TERMS OF REFERENCE
FOR
APPOINTMENT OF CONSULTING FIRM FOR FEASIBILITY STUDY (Including ESIA) For APPROXIMATE 70 MW (AC) GRID TIED SOLAR POWER PROJECT AT MATARBARI, COX'S BAZAR

1. Project Background

Electricity plays a pivotal role for the socio-economic development of a country. In the recent years Bangladesh has experienced booming economic growth, rapid urbanization and increased industrialization. The Government of Bangladesh has set target to be a high-income country by 2041.

To fulfill the GoB's vision and objectives of electrification, development of renewable energy resources will play a vital role. The government has taken appropriate measures for generating environment-friendly electricity from renewable energy sources. Present generation from RE sources has increased to 1202 MW. The Hon'ble Prime Minister has declared to generate up to 40% from clean energy by 2041. Coal Power Generation Company Bangladesh Limited (CPGCBL) has taken initiative to implement a Solar Power Plant at Matarbari, Cox's Bazar.

2. Purpose of the Assignment

The main objectives of this assignment are:

a) To increase the RE share in total electricity generation mix;
b) To assist CPGCBL in developing RE based power generation project with Battery Energy Storage Systems (BESS);
c) To attract investment;
d) To develop business model for the solar project;
e) To assess the site specific Environmental and Social Impacts.

3. Duration and Location of the Services

The duration of this assignment will be 06 (six) months. The location of service will be at Matarbari under Cox's Bazar district of Bangladesh. The sites for the feasibility studies are:

(a) Ash Pond area of Matarbari 2x600 MW USC Coal Fired Power Project; and
(b) Embankment area of Matarbari 2x600 MW USC Coal Fired Power Project.

Sites are at various stages of development. Current ground level of ash pond area is approximately MSL +6 meter. Whereas, embankment area is already developed. Height of the embankment is around MSL +10 to 14 meter. Solar PV panels will be installed at the slopes of the embankment.

4. Scope of Services

The scopes of services for the feasibility include the following. The consultants can propose some modifications in the scope of work to meet the objectives of the assignment.

a. **Technical feasibility Study**

Optimum generation option on the land parcel offered by CPGCBL in Matarbari with: -

A. Solar generation only
B. Solar and BESS option:

Option B.1: 50% of solar MW generated injected to grid and 50% to BESS for peak hour feeding – daily one cycle of charge & discharge and
Option B.2: 100% solar to BESS for peak hour feeding

The scope will include but would not be limited to:

- Site visit of proposed RE plant;
- Review previous pre-feasibility study, feasibility study, ESIA reports, Embankment design documents etc.;
- Determine the Plant Capacity;
- Review the available technology in the market and recommend the best technology for the project and fix the efficiency level of the equipment. Detailed technical specification of each equipment of power plant (from PV panel up to transmission line). Provide recommendation on mandatory spare parts. Conduct Shading analysis including near and far shading. Prepare layout of the plant and complete single line diagram of power plant including all protection & metering system. Analysis of the solar radiation data of the proposed location. Yield calculation using PV simulation software (It includes month wise energy generation, Loss diagram over the whole year, Specific energy yield, Month wise performance ratio etc.);
- Evaluation of the location & size of land, plant capacity, technology, logistic arrangement, grid connection facility, IEE, ESIA, investment, financing and operation cost estimation, possible tariff modality options, maximum possible RE sizing within the location with optimum combination of options mentioned in option A and B;
- Study of site details (Assessment of required land, water, power, and other infrastructure facilities including, solar radiation, climatic conditions, flood level, soil condition, etc.,) for each of option A and B. (Evaluation of options for solar panels to be compliant with all applicable codes, standards, and statutory requirements);
- Impact assessment of installation of Solar PV plant on the existing Embankment of Matarbari 2x600 MW USC CFPP. Based on the assessment, recommendation to be provided whether the embankment is capable/ suitable for the installation of Solar PV plant on it or not;
- Evaluation of available technologies for solar power plant maximum generation with minimum land footprint. Evaluation of equipment performance, losses, degradation pattern for each technology;
- Battery disposal system with recommendation;
- Estimation of solar power generation (MKWh) using available tools like WASP, PV Syst, SAM or Equivalent (software output report have to be submitted);
- Evaluation of various types of Panel, Structure (fixed tilt, tracker controlled – single axis / multi axis). technologies for Remote Monitoring System, SCADA, Shading analysis, metering system and Protection system;
- Techno-commercial evaluation of the selected options based on the location of installations and climatic conditions;
- Finalization of the best suitable technology supported by comparative statement of different technologies involving efficiency, CAPEX/OPEX/DEVX, final product (power) tariff ;
- List of balance of plant packages like:
    i. Including electrical BOP, Metering, SCADA;
    ii. Panel cleaning system (Consultant should assess Manual cleaning system and

