ENA

Electric Networks of Armenia (ENA)

Expression of Interest for
for Demand Forecast and Integrated Distribution System Planning Consulting Services

TR-DF-DP-01

Two Lots:

Lot 1 – Electricity Demand Forecast for Armenia

Lot 2 – Integrated Distribution System Planning

Rev 0 – 2nd October 2018

CONTENTS

ABBREVIATIONS

Symbol / Notation	Description
$, US$ or USD	United States Dollar
ADMS	Advanced Distribution Management System
AMI	Alamance Metering Infrastructure. Refers to the meter data management system, (MDM or MDMS) smart meters etc
CIS	Customer Information system
DCC	Dispatch Control Centre
DER	Distributed Energy Resource Management
DER DRMS / DERMS	Distributed Energy Resource Management System
DNA	Distribution Network Application
DR	Electrical power Demand Response
ENA	Electric Networks of Armenia
EOI	Expression of Interest
ERP	Enterprise Resource Planning system
FLISR	Fault Location Isolation and Service Restoration
GIS	Geographic Information System
GoA	Government of Armenia
HV	High Voltage
ICCP	Inter-Control-Centre Communication Protocol. For example, communication between the Transmission SCADA and the Distribution SCADA system
IFC	International Finance Corporation
IFS	Independent Front-End System. The communication part of the SCADA system to enable communications with substations and outstations.
IMM	Information Model management
ISO	International Standards Organisation
IT	Information Technology
KPI	Key Performance Indicators
kV	Kilovolt
kW	kilowatt (1 kW = 1000 watt)
kWh	kilowatt-hour (one thousand watt-hours)
LV	Low Voltage
MDM or MDMS	Meter Data Management System. The system that allows communication with AMR, smart meters through GPRS, meter data concentrators etc
O&M	Operation and Maintenance
OM or OMS	Outage Management system
QA	Quality Assurance
RoA	Republic of Armenia
RFP	Request for Proposal
SCADA	Supervisory Control and Data Acquisition system
T&D	Transmission and Distribution
TOR	Terms of Reference

Symbol / Notation	Description
UI	User Interface

EXPRESSION OF INTEREST FOR FOR DEMAND FORECAST AND INTEGRATED DISTRIBUTION SYSTEM PLANNING CONSULTING SERVICES

1. SCOPE

1. The company Electric Networks of Armenia (ENA) invites interested consulting companies to express their interest for the consultancy services for Two lots namely:
   Lot 1 – Integrated Distribution Planning and
   Lot 2 Demand Forecast.
2. The scope of works for the two lots is included as Appendix A and Appendix B as the Terme of Reference for the full services. These attached TORs are however preliminary and under development and included here for a better appreciation of the tasks in hand. These TORs will be finalized and issued with the Request of Proposals to the short-listed companies.
3. The consultants can express interest for one or both lots.

2. TIMING AND NEXT STEPS

4. Interested Consultants are requested to register their expression of interest and submit their required documentation specified herein by the 9th of November 2018 to the address below by electronic mail or on paper.
5. ENA will analyze the submitted documentation and will structure the specifications and invite the short-listed companies to submit their bids.
   This document forms the initial TORs which will be refined before the issuing the Request for proposal to the invited consultants.
6. The consultancy contract is expected to commence mid Jan 2018.

3. CONTACT DETAILS

7. The interested party is therefore invited to request this information from the following contact points within the organization.
8. E-mails: papazyan_zh@ena.am; gevorgyan_ar@ena.am
9. Address: Armenakyan Str. 127
   0047, Yerevan, Armenia

4. ELIGIBILITY

4.1. GENERAL

1) Conflict of Interest

b) No-conflicts of interests shall be declared in connection with the operations of ENA.

3) Ineligibility based on a United Nations resolution or Borrower's country law

d) Not having been excluded as a result of Armenia's laws or official regulations, or by an act of compliance with UN Security Council resolution.

5) History of non- performing contracts

f) Non-performance of a contract did not occur within the last Five (5) years prior to the deadline for application submission, based on all information on fully settled disputes or litigation. A fully settled dispute or litigation is one that has been resolved in accordance with the Dispute Resolution Mechanism under the respective contract, and where all appeal instances available to the bidder have been exhausted.

7) Pending Litigation

h) All pending litigation shall in total not represent more than twenty percent (20%) of the Bidder's net worth and shall be treated as resolved against the Bidder.

4.2. FINANCIAL

1) Historical Financial Performance Submission of audited balance sheets or if not required by the law of the bidder's country, other financial statements acceptable to the Employer, for the last Five [5] years to demonstrate the current soundness of the bidders financial position and its prospective long term profitability.

2) Minimum average annual turnover of USD one (1) Million calculated as total certified payments received for contracts in progress or completed, within the last Five (5) years

- Financial Situation
- Financial Resources

10. The Bidder must demonstrate access to, or availability of,

- financial resources such as liquid
- assets, unencumbered real assets,
- lines of credit, and other financial means, other than any contractual advance payments to meet:

4.2.2. Cash Flow

1) The following cash-flow requirement: USD 0.1 Million and

2) the overall cash flow requirements for this contract and its current commitments.

4.3. GENERAL EXPERIENCE

11. Experience under contracts in the role of consultant, subconsultant, or management consultant for at least the last Four (4) years prior to the EOI submission, and with activity in at least nine (9) months in each year.

4.4. SPECIFIC EXPERIENCE

12. (a) Participation as consultant, management consultant, or subconsultant, in at least two (2) contracts within the last five (5) years, each with a value of at least USD 0.4 (zero point four) million, that have been successfully and substantially completed and that are similar to the proposed Services. The similarity shall be based on the physical size, complexity, methods/technology or other characteristics as described in the functional requirements.

A ANNEX A LOT 1

B ANNEX B LOT 2

ENA

Electric Networks of Armenia

Terms of Reference

TR-DP-01

Integrated Distribution System Planning /

Distribution Network Master Plan

Rev 4 - 11 March 2018

CONTENTS

ABBREVIATIONS

Symbol	Description
$, US$ or USD	United States Dollar
CSPT	Completely self-protected transformers
EDI	Energy Network Design Institute CJSC
ENA	Electric Networks of Armenia
EOI	Expression of Interest
FIs	Financial Institutions
FY	Fiscal Year
GIS	Geographic Information System
GoA	Government of Armenia
HH	Household
HV	High Voltage
IDSP	Integrated Distribution System Planning
IEC	International Electrotechnical Commission
IFC	International Finance Corporation
kV	kilovolt
kW	kilowatt (1 kW = 1000 watt)
kWh	kilowatt-hour (one thousand watt-hours)
LV	Low Voltage
MV	Medium Voltage
MW	megawatt = 1000 kW
O&M	Operation and Maintenance
QA	Quality Assurance
RoA	Republic if Armenia
TOR	Terms of Reference
WBG	World Bank Group

INTEGRATED DISTRIBUTION SYSTEM PLANNING TERMS OF REFERENCE

1. GENERAL ABOUT THE TOR

1.1. ABOUT ENA

CJSC "Electric Networks of Armenia" (ENA) was founded in May of 2002 through the merger of four state regional companies ("Yerevan Electric Networks", "North Electric Networks", "South Electric Networks" and "Central Electric Networks") distributing and selling electric energy. The company is mainly engaged in regulated distribution and sales of electric energy, with a grid of 36,000 km. The company has an exclusive license for distribution of electric energy within the Republic of Armenia. Power distribution is implemented at tariffs confirmed by the Public Services Regulatory Commission of the Republic of Armenia (RoA). The company provides service to about 985,000 customers.

