



**RURAL ELECTRIFICATION AGENCY**

ENERGY = EMPOWERMENT = EFFICIENCY

**NIGERIA ELECTRIFICATION PROJECT**

## **TERMS OF REFERENCE (TOR)**

**CONSULTANCY SERVICES FOR PROJECT FEED (FRONT – END –  
ENGINEERING – DESIGN) FOR PHASE 3: ENERGIZING EDUCATION  
PROGRAM UNDER THE RURAL ELECTRIFICATION AGENCY**

**December 2019**

## DRAFT TERMS OF REFERENCE

### For Consultancy Services for FEED (Front – End – Engineering – Design) for Rural Electrification Agency (REA).

#### 1. BACKGROUND

The African Development Bank ("The Bank") has provided financial support to Rural Electrification Agency (REA) through Federal Ministry of Power, Works and Housing, under the Nigeria Electrification Project (NEP). The Project will set up an aggregate of 19.5MWp Captive Solar Hybrid PV & Gas Powered Plant under the "Energizing Education Project" (EEP) for the 8 Federal Universities. The Bid for Engineering, Procurement, and Construction (EPC) Contract of this 19.5MWp Captive Power Plants Project (the Project), including initial one (1) year of operation and maintenance services is expected to be concluded by second quarter 2020.

It is anticipated that contract with the successful bidder would be signed immediately and the implementation of project would commence. REA (the Employer) now intends to hire a Consulting Firm to conduct the FEED (Front – End – Engineering – Design), for the installation of the 6 solar PV hybrid plants with storage and 2 gas fired plants (under Phase III).

The Consulting Firm shall perform the FEED by conducting energy demand audit measurements at the sites under consideration and then develop detailed designs for the Solar Hybrid Power and Gas Fired Plants using the data obtained from the energy demand audit that will serve as inputs to the Front-End-Engineering-Design (FEED) and subsequently build technical specification line items for Standard Bidding Documents and Bill of Engineering, Measurement and Evaluation (BEME).

The implementation period for this service contract is expected to be 6 months in total.

#### 2. DESCRIPTION OF THE PROJECT

Phase III of the Energizing Education Program (EEP) will be implemented in the following 8 Federal Universities.

S/N	Location	State	Region	Plant Type
1	Modibbo Adama University of Technology, Yola	Adamawa	North East	Solar
2	Federal University of Dutsin-Ma	Katsina	North West	Solar
3	Federal University of Lafia	Nasarawa State	North Central	Solar
4	Federal University of Lokoja	Kogi State	North Central	
5	Federal University of Technology Owerri	Imo State	South East	Gas& Solar
6	University Of Port Harcourt	Rivers	South South	Gas
7	Federal University of Uyo	Akwa Ibom	South South	Solar
8	Federal University of Technology Akure	Ondo	South West	Solar

### 3. SCOPE OF WORK

#### 3.1 Objectives of the Assignment

The objectives of the consulting services are to conduct the FEED, including the preparation of designs and technical specifications which form part of the bid documents, for the installation of Solar PV hybrid plants with storage and gas fired Thermal power plants for the 8 Federal Universities. The consultant shall perform energy demand audit measurements using the Power and Energy Data Loggers at the Universities with a high standard of workmanship, accuracy, and in accordance with the best practices. Thereafter, the future expansion forecast will be carried out with Homer, RETScreen or other approved tools and relevant report submitted for review.

This Consulting services will be executed to acceptable environmental and social standards and in accordance with the REA's requirements and the Bank's Safeguard Policies. The objectives of the services will be achieved through the following major activities:

- Perform energy demand analysis at all 8 universities;
- Evaluate the MV/LV distribution network at all 8 universities in order to identify required actions for the distribution network upgrade to accommodate the proposed power solutions;
- Provide assessments on streetlight distribution infrastructure at all 8 universities and provide designs on new streetlight infrastructure;
- Perform investment grade energy audits and propose energy efficiency measures to be implemented.
- Design of Solar Hybrid PV Power Plants using Homer, PVsyst or other accredited design software;
- Design of Gas Fired Power Plants using Etap or accredited design software.
- Provide architectural and structural designs for Workshop and Training centre for renewable energy and recommend the equipment to be outfitted;
- Provide transient stability analysis on the distribution network on ingress of proposed power plant using ETAP power analysis software (or any other software of equivalent capability) and suggest the best connection mechanisms;
- Development of Technical Specifications for the power plants, the distribution network and street lighting on a site by site basis; and
- Conduct Financial Pre-Feasibility Studies based on the above technical specs.