automatic cleaning system including dry and wet method. In case of wet method, impact of the saline water use in panel cleaning need to be assessed.);

iii. Roads and Drains;
iv. Zero discharge plant;
v. Reject water conditioning;
vi. STP etc.

- Power Evacuation

  i) Recommend on the method of power evacuation and the necessary agreement required with concerned utilities/PGCB. Identify key issues and provide solutions/ recommendations for grid stability to the utility to accommodate and integrate the solar power generated from the proposed plants. Identify additional investments and its cost estimates required for successful integration of the solar project. Study the existing power system and identify gaps, load centers to ensure that the renewable energy generated is fully utilized without any curtailment. Conduct Network Modelling, Electrical connection specification, Load Flow Analysis, Contingency Analysis, Short Circuit Study, etc as required by PGCB.

  ii) Preparation of overall plot plan, Conceptual Design, and Single line diagram (for the options A and B and block layouts for solar power generation plant, BESS, Electrical transmission network and other applicable facilities including all Mechanical, Electrical, Civil, Protection, Control & Instrumentation systems, testing facilities, SCADA, considering safety distance for each facility and emergency response planning etc.

- Planned Monitoring Technology/Remote Monitoring

- Test Soil Condition

  Carry out soil testing at the site to assess the soil condition and load bearing capacity and recommend the kind of foundation required for the solar panels. The borehole layout plan should be shown in the Digital Topographical survey map in x, y, z Co-ordinate. The 'z' co-ordinate shall be in respect to SOB/PWD BM; Execution of Standard Penetration Test (SPT) at an interval of 1.5m depth with collection of disturbed soil samples up to final depth exploration of each boring; For each bore-hole, minimum depth of boring shall be 20m. If poor quality soil encountered (say SPT value<20) the depth shall be extended up to 30m or more. (Normally SPT is taken @1.5m interval, but SPT must be taken at 1m interval up to top 6m depth); If clayey soil is encountered at any depth during boring, undisturbed soil samples must be collected with the help of shelby tubes.

- Conduct Morphological, Geotechnical and Topography study of the site.

- Civil construction requirement:

  Based on soil condition consultant should make recommendations on the following:

i. Recommendation on required ground improvement / elevating structure for RE plant and final ground level;
ii. Source of fill;
iii. Location of major equipment items;
iv. Recommendation of foundation type;
v. Recommendation for mounting structure and soil / flooding protection

In addition to the above the Consultant shall provide descriptions of each major civil structure including its location. The report shall consider other civil items required for a complete plant design such as, drainage, roads etc.

- Detailed technical specifications of Solar power Generation for the selected capacity with all applicable ancillary equipment and facilities including as below:
  i. Plant sizing calculations & System configurations;
  ii. Plant Layout;
  iii. Technical details of solar panels, inverters, transformers and Remote Monitoring System, SCADA, Battery, central monitoring system, Module Mounting structure, DCDB, ACDB, pooling substation, etc.;
  iv. Generation plant network from the production plant till grid connectivity terminal point;
  v. Fire protection & detection system;
  vi. Damage detection and protection system;
  vii. Painting and coating on structures, electrical components, building etc., (Considering Coastal Environment);
  viii. Auxiliary power requirement;
  ix. All the required Electrical, Mechanical, Civil, C&I systems and ancillary systems and utilities including power, water, etc.;
  x. Standard performance data sheet of major equipment.
- Preparation of preliminary Bill of Quantities (BOQs) as per the layout.
- List of the waste generated and waste management
- Socio-Environmental Risk Assessment
- Assess Agriculture and Fisheries Prospect:

  Agricultural, animal husbandry and Fisheries possibility of farming in the RE site below the erected modules and open locations in the site to introduce multipurpose use of land.
- Health Safety and Environment (HSE) Requirements
- Potential challenges
- Suggested manufacturing vendor database.
- Share complete list of component wise proven vendors along with contact details
- Identification, prioritization of OEMs for collaboration & the corresponding nature of collaboration.
- List of codes and standards applicable.
- List of Statutory approvals, No Objection Certificates (NOCs)/ permissions from all the applicable approval authorities (i.e Local Government, SREDA, etc).
- Review legal and institutional aspects of the land, environment and other issues for the proper

implementation of the project.

- Detailed list of safety measures and facilities for the safe execution operation
- Tentative project Implementation Schedule
- Suggest Project Implementation Methodology including PPA, IA etc. signing process
- Assessment logistic feasibility during consignment and construction phase. The Consultant shall perform a detailed study on the logistics plan for oversized & heavy equipment transportation during power plant construction. In addition, the report shall review the road system modifications which may be needed to transport goods from port to site.
- O&M philosophy
- Manpower requirements for implementation and operations of the facility.
- Decommissioning Plan
- Owner's Engineer and Engineering Procurement and Construction:
    i. Scope of Work
    ii. Prequalification Criteria
    iii. Development of bidding and evaluation strategy
    iv. Contracting strategy and financing considerations
    v. EPC term sheet
    vi. Bidding document [Standard of bidding document format will be intimated during ordering i.e. as per World Bank/JICA/ADB/FIDIC standard]
- Detailed risk matrix
- List of spare parts
- Development of long-term project financing and working capital term sheets including indicative terms and due diligence/compliance requirements
- Proposed investment incentives

b. Commercial feasibility Study

- Life Cycle Cost Estimation for the facility including:
    i) Preparation of CAPEX calculations;
    ii) OPEX Costing;
    iii) Project cost estimate with accuracy of ±10%, shall include the following:
        a) Basis of cost estimates;
        b) Phasing of expenditure;
        c) Possible costs and revenues for emission reduction certificates;
        d) Escalation in O&M costs and its basis;
        e) Replacement cost of specific components during the project life with breakups;
        f) Taxes, duties and levies applied to equipment for solar power projects;

g) Financing cost;

h) Requirements for the execution of economic and financial analyses.

iv) Financial Model (including investment cost ($/kW), levelized cost of energy ($/kWh), subsidies, incentives (e.g. applied to the equipment's costs, carbon credit etc.), levelized energy tariffs, costs and benefits, total cost of ownership/life-cycle costs of plant, payback time, insurances costs, costs recovery, IRR, NPV, etc.). Cost estimation should be with an accuracy of ±10%.

v) Multipurpose use of land needs to consider for calculation of leveled tariff and tariff modality.

vi) Sensitivity analysis of project cost with respect to various generation plant capacities.

vii) Calculations and assumptions for arriving at the project cost

viii) Commercial feasibility evaluation (considering CAPEX, IDC, OPEX, Depreciation, efficient debt structuring, loan repayment and arriving at tentative sale tariff to be executed for considering 20 years of operation) and indicating of final feasible tariff specifically for considering PPA.

c. Environmental and Social Impact Assessment

- Environmental, Social, Disaster and RAP Issues:

Review the existing environmental laws and regulations and recommend environmental issues that may arise as a result of the implementation of the project. Conduct assessment of social, disaster and environmental impacts (IEE, DIA, ESIA) of the project at the selected sites. The assessment shall include an analysis of current formal/ informal land use in the project area as well as impacts associated to connecting the PV plants to the grids. Based on collected data, the environmental impacts and subsequent mitigation and management required should be reflected in the EIA/ESIA report. Disaster impact assessment along with possible mitigation and management requires to be added in the DIA report. Institutional arrangement for environmental, social, disaster monitoring and management for the project should also be reflected in the report. Prepare a full IEE, EIA/ESIA, DIA as per development partner agencies and Department of Environment (DoE), Bangladesh guidelines. Arrange necessary approval on IEE, EIA/ESIA, DIA report from Department of Environment, Bangladesh. It can be noted that the consultant shall pay all the fees for the approval of such report as per the DoE guidelines. Review existing RAP prepared for Matarbari 2x600 MW Coal Fired Power Project and provide recommendation. Develop the RAP as per development partner agencies requirement and Department of Environment (DoE), Bangladesh guidelines.

- Conduct Flood/ Cyclone Risk Assessment:

Conduct a flood risk assessment of the site. Based on secondary flood level data and documentation about flood in the region, the consultant will assess major geological structures

in the area and geotechnical conditions likely to be encountered on site. The consultants will also assess the hydrology/ hydrogeology of the area and potential risk of flooding as well as historical records or previous investigations, mining/landfill use, possible contamination sources etc.

Conduct a Cyclone Risk Assessment. Based on secondary Cyclone data in the region. Consultant should consider potential risk of wind speed, wind direction etc during Cyclone.

5. Detailed Outputs of the assignment (and applicable quality standards, where applicable)

5.1 Team Composition and Qualification Requirements for the Key Experts (and Any Other Requirements that Will Be Used for Evaluating the Key Experts)

Consulting services are solicited from Renewable Energy Experts experienced in preparing a solar based power plant of minimum capacity of 40 MW. Consulting firms should have experience to perform the consultancy services, experience of similar assignments, experience in similar conditions, firm's capability, and availability of appropriate skills among key staff, availability of resources, relevant transactional experience. The Proposer is expected to engage the following categories of key experts for the Project and CVs shall be submitted accordingly:

- **Solar Expert and Team Leader (Position-1 International, 6 person months):** The Team Leader must have at least a Bachelor's degree in Engineering or Masters in Renewable Energy from a recognized institute with minimum of 20 years of experience including minimum 5 years of experience in the field of solar energy technology. He should preferably have experience of carrying out feasibility study of minimum of 40 MW solar plant. The solar expert should have good knowledge of PV standards and experience on resource assessment and calculation of energy yield for solar PV projects.

- **Power System & Power Evacuation Specialist and Deputy Team Leader (Position-1 National, 6 person months):** The Power System Specialist should have at least a Bachelor's degree in electrical engineering from a recognized institute and 15 years of experience in the power sector including in power generation, transmission network analysis, grid integration of renewable energy-based generation. He should have knowledge of integration of solar projects with the national grid as well as stability of the national grid. He should be able to perform Network Modelling, Electrical connection specification, Load Flow Analysis, Contingency Analysis, Short Circuit Study, etc as required by PGCB. He should have experience in electrical system design. He should be able to estimate associated cost required for successful integration of the solar projects.

- **Civil Design Expert** (**Position-1 National, 3 person months):** At least a Bachelor's Degree in Civil Engineering from a recognized institute with a minimum of 15 (fifteen) years of experience in the power sector including at least 5 (five) years of experience in designing of Power Plant related infrastructure is required. It would be desirable for the civil engineer to have expertise in designing foundations and structures of RE in marshy/ flood prone area with buoyancy uplift challenges.

- **Environmental and Social Expert (Position-1 National, 5 person months):** The Environmental and Social Expert must have at least a Master's degree in Environmental Science from a recognized institute. The expert must have a minimum of 10 years of experience in the field of environment as well as safeguard policies and able to carry

out detailed environmental and social study of solar sites. He should have experience of RAP preparation.

Legal & Institutional Expert (Position-1 National, 3 person months): The Legal Expert must have a Master's degree in Law from a recognized institute of higher learning. The expert must have a strong background and experience in Bangladesh law and legislation related to land management, environment and conservation and natural resource management. The expert must have a minimum of 5 years of relevant and practical experience. The expert must preferably have experience in drafting commercial documents.