In September 2015, the Russian Tashir Group acquired ENA with the objective of improving operational efficiency (e.g. reduce commercial losses; optimize costs); this is expected to contribute to improvement of financial standing of the company to improve end-user tariffs and quality of supplies. The company has now embarked on a significant investment program which is at various stages of implementation. ENA now requires the services of a specialist consultancy firm (the Consultant) to support ENA in implementing its investment program, by undertaking an Integrated Distribution System Planning. This Terms of Reference (TOR) describes the services to be provided by the Consultant as defined in the sections below. A brief background and context is provided below in order to outline the interdependencies of the operation and services to be provided.

1.2. BACKGROUND

ENA has started the implementation of a $200 million investment program approved by the regulator and has achieved a reduction of overall system losses from about 12% to 8.2% countrywide, out of which about 7% are estimated to be technical losses and about 1.2% commercial losses. ENA engaged the Energy Network Design Institute CJSC (EDI) to study and identify the urgent requirements for the first phase of the development, which resulted in a report supporting the $200 million investment.

ENA's engineers, based on this work and from their internal design process, have established an additional investment plan for further rehabilitation and expansion of the distribution network over the next 10 years with an estimated budget of $500 million, bringing the total investment since take over to about $700 million. The company has submitted its 10-year investment plan to the regulator and is now in discussions for the approval of this additional $500 million investment plan.

The $700 million investment initiative is now considered as a single initiative, and ENA management is looking to optimize these investments in the most cost effective way. In order to achieve this, it is important to consider, amongst others, the following approaches:

(a) Consider investments that can be immediately implemented (i.e. with one to two-year timeframe) that do not depend on network optimization;

(b) Develop an Integrated Distribution System Plan (IDSP) to ensure that maximum benefits of the balance of investment can be achieved, in order to provide sustainability;

(c) Ensure that the IDSP is built using a reliable demand forecast. Demand forecast will be undertaken as a separate activity; and

(d) Consider the implementation of GIS systems to support both the billing and network operation and management.

ENA is setting up a separate unit to work on the IDSP and support the implementation of the investment plan. ENA continues to work with EDI to support them with system modelling in order to confirm losses on a regular basis, a crucial part of the regulator's verifiable KPIs.

ENA has also engaged IFC advisory to provide support for managing the implementation of the investment plan, and specifically with the prioritization and optimization of the defined investment, distribution planning, Demand forecast and GIS implementation.

ENA now intends to employ a Consulting firm to undertake the Integrated Distribution System Planning to underpin the investment with a robust development plan that will deliver long lasting benefits to the business by reducing losses, improving reliability of supply, and enhancing quality of service.

1.3. PURPOSE

According to the existing Armenians regulatory requirements Distribution Network Operator shall submit annual network development plans for approval by PSRC. These plans shall be revised on annual bases and provide information about planned network expansion, rehabilitation, improvement etc. to PSRC and public.

The annual Network Development Plans mentioned above are rather medium-term and shall be based on a Master Development Plans or an Integrated Distribution System Plan.

A new Master Development Plan for Electricity Networks of Armania shall address all aspects with regard to the long-term or strategic planning given new reality and conditions as well as expected challenges and an unprecedented investment program in distribution networks of Armenia.

1.4. OBJECTIVES OF THE STUDY

1) The main objective of the study is to formulate a blue print for the Electricity Networks of Armenia Master Development up for the next 10 years which shall be practical and comprehensive. The Master Plan shall coordinate generation, transmission and distribution expansion to ensure with confidence that all proposed capital investments are not ad hoc and are instead part of a long-term structured plan. It will ensure that distribution network expansion is economically efficient and will provide a realistic framework for customer service improvement and loss reduction. The study shall use the least cost analysis to compare various options available for development of distribution systems.
2) The second objective of the study is to conduct technical transfer and capacity building through on-the-job trainings, seminars and technical workshops for ENA staff in modern planning techniques and tools.

1.5. EXPECTED KEY OUTPUTS

The expected key outputs of the study shall include but not limited to the following:

1) A review of the detailed long-term demand forecast for ENA that will be prepared by others.
2) A series of least cost distribution expansion plans matched to expected demand growth as well as generation and transmission expansion plans.
3) An estimate of distribution investment costs to meet demand growth;
4) A program of distribution loss reduction initiatives;

5) A targeted loss reduction program, with an assessment of returns expected from investments in terms of technical and non technical (commercial) loss reduction;
6) An assessment of the amount and timing of distribution investments for each system development scenario;
7) Institutional, legal and regulatory reform recommendations

1.6. KEY ACTIVITIES

The above outputs shall be achieved by using the least cost analysis to compare various options for generation, transmission and distribution through the following key activities to include:

1) Data collection, validation and analysis;
2) Assessing existing electricity demand and a demand forecast prepared by Demand Forecast Consultant, using appropriate forecasting methods;
3) Developing demand-side management options;
4) Assessing planned generation development, new generation sites, embedded renewable generation, interconnections and compare the likely development costs;
5) Analysis of the least cost staged generation expansion plans;
6) Undertaking computer modeling of the country's current existing power system down to power substation level, and analyze constrains;
7) Developing and conducting computer modeling of network expansion options to match the various generation expansion plans, and forecast demand growth;
8) Estimate annual investment requirements and investment net present values under each of the expansion plans and for reasonable set of input cost assumptions;
9) Assess annual distribution investment costs for the plan period, based on expectations regarding load density, age and conditions of the existing equipment, and a realistic projection;
10) Identify, analyze and prepare cost estimates for options and opportunities for loss reduction, including projects forming part of the overall master plan and stand-alone projects;
11) Prepare a detailed distribution capital projects program for the first 5 years of the master plan, including loss reduction subprojects.

1.7. SCOPE OF THE STUDY

In order to achieve the objectives and the expected key outputs mentioned above, the scope of work for the study shall cover the following items:

1.7.1. Data Collection

The accurate and up-to-date data shall be collected and include but not limited to the following:

1) Legal & Regulatory framework;
2) Inventory of current network assets;
3) Current Demand;
4) Existing, on-going and/or expected power system development plans including generation, mining and transmission expansion projects;
5) Present and future situation of the interconnections;

6) Expected big industrial, development and infrastructure projects;
7) Expected embedded and renewable generation projects and sites;
8) Environmental limitations;
9) Review and Confirmation on Power Demand-Supply Balance;

1.7.2. Data validation and analysis

The consistency, accuracy and validity of collected data shall be verified, analyzed and crosschecked.

1.7.3. Assessment and adoption of the appropriate and realistic system development and operation criteria based on the current state

This shall address several planning criteria including but not limited to the following:

Technical Evaluation Criteria

- Limit voltage deviation & voltage drops under different regimes;
- Permissible network element loads (lines, transformers, etc);
- Lifetime and actual state of the equipment;
- Public & Personnel Safety;
- Efficiency & Technical Losses;
- Security and reliability of supply; and/or,
- Supply continuity and thereby depending reserve supply requirements for various groups of customers.

