that, there is a requirement that foreign engineers should register with the respective Engineers Registration Boards.

## 8.0 CONTRACT

**Type of Contract shall be "The Lump Sum Fee Plus Reimbursable Expenses".** The Consultant's total remuneration shall not exceed the Contract Price and shall consist of (i) a fixed lump sum fee including all Consultant's Personnel costs; plus (ii) reimbursable expenses actually and reasonably incurred by the Consultant and/or its Personnel, in the performance of the Services.

## 9.0 PAYMENT SCHEDULE

The indicative payment schedule is as follows:

- 10% of contract price as advance payment against an acceptable bank guarantee;
- 20% of contract price upon submission and acceptance of the Interim Report;
- 20 % of contract price upon submission and acceptance of the Draft Final Feasibility;
- 20 % of contract price upon submission and acceptance of the Draft Tender Documents;
- 15% of contract price upon submission and acceptance of the Final Feasibility Report; and
- 15% of contract price upon submission and acceptance of the Tender Documents.

## 10.0 ANNEX

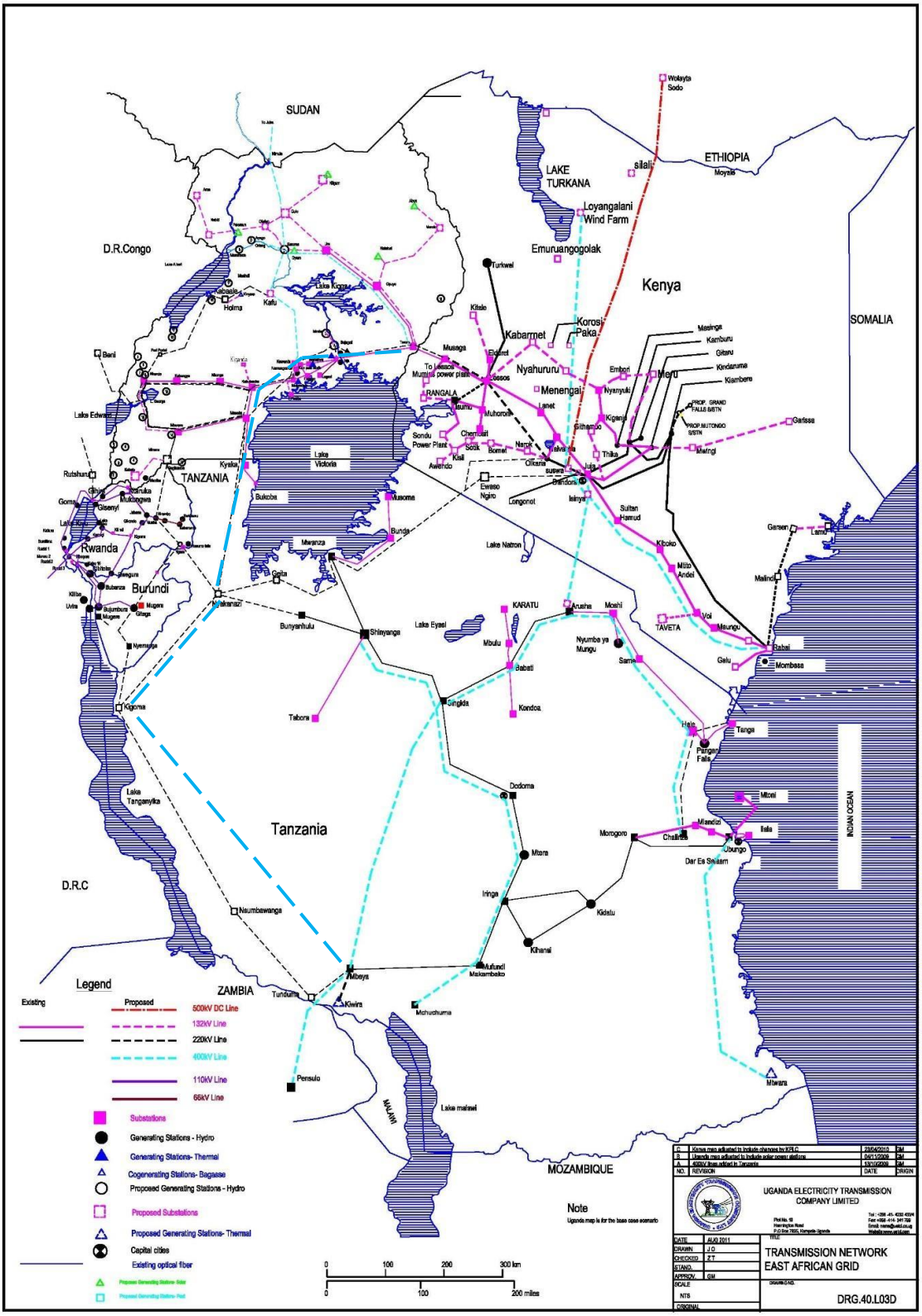
### 10.1 Power Map of the sub-region

### 10.2 TANESCO Power grid map 2044

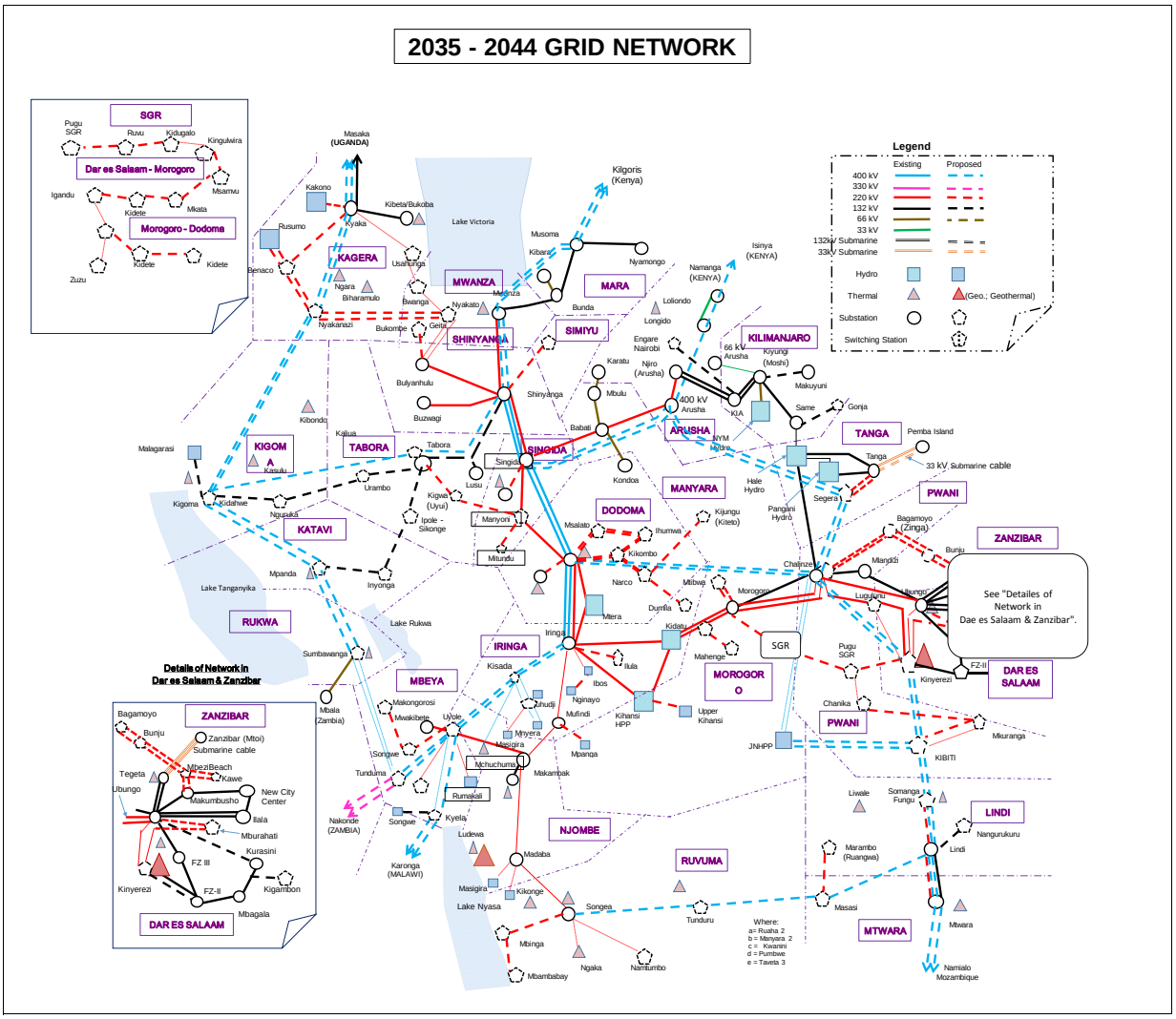
### 10.3 UETCL Grid Map 2040

### 10.4 Coordinates of Location of Nyakanazi S/S, Kyaka S/S and Masaka S/S,

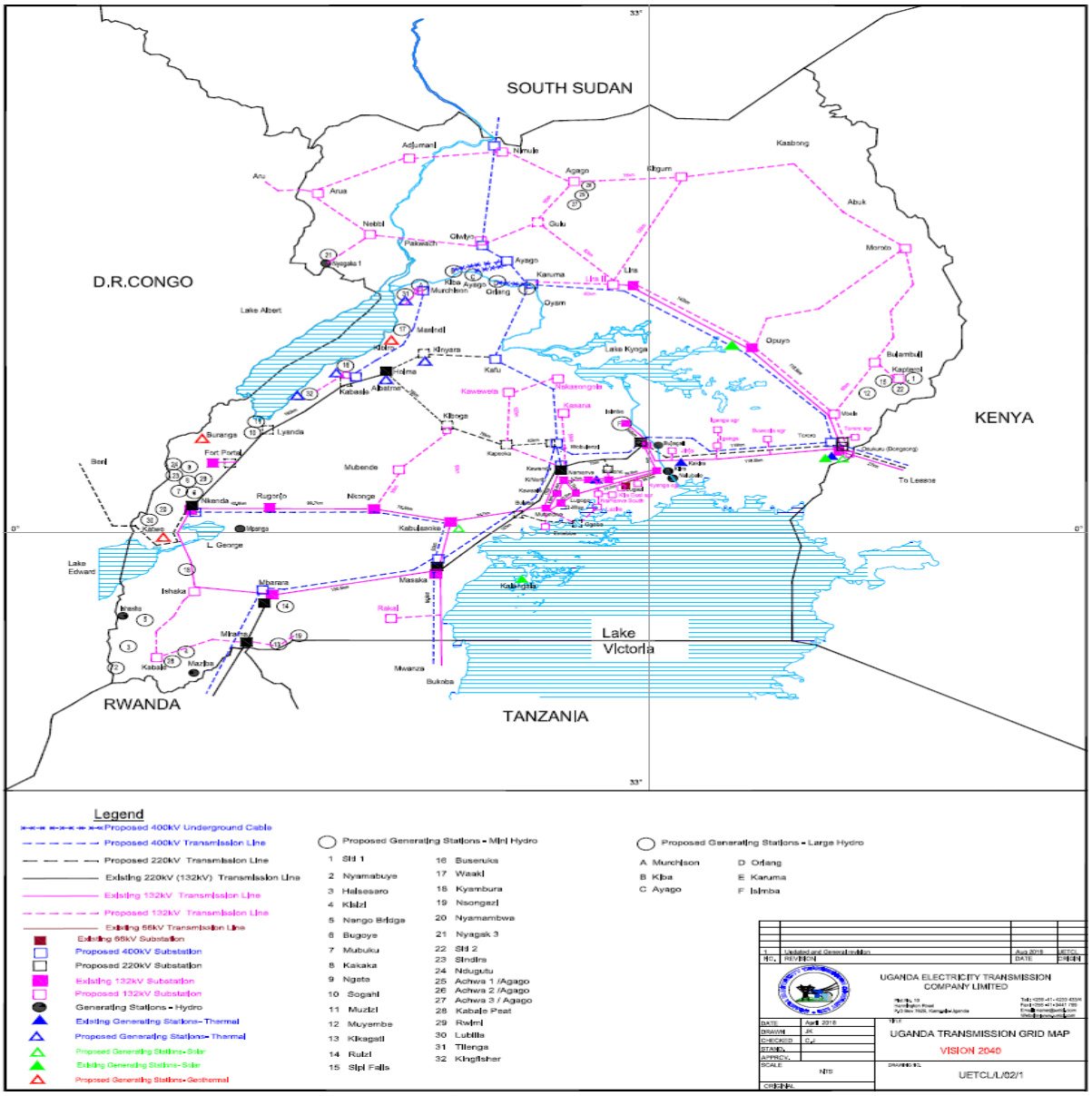
## 10.1 Power Map of the sub-region



## 10.2 TANESCO Power Grid Map 2044



## 10.3 UETCL Grid Map 2040



## 10.4 Coordinates of Locations of Nyakanazi S/S, Kyaka S/S and Masaka S/S

### 10.4.1 Location of Nyakanazi Sub-station Site

The new substation coordinates of the plot corners as pegged on site by TANESCO by concrete and wooden markers are.

| Name | Zone | Datum WGS84 | | Alt(m) |
|---|---|---|---|---|
| | | Easting | Northing | |
| 070NYA1 | 36M | 301224 | 9669380 | 1308.9 |
| 070NYA2 | 36M | 301478 | 9669063 | 1308.9 |
| 070NYA3 | 36M | 301798 | 9669320 | 1308.9 |
| 070NYA4 | 36M | 301537 | 9669621 | 1308.9 |

The size of the plot is 400 x 400 m.

The substation site has been selected taking into account:

- Good access from the road Nyakanazi - Biharamuro
- Flood protected
- Not too far from the town
- Quite flat topography with a sloping terrain in direction South – North

### 10.4.2 Location of Kyaka Sub-station Site

Kyaka substation will constitute an extension to the existing substation. The co-ordinates of the substation are as detailed as follows:

| Substation Easting (m E) | Northing (m S) |
|---|---|
| 323413 | 9861462 |

### 10.4.3 Location of Masaka Sub-station Site

| | Masaka SS | |
|---|---|---|
| Points | Eastings | Nothings |
| 1 | 353479.9 | 9964042.93 |
| 2 | 353694.35 | 9964041.75 |
| 3 | 353685.89 | 9963850.87 |
| 4 | 353556.47 | 9963852.05 |
| 5 | 353556.47 | 9963934.55 |
| 6 | 353483.58 | 9963932.29 |
| | | |
| UTM | Arc 1960 | |