- **Financial/ Economic Analyst (Position-1 National, 3 person months):** The Financial/ Economic Analyst must have a Masters in Economics/ Finance/ Business Administration from a recognized institute subject with a minimum of 5 years of experience in financial/ economic analysis. The specialist shall be able to provide the cost benefit analysis of the solar project in financial and economic terms. Provide also a basis for solar PV development plan for Bangladesh based on the existing available generation and identify the benefits based on fall in solar PV prices, Storage price etc.

- **Energy Storage Expert** (**Position-1 International, 3 person months):** At least a Bachelor's Degree in a related Engineering specialization from a recognized institute with a minimum of 10 (ten) years of experience in the power sector including at least 3 (three) years of experience in Energy Storage.

- **Bid Advisor/ Transaction Specialist (Position-1 Local, 3 person months):** The consultant should preferably have a degree in business administration, engineering or economics from a recognized institute and preferably 10 years of working experience in the energy sector, specifically on a competitive bidding framework in renewable energy. The specialist will prepare a competitive bidding framework. The specialist will also prepare a solar business plan incorporating the existing and proposed plan for solar project.

5.2 Reporting Requirements and Tentative Time Schedule for Deliverables

- Inception Report within 15 (fifteen) days of signing of contract
- Soil Test Report within 2 (two) months of signing of contract
- Interim Report within 2 (two) months of signing of contract
- Draft IEE, EIA/ESIA, DIA, RAP report within 4 (four) months of signing of contract
- Final IEE, EIA/ESIA, DIA, RAP report within 5 (five) months of signing of contract
- Approval of IEE, EIA/ESIA, DIA, RAP report from Department of Environment, Bangladesh, within 6 (six) months of signing of contract
- Standard Tender Document within 5 (five) months of signing of contract
- Standard PPA, IA Document within 5 (five) months of signing of contract
- Draft Feasibility Study Report within 5 (five) months of signing of contract
- 2 (Two) stakeholders meeting
- Training/Study tour during the duration of the study
- Final Feasibility Study Report within 6 (six) months incorporating comment from stakeholders

5 (Five) copies of each report (except Final IEE, EIA/ESIA, DIA, RAP report and Final Feasibility Study Report) have to be submitted along with a soft copy;

10 (Ten) copies of Final IEE, EIA/ESIA, DIA, RAP report and Final Feasibility Study report have to be submitted along with a soft copy;

Person to receive the Report: Director General, Power Cell

The consulting firm will report to Director General, Power Cell for billing and contract management. For work execution purposes, the consulting firm will report to Managing Director, CPGCBL.

5.3 Relevant background information or materials for the assignment*: Not applicable*

5.4 Indication is downstream work is potentially considered: No downstream work is expected at the end of the feasibility study.

5.5 Training and capacity building requirement*: M*anpower training: Training and capacity building requirement: To enrich the experience of officials of Power Division, Power Cell, CPGCBL and other utilities, consultant will arrange for a training program of approximately 10 personnel. The place and duration of training will be determined in consultation with client.

5.6 Equipment procurement*: —Not applicable*

6. Client's Input and Counterpart Personnel

(a) Services, facilities and property to be made available to the Consultant by the Client:

Facilitation and Reporting
The utility company will ensure access to the available pertinent information to this assignment. Consultant will work in close association with Utility Company Office, and other relevant utilities. A coordination mechanism will be set up to review progress, provide guidance and advice. The designated personnel of the entities will interact with the Consultants and provide data, arrange discussions and assistance as required. The Consultant will work under the guidance of CPGCBL and relevant Utility Company. The day-to-day work will be monitored by a representative of the CPGCBL.

Logistics Support
The Consulting Firm will be responsible for their own logistics.

(b) Professional and support counterpart personnel will be/not be assigned by Utility Company to the Consultant's team

(c) Selection of sites and concerned Utility: The final list of sites and the concerned utility under whose guidance the study will be carried out will be mentioned when RFP will be issued.

7. Client will provide the following inputs, project data and reports to facilitate preparation of the Proposals:

The consultant will have to collect relevant project data and reports from the respective departments as required to successfully completing the study.