Economic evaluation criteria

- Economic calculation methods;
- Investment costs;
- Maintenance cost;
- Cost-Benefit assessment and project appraisal methods; and,
- Criterion for the consumer supply sufficiency evaluation.

Adoption of appropriate, implementable and measurable criteria and methodology are critical for development of a realistic ENA Master Development Plan

1.7.4. Detailed demand forecast

While the long-term spatial demand forecast for Armenia shall be developed by another Consultant, the results of the long-term demand forecast shall be reviewed and incorporated into the Master Plan Development accordingly.

The developed forecast shall be reviewed to down to the level of the districts and where practically achievable at the substation level, with demand disaggregated between main consumers/customer groups.
See Section Collaboration with the Demand Forecast Consultant below for more details.

1.7.5. Technical evaluation & criteria based assessment of the system

Both current and staged future statuses of the distribution system shall be evaluated in accordance with adopted criteria and methodology. Computerized power flow and other technical analyses shall be used to identify current and expected "bottle-necks" and potential projects.

1.7.6. Identification of necessary projects

Based on technical evaluation and assessment the projects addressing improvements in following areas shall be identified:

- Safety;
- Security & Reliability;
- Quality of supply;
- Technical and non-technical (commercial) loss reduction;
- Efficiency;
- Environmental Impact

1.7.7. Economic analysis, projects appraisal and least cost alternative selection

In all cases where various alternative projects are possible all of them shall be analyzed and compared with regard to the least cost and/or highest cost-benefit results.

Nevertheless, for the projects related to public and personnel safety results of technical evaluation and technical standard requirements shall prevail. In most of the cases this type of projects shall be considered as "must-run".

Projects with one possible solution shall be analyzed with regard to the staging and timing of investments.

Based on above a matrix of possible scenarios shall be generated and optimization computations shall be performed.

1.7.8. Documents, Regulations & Initiatives

With respect to the Distribution Company's Vision, Values and Mission and based on analysis of existing legal, regulatory and other requirements as well as current status, projected development scenarios the package of initiatives for revision of existing and development of new regulations shall be prepared in the following areas:

- Procedures;
- Methodologies;
- Regulatory Initiatives; and,
- Legal Initiatives.

2. MASTER DEVELOPMENT PLAN

Completing activities and producing key deliverables described above will help to create a comprehensive Master Development Plan for ENA.

The final Master Development Plan shall meet the objectives described above and shall be based on detailed analysis and optimization of the best development alternatives.

It shall provide reasonably detailed cost, investment and budget estimates.

It will ensure that distribution network expansion is economically efficient and will provide a realistic framework for customer service improvement and loss reduction.

3. SPECIFIC REQUIREMENTS AND CONDITIONS

Other than general requirements above there is a number of specific requirements and conditions described further in this Section.

3.1. COLLABORATION WITH DEMAND FORECAST CONSULTANT

As mentioned elsewhere in the document a separate consultant will be employed by ENA to undertake the Demand forecast. This consultant will be responsible for all data connected with Demand forecast. Data collected by either consultant will be mounted in a shared drive and made available to both consultants, to ease data availability and collection. Data requirement/schedules by either consultant will be made available to the other consultant.

It is expected that the two contracts will run concurrently but Demand Forecast will be completed in a much shorter time, to provide the IDSP consultant with data to undertake the planning development options.

Meetings may be required to be undertaken with both consultants present to expedite progress, and it is expected that every effort shall be made by both consultants to provide positive and proactive collaboration.

In case of any disputes these shall be referred to the project managers of ENA and IFC.

3.2. DEMAND FORECAST

Demand forecast will be conducted by others and the results will be made available to the Consultant to use it for the distribution planning.

The consultant will review this Demand forecast and if there are any issues, comments, discrepancies they will communicate this to ENA and IFC in order for this to be considered by the Demand Forecasting consultant.

3.3. DATA COLLECTION AND SYSTEM MODELLING

3.3.1. Data collection and validation

1) Network data

ENA maintains a database with the characteristics of all power system components, as well as their parameters. A model of the connectivity of the existing distribution system was prepared by EDI, and it has been used in several studies conducted by EDI. Considering that the model was set up for proprietary software, it is not clear at the moment whether the model can be transferred to another simulation software. In any case, ENA will make the existing database available to the Consultant, and will collect additional data if deemed necessary by the

Consultant to prepare the IDSP. If needed, the Consultant shall build the network connectivity model based on the information/data that will be provided by ENA. The network connectivity model built by the Consultant will need to be tested using parameters and readings (voltage and current of feeders and transformer loading) that will be provided by ENA. The results obtained by the Consultant must reflect existing operating conditions of the network. Before proceeding with the preparation of the different scenarios, the Consultant must agree with ENA and IFC as to the suitability of the network model to conduct long-term planning.

2) Load data

ENA will commission a long-term Demand forecast as a separate activity. The results of the forecast will be provided to the Consultant to be used as input to the IDSP. The information will include time series data to enable the calculation of system performance, including losses.

3) Collaboration with EDI

The Consultant will also have to develop working relationships with the EDI institute to establish data quality alignment and develop a mechanism to enable comparison of baseline system modelling to enable the confirmation of the EDI system quality of modelling in the case where the institute continues to provide services to ENA using their own software.

4) Asset Register Data

Asset register data will be provided by ENA with the aging characteristics of the assets to enable distribution planning decisions.

5) Site visits for data verification

The Consultant will carry out sample visits to substations and distribution lines to ascertain the condition of these assets compared to the asset registry valuation of their life. This should include visits to assets that have been identified by ENA for replacement in the initial implementation plan.

The Consultant shall advise ENA on potential improvements on the asset register and any analytics that can benefit the company.

6) Confirmation of characteristics and operational standards

The Consultant shall process the data given to him by ENA, and validate it by checking for its quality and consistency, using as a comparison its own data/parameters for similar system components.

In case of discrepancies, the Consultant must highlight the suspicious data and discuss it with ENA and IFC, so that a decision can be made as to the data to be used in the simulations.

The Consultant shall also establish ENA's current operational practice in terms of acceptable operating range of lines and equipment: voltage profile and tolerances, loadability of system components, reliability and quality of supply, to ensure that they are in line with best industry practices.

These shall be established as the system characteristics database for potential disclosure to the regulator or to the public.

3.3.2. Review and incorporate early investment plan

As part of the support provided to ENA, IFC will undertake a review of the preliminary investment plan prepared by ENA's engineers to further support equitable early investment. The results of this work, which started in December 2017, will precede the IDSP work and subsequent investment plan. The Consultant shall review this work and incorporate the results of the deliberations into the IDSP.

The Consultant will take cognizance of these recommendations, reviewing and considering them in the development of the IDSP.

3.4. SET UP UNIT COST AND PROJECT COSTING SYSTEM

Following the collection of data, the Consultant shall set up a comprehensive unit cost database system, based on the data provided by ENA. Any missing data will be complemented from the Consultant's database and experience.

A separate tool shall be developed by the Consultant to establish the easy setting up of project scope and project costing using this database as a lookup. This costing shall produce the detailed costing as well as some analysis of equipment and costs by type of equipment used for management purposes.

3.5. MODELLING OF PRESENT NETWORK

3.5.1. Network model

Once data are validated and captured in the system model built by the Consultant, the Consultant shall prepare a base-case scenario reflecting existing system parameters, and operating conditions, and including, but not limited to the Generation and Transmission System.