In order to maintain close liaison between Project Management Unit (PMU) at REA, the Employer requires that the Consultant's design staff members are all located on the REA selected Project sites or at a minimum in the six (6) geo-political zones in Nigeria: North East, North West, North Central, South East, South South, and South West.

## **4. DETAILED DESCRIPTION OF THE ASSIGNMENT**

### **4.1 FEED & Energy Efficiency studies**

The FEED study is a critical phase in the development of large projects – particularly those that are unique in terms of scale, technology, or configuration, where reference plant cost and performance information is unavailable. The main objective of the FEED study phase is to establish and define the technical scope of work and project execution in sufficient detail to determine the project cost and commercial terms that form the basis of a firm EPC price and proposal for the Project. Doing so requires completion of the total Solar Hybrid PV/Gas Fired Plant engineering and planning effort, which reduces the Project risk before moving into detailed engineering and construction.

The Consultant shall conduct Front-End Engineering Design as defined in the contract for the above works and specifically carry out the following duties:

- a) Perform complete energy demand assessments at all 8 universities to gain a full understanding of the current load duration curves so as to adequately size the power plants. Short term and tactical demand forecasting for the mid-term will also be conducted for the 8 universities. Where significant additional load is expected in the short-medium term, these should also be factored into the analysis as well as energy conservation measures with a feasible payback as identified in this assignment
- b) Conduct investment grade energy audits at all 8 sites and propose costed set of energy efficiency measures that could be adopted at locations/load centres. Conduct financial analysis for each measure presenting investment metrics NPV, simple payback and IRR;
- c) Evaluate the existing MV/LV distribution network and develop layouts and a single line diagram (SLD) indicating all major equipment and machines on the entire distribution network and identifying required actions to upgrade the network to accommodate the future power solutions.
- d) Perform transient stability analysis on the distribution network using ETAP power analysis software (or any other software with similar capability) to ensure stability of the network on ingress of new power solutions and suggest the connection mechanism. This will include a network steady state and transient stability analysis. Where the power plant is utility grade PV, evaluate the Fault ride through requirements for the power plant.
- e) Inspect the existing streetlight distribution infrastructure on the entire University/Hospital layout network and develop layouts and a single line diagram (SLD) and identifying additional lighting needs (if applicable). Street light analysis should include detailed illuminance analysis.
- f) Provide a suitable design for the Workshop and Training centres with fully equipped electrical & mechanical training equipment.
- g) Prepare a "FEED Report & Energy Efficiency plan" for the works under the contract and supply 5 copies of the same to the Employer for future reference

### **4.2 Detailed Project design**

- 4.2.1 Conduct technical and financial pre-feasibility studies for each Solar PV hybrid project site.

- a) Assess the most appropriate technology solution including a cost benefit analysis (batteries vs no batteries, diesel back-up vs no back-up, inverter connection mechanism etc.)
- b) Size power plant. Different scenarios shall be provided, such as the ones that lead to: (i) minimum LCOE, (ii) Minimum O&M costs, and (iii) Maximum solar PV contribution.
- c) Design or recommend system upgrades required in distribution network within the campus, as well as street lighting. This should include the metering infrastructure for the different building, in order to ensure proper monitoring.
- d) Estimate budget required for installation and commissioning of all power plants on a site by site basis
- e) Assess technical and economic feasibility of the different scenarios (at least 3 scenarios).
- f) Recommend a final Power solution for each campus according to needs and resources available.