This shall include the entire power network of Armenia including transmission lines and transmission substations down to 10 kV, as well as the generation sources.

Although the modelling of the power network will be established for the transmission system, this will not include studies for the Transmission network, which is beyond the scope of the current project. The system, however, will be used to calculate fault level in-feeds and power flows into the distribution substations.

1) Primary and main secondary network

The model shall also include the primary and secondary distribution network. The secondary network shall include the main lines with all the switches and isolators that can enable the optimum operation of the network. This is effectively all the network except the Low voltage network.

2) Low voltage

The model shall also include the LV network that has already been modelled in order to obtain the picture of the voltage profiles. If the network has not already been modelled the consultant shall undertake representative – selective LV networks to model in order to address design issues.

3.5.2. Load flows and loss calculations

The Consultant shall conduct load flow studies of the distribution network, based on the demand forecast provided by ENA, and the Consultant must define the distribution system reinforcement and expansion plans to meet the forecasted demand. These load flows shall include the usual maximum and minimum loads. Results shall be compared with the available outputs from the EDI modelling. Any discrepancies shall be investigated and discussed before proceeding to the next steps.

The analysis shall also include the load time series to establish distribution system and compare them with the actual figures and the results from the EDI modelling.

The load profiles shall be analyzed with consideration of system operation and in preparation for the system distribution planning.

This should establish the performance of the current system and its limitations and constraints.

3.6. SYSTEM DESIGN CONSIDERATIONS

3.6.1. Smart grid

Smart grid considerations will be an integral part of the distribution planning above. Although this is a developing environment and it is not well understood, and therefore implications are fast changing, several components that form part of so-called smart grids will be considered in the IDSP. This will include consideration of:

- Advance Distribution Management System;
- Remotely controlled sectionalizers and auto-re-closers;
- Smart metering;
- Battery storage;
- Integration of renewables in the distribution system; and
- Completely Self-Protected Distribution Transformers.

The will be covered in recommendations for equipment specifications and will result in deliverables.

3.6.2. Voltage upgrade considerations

The current power system is based predominantly on 10-kV distributors and a 35-kV primary distribution system supplied through the 110kV system. Many countries, as loads grow, have replaced their distribution by 20kV or 22kV networks, depending on whether they had 10kV or 11kV systems, as equipment manufacturers are rationalizing designs to reduce manufacturing costs (for example they are now predominantly manufacturing 25kV circuit breakers). The wayleave space for 10kV circuits is double that of 20kV to carry the same amount of power and it will become an impossible task to accommodate future growth.

In view of the major investment under consideration and the massive rehabilitation work, it is important for ENA management to appreciate the benefits of a potential voltage upgrade and the complexities and phasing of such an exercise. The considerations will include approaches such as:

(a) Use the model for the existing system to consider voltage upgrades;

(b) Draw from experiences in other countries who have changed / rationalized their distribution networks;

(c) Provide substantiated pros and cons of maintaining the current voltage levels system versus changing;

(d) Present the challenges in adopting a voltage rationalization to, for example, 20kV or 35kV distribution;

(e) Consider options, such as starting with large cities and using existing equipment for outlying areas;

(f) Set out the steps / timing of possible scenarios, e.g. using dual voltage transformers, gradual rehabilitation of distribution network to a high voltage level, cable replacing/upgrading policies; and

(g) If voltage rationalization is a clear winner, the Consultant shall prepare the detailed additional work that is required to design project, documents, specifications, etc. to roll out the project.

Such a decision is expected to be complex and needs to be considered as early in the project as possible.

The deliverable for this task is expected to be a small stand-alone report that considers all above issues.

3.6.3. Earthing considerations

ENA's existing distribution network earthing policy shall be reviewed for the distribution network between the primary substations down to the consumer level, and the Consultant shall produce recommendations to be considered for implementation under the rehabilitation project.

3.6.4. Conductor optimization

Conductor optimization shall be undertaken to consider the size and type of conductors that should be used in the major rehabilitation exercise for both the overhead and underground distribution network.

3.6.5. Review of MV distribution line design

The Consultant will review the current practices of MV distribution line design and shall provide recommendations for an improved design with lower costs and equal or better performance, footprint, etc.

3.6.6. Review of LV system design principles

The Consultant shall study the existing design of the LV (0.4-kV) network and offer recommendations for an improved layout and configuration.

3.6.7. Capacitive compensation

Once the existing system has been modelled and development options have been defined, the Consultant shall undertake capacitive compensation optimization analysis to improve system performance and quality of supplies, and reduce losses. A plan shall be developed with costing and cost benefit analysis for the capacitor installation program. These capacitor installation initiatives shall be included in the investment plan.

3.6.8. Voltage Boosters

The distribution planning should consider the use and placement of voltage boosters in areas with long distribution lines to delay and optimize investment.

3.6.9. Distribution Transformer optimization

As part of the review of system design, the Consultant shall consider the current practice of distribution transformers with regards to a) the support structures and transformer configuration to reduce costs; and b) types of distribution transformers, their efficiency and other characteristics used.

The Consultant shall produce a report for the proposed changes to support their approval.

3.6.10. Use of Completely Self-Protected Transformers (CSPT)

For transformer replacements in remote areas and general installation of new transformers in areas other than large installations, completely self-protected transformers (CSPT) may be considered for installation. The Consultant shall consider the benefits and experience of CSPT and discuss with the utility their use and benefits. The overall cost reduction in the operation shall be established. This shall be for both single and three phase transformers.

An interim with recommendations shall be produced and a policy decision will have to be reached with ENA for implementation or otherwise in the investment plan.

3.6.11. Advanced Distribution Management System

The Consultant shall consider the current mode of the distribution system control, means of communication, management of control, safety, etc. The Consultant shall also consider mini control centres for smaller cities including switching devises.

The consultant shall advise from his experience recommendation on Advanced Distribution Management Systems.

3.6.12. Maintenance management practices

The Consultant shall review current maintenance management process and provide recommendations for its improvement.

3.7. MEDIUM AND LONG-TERM SYSTEM DEVELOPMENT

Once the Consultant has undertaken the system modelling and completed the design considerations, it will proceed with considering the development of the future system in 5-year stages, reflecting the projected demand. Loading shall be apportioned according to the Demand forecast.

The system development shall consider system re-configurations, topology and reconfiguration flexibility as well as use of smart switches to provide improved flexibility and reliability.

The system development shall be conducted for the main grid for the next 5 and 10 years and then take a longer 20-year term outlook for the primary distribution network and main distributors. The system requirements for the next 5 and 10 years will be covered within the current investment plan.

The system losses shall be calculated based on the time series for the projected years.

3.8. FAULT LEVEL CALCULATIONS

3.8.1. Fault level calculations

Fault level analysis will be carried out as described below to determine design parameters and equipment specifications.

Fault level analysis should be carried out for a) the existing network and b) the future proposed options to establish fault levels at distribution substations.

Fault level analysis shall be carried out for both single and three phase faults at the distribution substations.

The analysis will consider the distribution system only with the entire primary substations included.

This will be used to check the ratings of the switchgear employed and future requirements.

3.8.2. Protection co-ordination check

The consultant shall in his proposal consider if it is possible to conduct a check of present Overcurrent relay settings against the fault levels that will be calculated and shall cost this component of works separately.

The work shall comprise of the following:

Following the fault level analysis above, the Overcurrent protection coordination of the existing protection relays at the distribution substations shall be checked and the results shall be presented and discussed. This shall include the grading and protection margins of the power transformers and incoming transmission feeders.

Any issues that are identified shall be brought out early for discussions and consideration to address problems.

Protection coordination shall be carried out for the future options to check and ensure protection coordination for each option / stage of development.

The protection coordination shall be carried out for the standard overcurrent protective functions of the protection relays but it is not intended to be used as a protection setting exercise for all the functions of the protective relays used in the system.

Protection setting calculations reviews are not in the scope of this work.

3.9. ECONOMIC/FINANCIAL ANALYSIS AND INVESTMENT PLAN

3.9.1. Economic/financial analysis

As part of the IDSP work the Consultant will undertake a cost benefit analysis of the proposed development options to determine the most appropriate scheme.

A complete economic and financial analysis will be conducted for the proposed options.

This shall include the revision of the financial model prepared by ENA and show the resulting benefits.

3.9.2. Investment plan

Once the planning is complete and together with all the optimizations and the project costing tools the Consultant shall develop the revised investment plan which will include all the works that will have to be procured and implemented by ENA. This shall include the phasing of the works and their prioritization / grouping to ensure the optimum implementation plan for the investment.

3.10. CAPACITY BUILDING

Substantial part of the training will be provided by the Consultant's staff as part of the on-the-job-training and formal training.

Training on power factory software. The "Power Factory" software package will be used by the Consultant to undertake the planning work for ENA. Training will be established by the Consultant to train two engineers on the full use of the software and all its functions utilised in the distribution utility. A user report with examples will be provided to ENA staff. ENA will decide if they wish to purchase such software for their own use.

4. DELIVERABLES / REPORTING REQUIREMENTS

The general following reporting requirements are shown on the table below.

Table 1. Reports schedule

Report No	Description	Timing Frequency
1	Inception report	30 days from mobilisation
2	Monthly Report (MRep)	5 working days after the end of each calendar month.
	Minutes of meetings	As and when
3	IDSP Report Draft. Individual reports may need to be produced for specific subjects which will be discussed with ENA and IFC	6 months
4	IDSP Report Final	8 months
5	Investment Plan	8 months

The Prospective Bidder shall prepare a detailed project schedule similar to the example below and submit it together with his bid

#	KEY ACTIVITY	OTPUT	START DATE	END DATE
1	**Data collection, validation and analysis;**			
1.1	Legal & Regulatory framework;			
1.2	Inventory of current network assets;			
1.3	Current Demand;			
1.4	Existing, on-going and/or expected power system development plans including generation, mining and transmission expansion projects;			
1.5	Present and future situation of the interconnections;			
1.6	Expected big industrial, development and infrastructure projects;			
1.7	Expected embedded and renewable generation projects and sites;			
1.8	Environmental limitations;			
1.9	Review and Confirmation on Power Demand-Supply Balance;			
2	**Data validation and analysis**			
3	**Assessment and adoption of the appropriate and realistic system development and operation criteria based on the current state**			
3.1	Technical Evaluation Criteria			
3.1.a	*Limit voltage deviation & voltage drops under different regimes;*			
3.1.b	*Permissible network element loads (lines, transformers, etc);*			
3.1.c	*Lifetime and actual state of the equipment;*			
3.1.d	*Public & Personnel Safety;*			
3.1.e	*Efficiency & Technical Losses;*			
3.1.f	*Security and reliability of supply;*			
3.1.g	*Supply continuity and thereby depending reserve supply requirements for various groups of customers.*			
3.2	Economic evaluation criteria			
3.2.a	*Economic calculation methods;*			

3.2.b	*Investment costs;*
3.2.c	*Maintenance cost;*
3.2.d	*Cost-Benefit assessment and project appraisal methods;*
3.2.e	*Criterion for the consumer supply sufficiency evaluation.*
4	**Detailed demand forecast**
4.1	Assessing potential energy sources for generation development, new generation sites, embedded renewable generation, interconnections and compare the likely development costs;
4.2	Analysis of the least cost staged generation expansion plans;
4.3	Developing demand-side management options;
4.4	Undertaking computer modeling of the country's current existing power system down to power substation level, and analyze constrains;
4.5	Developing and conducting computer modeling of network expansion options to match the various generation expansion plans, and forecast demand growth;
5	**Technical evaluation & criteria based assessment of the system**
6	**Identification of necessary projects**
7	**Economic analysis, projects appraisal, Optimization and Least Cost Alternatives Selection**
8	**Financial analysis, planning & budgeting**
8.1	Estimate annual investment requirements and investment net present values under each of the expansion plans and for reasonable set of input cost assumptions;
8.2	Assess annual distribution investment costs for the plan period, based on expectations regarding load density, age and conditions of the existing equipment, and a realistic projections;
8.3	Identify, analyze and prepare cost estimates for options and opportunities for loss reduction
8.4	Prepare a detailed distribution capital projects program for the first 5 years of the master plan, including loss reduction subprojects
9	**Legal, Regulatory and Procedural Initiatives**
10	**Initial Draft Master Development Plan**
11	**Final Report & Presentation**

5. PROVISIONS BY CLIENT

This section indicates data, local services, personnel, and facilities to be provided by ENA.

5.1. DATA AND INFORMATION

The Consultant shall produce a list of data that he requires to undertake the work. ENA shall provide any available data.

5.2. OFFICE SPACE AND ACCESS

Office accommodation for the Consultant will be provided by ENA free of charge with basic furniture.

Meeting rooms will be provided for any meetings that may be required.

No telephone service will be provided.

Offices for ENA's counterpart staff will be provided by ENA in the same premises as for the Consultants with full facilities including computers and communication.

Access to the substations and ENA offices will be arranged by ENA.

5.3. COUNTERPART STAFF

A special IDSP unit will be set up for the execution of the project and currently two engineers are planned to be seconded to the Consultant for the duration for the project. These will be competent engineers who will be fully trained in the use of the software and the modelling techniques. These engineers will also act as the Consultant's interfaces for data collection and other project activities, as required.

ENA staff allocated to the project will be under the Director of Engineering, which will be the project owner.

5.4. TRANSLATION

No translation services will be provided by ENA.

During discussions and meetings with ENA the consultant shall provide for his translation.

6. CONSULTANT PROVISIONS

6.1. INTERNATIONAL TRAVEL AND ACCOMMODATION

The Consultant will be responsible for the travel of its staff in and out of Yerevan for the execution of the services. The number of trips, include any visas and excess luggage required, shall be indicated and costed as part of its proposal.

ENA will provide support with invitation letters that may be required.

The Consultant shall also be responsible for the accommodation of its staff.

6.2. LOCAL TRANSPORT – TRANSPORT WITH RENTED VEHICLES

The Consultant will be responsible for local transport within Yerevan.

For travel to other cities, the client will provide transportation with its own cars and staff.

6.3. PORTABLE COMPUTERS, AND TELEPHONES

The consultant's international staff are expected to have their own portable computers which they will import and re-export. ENA will arrange for projectors for presentations. The

Consultant will provide its own mobile phones and sim cards while in the country. Internet connection while in ENA will be available through a wireless network, although communications cannot always be guaranteed and are advised to have their own mobile communication.

6.4. PROJECT SOFTWARE

The Consultant shall provide the Power Factory DigSilent software to undertake the work.