#### 4.2.2 Conduct technical and financial pre-feasibility studies for each gas-fired project site.

- a) Assess the most appropriate technology solution for gas fired generators and diesel engines back-up for critical infrastructures, etc.
- b) Size power plant(s). Different scenarios shall be provided, such as the ones that lead to: (i) minimum LCOE, (ii) Minimum O&M costs, and (iii) Gas engines with good electrical and mechanical efficiencies.
- c) Consultant shall be required to provide comparative cost advantages and analysis on the following gas fired fuels; LNG, CNG, PNG and as well as diesel in relation to cost(s) per kWh, SCM (i.e. standard cubic meter of gas), Equipment and maintenance.
- d) Design or recommend system upgrades required for the distribution network within the campus, as well as street lighting. This should include the metering infrastructure for the different buildings, in order to ensure proper monitoring.
- e) Estimate budget.
- f) Assess technical and economic feasibility of the different scenarios.
- g) Recommend a final solution for each campus according to needs and resources available.

#### 4.2.3 Provision of detailed designs for each project site, including engineering drawings, Bill of Quantities, cost estimation and technical specifications

- a) Provision of Plant Design and drawings, including detailed layouts and Single-Line Diagrams of approved technical solution.
- b) The Consultant shall provide the design for the plant including all required electrical, mechanical, structural & civil works, which form the basis of the construction and equipment contract documents. The Consultant shall assume responsibility for the adequacy of such designs.
- c) Provision of Architectural and Structural designs for Workshop & Training Centre with recommended electrical & mechanical equipment to be outfitted.

- d) Equipment specification: The Consultant shall prepare equipment specifications for each site that will provide adequate power requirement with a minimum solar fraction of 70% for Solar PV hybrid sites and a minimum nitrogen oxide and noise emissions for the gas-fired power plant sites with the below activities.
- e) Assess gas-fired power projects for compliance with technical and environment standards and regulations.
- f) Provision of Bill of Quantities (BOQ) and Bill of Engineering Measurement for Evaluation (BEME) that will be included in the Bidding document on a site by site basis.
- g) Based on the BOQ, provide a detailed cost estimation for each project site.
- h) Propose technical evaluation criteria to be used during the evaluation of Expressions of Interest or proposals.
- i) Know-how and Technology transfer (KHTT) to enhance the Employer's technical knowledge on solar PV hybrid and gas fired power systems development and project management capacity through on-the-job training.

## 5. CONSULTING FIRM'S QUALIFICATION

- The consulting firm must be a registered Engineering Consultancy Firm and shall have at least 10 years of cumulative experience in design and installation of Solar Hybrid PV Power Plants and Gas Fired Power Plants;
- Must have at least 5 years' experience in developing and operating utility scale solar PV and gas fired power construction projects.
- Must have worked as independent consulting engineer in at least 5 solar projects larger than 5 MWp and total track record more than 10 MWp and gas fired power constructions.
- Must have a track record in grid interconnection at 11 KV or more for at least two (2) projects.
- Must have a track record in civil works for at least two (2) solar PV projects and two (2) gas fired projects.
- Must have conducted two (2) Energy Demand audits for distribution systems; and
- Evidence of having used ETAP power analysis software or equivalent to perform analysis on the distribution network to ensure energy efficiency and stability of the network and proof of project where such analysis has been performed.

### 5.1 Team Composition

The Consulting Firm is expected to have and assign adequately qualified key personnel to carry out the Consulting Services. In particular, the key personnel should possess the qualification and experience as indicated below:

S/N	PERSONNEL	REQUIRED QUALIFICATION & EXPERIENCE	PERSON/MONTH
1	Team Lead/ Solar Expert	Bachelor's Degree in Electrical Engineering with 10 years of general experience and over 5 years of experience in solar and	1/6

		solar hybrid power projects. He/she shall have experience as a team leader, directing the design, development and operation of at least two (2) solar (hybrid) projects of an installed capacity of 5 MW or above.	
2	Civil Engineer 1	Bachelor's Degree in Civil Engineering with 10 years post qualification experience in Foundations, Structures and at least 3 years of experience for solar photovoltaic (PV) and/or gas projects	1/6
3	Civil Engineer 2	Bachelor's Degree in Civil Engineering with 5 years post qualification experience in Foundations, Structures and at least 2 years of experience for solar photovoltaic (PV) and/or gas projects	1/6
4	Electrical Engineer 1	Bachelor's Degree in Electrical Engineering with 10 years of general experience and over 5 years of experience in gas fired power plant.	1/6
5	Electrical Engineer 2	Bachelor's Degree in Electrical Engineering with 6 years post qualification experience in Solar PV and/or Solar PV / Gas Hybrid power projects. AutoCAD proficiency is required.	1/6
6	Safeguard Specialist (Health, Safety & Environment	Bachelor's Degree in Social Sciences or equivalent with 5 years post qualification experience in HSE with at least 3 years of experience in Solar photovoltaic/Gas projects environment.	1/6

7	Financial Expert	Bachelor's Degree in Accounting, Finance or related field with 5 years post qualification experience in financial and economic analysis of power projects and systems. At least 2 years demonstrated experience modelling and investment experience on solar photovoltaic projects and/or gas powered construction.	1/6
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## 6. DELIVERABLES

The consultants are expected to work in collaboration with the members of Rural Electrification Agency / Nigeria Electrification Project toward successful execution of the assignment to achieve the deliverables as indicated below:

S/N	Deliverables	Timeline	Payment Schedule
1	Inception Report	T + 2 weeks	10%
2	Draft Energy Demand Analysis Reports	T + 6 weeks	30%
3	Final Energy Demand Analysis Reports	T + 8 weeks	
4	Draft Technical and Financial Pre-Feasibility study (Incl. evaluation of MV/LV distribution network, streetlights, energy efficiency studies).	T + 12 weeks	
5	Final Technical and Financial Pre-Feasibility study (Incl. assessments on MV/LV distribution network, streetlights, energy efficiency studies).	T + 15 weeks	45%
6	Detailed Design including drawings, BOQ/BEME & cost estimation for each site	T + 18 weeks	
7	Provision of Technical Bidding documents & Report on Existing distribution network/streetlights infrastructure and equipment with SLD and provision of Architectural & structural design for the Workshop and Training Centre including recommendations of equipment for the electrical and Mechanical workshops and training centre.	T + 20 weeks	30%
8	Provision of Detailed Project Report (DPR) and	T + 24	



	Equipment specifications.	weeks	
Note: T= Contract Signature date			

## **7. DURATION**

The assignment shall be for six (6) months.

## **8. CONSULTANT'S FACILITIES**

### **8.1 Housing and Office for Consultant**

The Consultant shall arrange its own accommodation and office.

### **8.2 Consultant's Transportation**

The Consultants shall arrange the rental vehicles including all necessary costs, such as drivers, fuels, maintenance fees, and insurances.

### **8.3 Equipment and Miscellaneous**

The Consultant shall arrange the office equipment including computers with necessary software at their own cost.

### **8.4 Travel and Hotel Accommodation in Nigeria (if identified).**

The cost of all travel and accommodation shall be included and arranged by the Consultant.

## **9. REPORTING**

The assignment will be implemented with direct reporting to the Head, PMU for the Nigeria Electrification Project.

## **10. REMUNERATION AND PAYMENT**

### **10.1 Terms of Payment for Consulting Services**

Payment shall be made against deliverables as outlined in section 6

### **10.2 Reimbursement**

The Consulting team shall get the reimbursements in line with the Contract Agreement.

## **11. COPYRIGHT AND OWNERSHIP**

All raw and finished materials shall be the property of REA. The firm shall maintain confidentiality of all information received from the REA and other sources concerning all data and insights obtained during the course of the assignment.

## **12. SELECTION METHOD**

Consultant will be selected in accordance with the Quality-and-Cost-Based Selection (QCBS) set out in the in the AFDB procurement framework for group funded operations, October 2015. [www.afdb.org](http://www.afdb.org)