The client reserves the right to purchase the software at any time during or after the end of the services from any authorised distributor of the software.

7. PROJECT MANAGEMENT TIME SCHEDULE

7.1. TIME DURATION AND START OF THE SERVICES

An estimated date for the start of the services is 1st of February 2018 and the project is expected to be completed within a maximum of 8 months.

The starting time shall be taken to be 14 days from the later of the following: a) signing of the contract between the parties; and b) advance payment to the Consultant as manifested on the transaction statement. ENA expects that the Consultant will engage the two ENA engineers, who will support data collection and data analysis during the execution of the project. One of the analysis engineers is expected to spend more time in the country with the client's staff but at a minimum the Consultant is expected to spend at least one week on site for the data collection, followed by at least three weeks on site during the running of the model of the existing system, followed by about a month in the country for the finalization of all the options development. A final visit for the discussions and presentations at the end of the project is then expected to require another two weeks on site.

7.2. ADVANCE PAYMENT

An amount of 10% (ten percent) of the agreed contract value can be made to the consultant as advance payment. The securitization shall be discussed during contract negotiations.

7.3. MEETINGS

Regular brief meetings will be held on a weekly basis.

While the Consultant is on site these will be face-to-face; when away from the office these will be via teleconference.

7.4. MANAGEMENT REPORTING ARRANGEMENTS

The Consultant will report to the project Manager of ENA and also to the project Manager of IFC. IFC will provide guidance and review all documents and progress by the consultant and will advise ENA on the way forward.

Any communication by the consultant by emails shall be copied to both project managers.

7.5. CAPACITY BUILDING

7.5.1. Workshops

At least three workshops are planned to be provided during the execution of the project, as follows:

- One workshop during the data collection work;

- A second workshop following the establishment of the existing system model; and
- A third workshop during model development.

7.5.2. On the job training

The Consultant shall provide on the job training to the respective Counterpart's personnel engaged at the different stages of this planning exercise.

7.6. LANGUAGE OF DOCUMENTS & TRANSLATIONS

All documentation produced by the Consultant, including reports and specifications, will be in the English language. For workshops, and where interpretation is required, the Consultant will provide its own interpretation facilities to enable communication with the client.

8. CONSULTANTS QUALIFICATIONS

8.1. QUALIFICATIONS AND EXPERIENCE

i) Company experience should include:
   - At least 10 years in the electricity sector
   - **Area of work**: Experience in power distribution system planning and operations, practical experience in implementation of distribution reinforcement and expansion projects would be considered as an advantage;
   - **Geographic experience**: Experience working in similar countries and systems as the client's country.

ii) Staffing: It is expected that at least two specialists will be engaged, including a senior expert who will act as the project manager and the client interface and a distribution planning expert. Both shall have good modelling experience and proficiency in DigSilent modelling software to undertake the work described under the distribution design. The expertise of the specialists will be as follows:
   - Project Management – Chief planning engineer's qualifications: At least a Bachelor's degree (Master's will be an advantage) in electrical engineering, with minimum 20 years' experience, including at least 10 years as team leader or deputy team leader, or generally in leading positions, 5 years of relevant international work experience on similar assignments, proven communication skills, proven competency in participatory approach. Fluency in English (Russian would be an advantage) with strong written and spoken skills.
   - Planning engineer's qualifications: At least a Bachelor's degree in electrical engineer with a minimum of 15 years' working experience in similar assignments, including at least 10 years of relevant international assignments (outside his/her country of origin)., with strong experience in system modelling for load flows, fault level calculations, conductor optimization, and capacitive compensation. Good communication skills and competency working with counterpart staff on system design are required. Fluency in Russian and / or English with strong written and spoken skills.

ENA

Electric Networks of Armenia

Terms of Reference

TR-DF-01

Electricity Demand Forecast for Armenia

Rev 3 - 1st March 2018

CONTENTS

ABBREVIATIONS

Symbol	Description
$, US$ or USD	United States Dollar
CSPT	Completely self-protected transformers
EDI	Energy Network Design Institute CJSC
ENA	Electric Networks of Armenia
EOI	Expression of Interest
FIs	Financial Institutions
FY	Fiscal Year
GIS	Geographic Information System
GoA	Government of Armenia
HH	Household
HV	High Voltage
IDSP	Integrated Distribution System Planning
IEC	International Electrotechnical Commission
IFC	International Finance Corporation
kV	kilovolt
kW	kilowatt (1 kW = 1000 watt)
kWh	kilowatt-hour (one thousand watt-hours)
LV	Low Voltage
LRMC	Long Run Marginal Costs
MoEINR	Ministry of Energy Infrastructures and Natural Resources
MV	Medium Voltage
MW	Megawatt = 1000 kW
O&M	Operation and Maintenance
QA	Quality Assurance
PSRC	Public Services Regulatory Commission/ Regulatory Authority
TOR	Terms of Reference
WBG	World Bank Group

ELECTRICITY DEMAND FORECAST CONSULTANT TERMS OF REFERENCE

1. GENERAL ABOUT THE TOR

1.1. ABOUT ENA

CJSC "Electric Networks of Armenia" (ENA) was founded in May of 2002 through the merger of four state regional companies ("Yerevan Electric Networks", "North Electric Networks", "South Electric Networks" and "Central Electric Networks") distributing and selling electric energy. The company is mainly engaged in regulated distribution and sales of electric energy, with a grid of 36,000 km. The company has an exclusive license for distribution of electric energy within the Republic of Armenia. Power distribution is implemented at tariffs confirmed by the Public Services Regulatory Commission (PSRC) of the Republic of Armenia (RA). The company provides service to about 985,000 customers.

In September 2015, the Russian Tashir Group acquired ENA with the objective of improving operational efficiency (e.g. reduce commercial losses; optimize costs); this is expected to contribute to improvement of financial standing of the company to improve end-user tariffs and quality of supplies. The company has now embarked on a significant investment program which is at various stages of implementation. ENA now requires the services of a specialist consultancy firm (the Consultant) to support ENA in implementing its investment program, by undertaking an Integrated Distribution System Planning. This Terms of Reference (TOR) describes the services to be provided by the Consultant to forecast the demand requirements for the ENA as defined in the sections below. A brief background and context is provided below to outline the interdependencies of the operation and services to be provided.

1.2. BACKGROUND

ENA has started the implementation of a $200 million investment program approved by the regulator and has achieved a reduction of overall system losses from about 12% to 8.2% countrywide, out of which about 7% are estimated to be technical losses and about 1.2% commercial losses. ENA engaged the Energy Network Design Institute CJSC (EDI) to study and identify the urgent requirements for the first phase of the development, which resulted in a report supporting the $200 million investment.

ENA's engineers, based on this work and from their internal design process, have established an additional investment plan for further rehabilitation and expansion of the distribution network over the next 10 years with an estimated budget of $500 million, bringing the total investment since take over to about $716 million. The company has submitted its 10-year investment plan to the Regulator and is now in discussions for the approval of this additional $500 million investment plan.

The $716 million investment initiative is now considered as a single initiative, and ENA management is looking to optimize these investments in the most cost-effective way. To achieve this, it is important to consider, amongst others, the following approaches:

1) Consider investments that can be immediately implemented (i.e. with one to two-year timeframe) that do not depend on network optimization;
2) Develop an Integrated Distribution System Plan (IDSP) to ensure that maximum benefits of the balance of investment can be achieved, to provide sustainability;
3) Ensure that the IDSP is built using a reliable demand forecast under the TOR defined here; and,

4) Consider the implementation of GIS systems to support both the billing and network operation and management.

ENA is setting up a separate unit to work on the IDSP and support the implementation of the investment plan. ENA continues to work with EDI to support them with system modelling to confirm losses on a regular basis, a crucial part of the regulator's verifiable KPIs.

ENA has also engaged IFC advisory to provide support for managing the implementation of the investment plan, and specifically with the prioritization and optimization of the defined investment, distribution planning, demand forecast and GIS implementation.

1.3. FUNDAMENTALS OF THIS ASSIGNMENT

ENA intends to employ a Consulting firm to undertake the Demand Forecasting to underpin the IDSP and the demand forecast shall be designed to support Network Investment Planning to deliver long lasting benefits to the business by reducing losses, improving reliability of supply, and enhancing quality of service in the most economical way.

The demand forecast shall be carried out to cover the next 10 years of development but at the same time enabling a longer outlook if it so desired by the company to address LRMC costs.

The Demand forecast shall provide estimates for the maximum annual MW and MVA demand, as well as electric energy (kWh) demand with an outlook at the seasonal variations and demand curve.

The Consultant is required to set up demand forecasting models to enable the update of the demand forecast in the future.

The scope does not include the definition of generation requirements or Transmission system development requirements.

The scope does not include any modelling of the distribution system, any work related to testing, any development options including substations which work will be carried by others.

1.4. COLLABORATION WITH IDSP CONSULTANT

As mentioned in the document, a separate consultant will be employed by ENA to undertake the IDSP. This consultant will be responsible for all data connected with network modelling. ENA will make data available to both consultants upon and the consultants are expected to produce the data lists they require.

It is expected that the two contracts may run concurrently but Demand Forecast will be completed ahead of the IDSP and in good time to supply the IDSP consultant with demand forecast data to enable him to undertake the planning development options.

IDSP consultant will provide a list and format of requirements to be completed by the Demand Forecast Consultant. However, both consultants may be required to participate in meetings to expedite progress, and it is expected that every effort shall be made by both consultants to provide positive and proactive collaboration.

Project issues and urgent needs shall be referred to the project managers of ENA and IFC.

1.5. BRIEF DESCRIPTION OF SCOPE OF WORKS

The scope of works shall include the following tasks, which are described further in Chapters 2-6.

1) **Identify Data Requirements.** Provide data requirements to ENA, who will supply the data. The consultant will review system and available Demand Forecast data, considering

the existing practices and material. The consultant shall make "reasonable assumptions" if data are unavailable and declare and agree these assumptions with the client

2) **Propose Demand Forecast Method.**
3) **Develop Demand Forecast Model(s)** and provide Demand Forecast analyis
4) **Capacity building**

2. DATA COLLECTION & REVIEWS

2.1. DEFINE DATA REQUIREMENTS, COLLECT AND ANALYSE DATA

The Consultant shall prepare data collection guidelines and a schedule of required data for the demand forecast and submit it with his bid to ENA give time to ENA to prepare these data. ENA will make best effort to collect such data and provide these to the selected Consultant as early as possible.

The Consultant shall review these data, have discussions with ENA and IFC and define any additional requirements that may become apparent.

The Consultant is not expected to interact with any of the distribution management and monitoring systems such as SCADA, GIS, or Customer Information Systems (CIS). ENA will extract and provide any data required from these systems and any other system under its jurisdiction.

2.1.1. Review Demand Forecasting information

In the data review process the Consultant shall consider the available demand forecasting information to develop a good understanding of the carried-out work and the associated issues. The Consultant is expected to hold discussions/interviews with institutions involved with demand forecasting impact, which may include:

(a) Ministries – Ministry of Energy and Natural Resources, others;
(b) PSRC;
(c) ENA;
(d) Any other institution agencies that may make information available (such as the WB, EBRD, ADB, EDI, etc.)

2.1.2. Collect and review ENA historical data including

(a) Historic demand/load data
(b) Customer historic data
(c) Industrial and large customer data
(d) Customer applications for both new supply and upgrades

Use the historical data to develop dependencies/ trends/ relations in forecasting demand for existing and future customers

2.1.3. Process Data

The Consultant shall review data and arrange them in a structured manner to set up the system for ENA to collect any future data in the required format and to provide inputs to the Demand Forecasting model to be developed.

The Consultant shall review the existing provability range of typical load curves, load duration curves and forms that he considers appropriate for the demand modelling.

2.2. DEMAND FORECAST MODEL CONSIDERATION

The Consultant shall consider any models, which are employed in the industry to forecast demand, or any forecast methodologies. However, the considered models and methodologies shall be industry proven to provide reliable and accurate results.

3. IDENTIFY SUITABLE DEMAND FORECAST APPROACH

3.1. BRIEF BENCHMARKING STUDY

Review international practices that are relevant to Armenia, for example at similar economic development/environment, intuitional framework, grid code, avoiding cases that are not relevant etc. This should include methodologies used and any rational for adopting respective models. It is expected that at least five countries may be selected to provide some weight to trends.

Similarly, review regional practices of countries on demand forecast.

Provide analysis on the philosophy applied to undertake demand forecast.

Assemble any lessons learned from the international and regional experience from the Consultant's own work and other work they have reviewed.

The output of this work can be in a stand-alone report, which can then be used as annex to the main report.

3.2. IDENTIFY KEY FACTORS AFFECTING DEMAND GROWTH

Identify factors that may affect demand development for ENA. These factors may include but are not limited with the following:

1) Economic growth;
2) Policy decisions (e.g., energy efficiency standards and incentives; pricing policies);
3) Technologies (e.g., end use appliances);
4) Industrial activities;
5) Import, export, or transit of power and interconnections that may influence system loading.
6) Distributed generation including roof top solar and small wind turbines;
7) Energy storage;
8) Energy promotion initiatives;
9) Energy shortages and unserved energy; and etc.

3.3. RECOMMEND APPROPRIATE DEMAND FORECAST METHODOLOGY

Based on the available data, the international and regional benchmarking comparisons and Consultant's experience the Consultant shall consider and propose the most appropriate Demand forecasting method. The Consultant shall present to and discuss with ENA and IFC the proposed method(s) with an objective of agreeing on the best methodology and model implementation. These methods may include, econometric models, Top-down, Bottom-up etc. The resulting method(s) may be a combined approach of several models. More than one models / methods may be adopted for the demand forecast to provide some flexibility and consistency with the current methodology.

3.4. DEFINE ROLES AND RESPONSIBILITIES

The Consultant shall consider roles and responsibilities connected to demand forecast for ENA and other institutions involved in the energy sector to help ENA manage expectations and inputs/impacts of demand forecast.

3.5. RECOMMEND TOOLS AND CAPACITY-BUILDING ACTIVITIES

The Consultant shall propose required tools over and above the models and tools that will be developed by the Consultant that would be required by ENA and the institutions involved. The Consultant shall transfer the knowledge on the Demand Forecast methodology, models, calculations, and tools to ENA.

4. DEVELOP MODEL AND UNDERTAKE DEMAND FORECAST

Having determined the most appropriate method the Consultant will proceed with the execution of the demand forecasting.

4.1. STANDARD HISTORIC/STATISTICAL TREND/METHOD

In addition to the above full model for the demand forecast, a standard simple historic based model shall be developed, based on the consumer grouping, consumer growth and some simple economic parameters reflecting current practices.

4.2. FORECAST POWER AND ENERGY

The Consultant shall unertake the development of Demand Forecast (Power – MW, MVA and Energy – KWh) using the agreed demand forecast model.

4.3. PERIOD OF FORECAST

The demand forecast for all the aspects mentioned in this section shall cover the next ten years, and namely for the period of 2018 to 2028.

Demand Forecast for the following 5 years (i.e., up to 2033) should be indicative for the distribution system requirments base case, and the expected uncertainties shall be identified.

4.4. BASE-HIGH-LOW CASES

The forecast will have at least the following three cases: a) Base Case, for the expected growth, b) a High Demand growth senario, and c) a Low Demand growth senario.

The high and low senarios will be discussed and agreed with ENA.

4.5. BACK-CAST

The Consultant shall use the developed model "to forecast in the past". For example, use the model to forecast last 5 years and 10 years, at the start of the respective period using the available date forecast for those periods. This analysis shall be applicable for the base case only and shall discuss deviations that may occur.

4.6. ACCURACY

In terms of accuracy, the proposed model shall:

- Compare performance of the selected method against any current systems/methods.
- Consider comparisons of performance of the selected method against the historic based simple method mentioned above.

This analysis shall be applicable for the base case only.

5. DELIVERABLES / REPORTING REQUIREMENTS

The following reporting requirements are shown on the table below

Table 1. Reports schedule

Report No	Description	Timing Frequency
1	Brief inception report outlining data collected, reviews, conclusions, etc.	30 days from the effective start date of the contract
2	Consultant requests data inputs from ENA	First batch with the contract signing. Second batch. ENA shall provide balance of data 2 weeks after additional data request by Consultant.
3	Monthly Report	5 working days after the end of each calendar month.
4	Minutes of meetings	As needed
5	Forecasting Model	13 weeks
5	Demand Forecast Final report	17 weeks

5.1. DELIVERY OF MODEL AND CAPACITY BUILDING

The Consultant will develop suitable package for the demand forecast preferably in excel, and will train ENA's staff on the use of the software model developed.

The Consultant will provide a user manual to ENA to accompany the Demand forecasting package to enable ENA staff for reference and teaching new staff to revise the demand forecast.

Training will be provided through purpose designed workshops/seminars.

Relevant on-the-job trainings will be provided to the counterpart staff throughout the entire duration of this assignment.

6. PROVISIONS BY CLIENT

This section indicates data, local services, personnel, and facilities to be provided by ENA.

6.1. DATA AND INFORMATION

The data currently available will be provided by the ENA upon the request of qualified bidders.

6.2. OFFICE SPACE AND ACCESS

Office accommodation for the Consultant will be provided by ENA free of charge with basic furniture during Consultant's stay in the country. Meeting rooms will be provided for any meetings that may be required. No telephone service will be provided. Offices for the counterpart staff will also be provided by ENA in the same premises as for the Consultants with full facilities including computers and communication. Access to the substations and ENA offices will be arranged by ENA.

6.3. COUNTERPART STAFF

A special unit will be set up for the execution of the project. Currently two engineers are planned to be seconded to the Consultant for the duration for the project. These will be competent engineers who will be fully trained in the use of the software and the modelling techniques. These engineers will also act as the Consultant's interfaces for data collection and other project activities, as required. ENA staff will be under the Director of Engineering, which will be the project owner.

6.4. TRANSLATION

The Consultant shall provide his translator during any meetings on site with ENA

7. DIRECT EXPENSES AND LOGISTICS

7.1. INTERNATIONAL TRAVEL AND ACCOMMODATION

The Consultant will be responsible for travel costs and subsistence of its staff. The costs shall include any visas, excess luggage, etc. and it shall be included and indicated in the proposal. ENA will provide support with invitation letters that may be required.

7.2. LOCAL TRANSPORT

The Consultant will be responsible for local transport within Yerevan. For travel to other cities, ENA will provide transportation with their cars and staff.

7.3. PORTABLE COMPUTERS, AND TELEPHONES

The Consultant's international staff are expected to have their own portable computers. ENA will arrange for projectors for presentations. The Consultant will provide its own mobile phones, SIM cards while in the country. Internet connection while in ENA will be available through a wireless network, although communications cannot always be guaranteed and the Consultant is advised to arrange for their own mobile communication.

8. PROJECT MANAGEMENT TIME SCHEDULE

8.1. TIME DURATION AND START OF THE SERVICES

The project is expected to be completed as per schedule above from time of contract signing. The estimated date for the start of services is 1st of May 2018. ENA expects that the Consultant will engage full-time the two ENA's engineers, who will support data collection and data analysis during the execution of the project.

8.2. ADVANCE PAYMENT

An amount of 10% (ten percent) of the agreed contract value can be made to the consultant as advance payment. The securitization shall be discussed during contract negotiations.

8.3. MEETINGS

Regular brief meetings will be held on a weekly basis using direct telephone calls or teleconferencing if this is required.

8.4. MANAGEMENT REPORTING ARRANGEMENTS

The Consultant will report to the project Manager of ENA and to the project Manager of IFC. IFC will provide guidance and review all documents and progress by the Consultant and

will advise ENA on the way forward. Any communication by the Consultant by emails shall be copied to both project managers.

8.5. WORKSHOP/TRAINING

The Consultant shall conduct two workshops during the execution of the project, as follows:

- one-day workshop to discuss the proposed model.
- one-day workshop following the submission of the demand forecast results to present the completed work.

A four-day training seminar /workshop shall be conducted for the use of the model. The training seminar will include issues with data, the methodology developed, assumptions and factors considered in developing the forecast, use of the software and documentation.

8.6. LANGUAGE

The language of the contract and communication with the Consultant shall be the English Language.

9. CONSULTANTS QUALIFICATIONS

9.1. QUALIFICATIONS AND EXPERIENCE

i) Company experience should include:

- Proven experience in preparing electricity demand forecasts. This should be the main focus of the company or the department of the company and should have carried out at least five similar demand forecasts.
- **Geographic experience**: Experience working in similar countries and systems as the client's country.

ii) Staffing: It is expected that at least two specialists will be engaged, including a senior expert, who will act as the project manager and the client interface, and a modelling specialist / expert. Both specialists shall have experience and proficiency in setting up demand forecasting models. The expertise of the specialists will be as follows:

- Project Management – Chief Forecaster Specialist: At least a Bachelor's degree (Master's degree will be an advantage) in economics or electrical engineering, with minimum 20 years' experience, including at least 10 years as team leader or deputy team leader, or generally in responsible positions, 5 years of relevant international work experience on similar assignments, proven communication skills, proven competency in participatory approach. Fluency in English (Russian or Armenian would be an advantage) with strong written and spoken skills.
- Demand forecast modelling engineer's qualifications: At least a Bachelor's degree in economics / finance / electrical engineering / IT with work on economics with a minimum of 15 years' working experience in similar assignments, including at least 10 years of relevant international assignments (outside his/her country of origin)., with strong experience in demand forecast. Good communication skills and competency working with counterpart staff on system design are required. Fluency in English (Russian or Armenian would be an advantage) with strong written and spoken skills.