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**FAST TECHNICAL ASSISTANCE (FTA)**

**FINAL DELIVERABLE**

**TERMS OF REFERENCE FOR DEVELOPMENT OF  
ELECTRICITY MASTER PLAN IN SEYCHELLES**

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## DETAILED TERMS OF REFERENCE FOR DEVELOPMENT OF ELECTRICITY MASTER PLAN IN SEYCHELLES

**Introduction:** Seychelles is an island country and is more than one thousand kilometres from any neighbouring country. It is deprived of any indigenous source of fossil fuel and so is heavily dependent on the import of refined petroleum to satisfy national needs, as well as the demands for international marine and aviation bunkers. The total installed capacity of electricity generation is around 100MW and is generated through four diesel-fuel fuelled thermal power stations, servicing the islands of Mahe, Praslin and La Digue, as well as the inner islands. The rate of electrification is nearly 100%. Transmission infrastructure is currently operating at 33 kV, with 11 kV distribution lines to most inhabited islands. Roughly 243 km of medium-voltage above-ground network exists, with a further 126 km of underground distribution network.

The Seychelles Energy Policy for 2010-2030 was formally approved by the Cabinet and adopted as official government policy in 2010. It recommends a sustainable development of the energy sector focusing on energy efficiency, renewable energy and reducing the dependence on oil to improve energy security. With an aim to diversify the energy supply, a 5% and 15% share of renewable energy is targeted for 2020 and 2030 respectively. The Energy Policy includes significant analysis of historical, existing and projected energy demand and supply, and proposes key changes to the institutional and regulatory framework for energy in the country, including strengthening the Seychelles Energy Commission, the creation of an independent energy regulator, and clearly defined IPP regulations to promote renewable energy development. The Energy Policy also represents the first formal recognition by the Government of Seychelles of the importance of renewable energy production. On the other hand, the Energy Policy is not a traditional policy or planning document and does not provide detailed targets, methods, or timeframes for instituting changes to energy management in the country.

**Context:** The Public Utilities Corporation(PUC) of Seychelles through their Nationally Designated entity approached CTCN and COI to support the development of the terms of reference to develop an electricity master plan. It is envisaged that a holistic plan will guide the utility company in the developing the electricity network in line with the transformation in the energy generation mix as laid out in the energy policy. The Electricity Masterplan will coordinate the development of the electricity infrastructure in the near and distant future as demand grows. It will highlight where work needs to be done and help to prioritise the many projects that will be undertaken. Significant investments need to be made to develop the electricity infrastructure and having an Electricity Masterplan will facilitate the process of obtaining financing for these projects from various funding bodies by helping to reduce the risk and by showing that they are part of a coherent plan.

**Objectives:** A consulting firm will be engaged to work closely with PUC to develop the electricity master plan for 2030. The overall objective of the assignment is develop a electricity master plan

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through analysis of the existing conditions, undertaking demand forecasting using relevant tools, identifying the least cost and economically viable means to reinforce, upgrade and expand distribution system including on- and off-grid, distribution loss reduction both technical and commercial through a proven utility operational approach, developing a demand side management programme and building capacity within the PUC to meet the goals as defined in the Seychelles Energy Policy.

## **1. Scope of Work**

### **1. Review and analysis of the energy sector with emphasis on electricity**

The Consultant shall undertake the following tasks:

- (i) Review existing reports regarding electrification plans and programs.
- (ii) Review and analyze all relevant laws and regulations.
- (iii) Review and analyze all relevant Government and PUC policy in relation to on- and off grid electrification.
- (iv) Identify the key gaps that are hindering the development of on and off-grid solutions.
- (v) Consult with stakeholder ministries, agencies and institutions regarding existing and planned approaches to on- and off-grid electrification.
- (vi) Summarize and provide recommendations for changes in legislation, regulation, policy and approaches to on- and off-grid electrification.

### **2. Primary energy survey**

Based on the existing data the Consultant shall

- (i) Identify the various sources of primary energy use and estimate their quantities.
- (ii) Estimate the primary energy consumption in various sectors and develop a primary energy balance for the country.
- (iii) Using demand forecasting models and tools project the growth of primary energy consumption upto 2030.
- (iv) Estimate the conversion of primary energy to secondary energy.
- (v) Undertake realistic estimation of the potential for harnessing renewable energy through different sources.

### **3. Electricity demand forecast**

The Consultant shall:

- (i) Collect the necessary data and information related to geographical divisions, demography, available infrastructure, socio-economic indicators, environmental and vulnerability checks, short, medium plans at national and local levels.

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- (ii) Investigate the social and economic conditions of settlements to assess the present and future electricity demand on Mahé, Praslin and La Digue using soft computing techniques, keeping in mind, availability of electricity, affordability, willingness to pay, potential productive uses of electricity, and population growth.
  - (iii) Prepare 10-year demand forecast (2019 – 2029) for each customer category.
  - (iv) Develop and analyze a range of demand forecasts scenarios (low/base/high growth, low/base/high elasticity between GDP and energy usage).
  - (v) Plot the average variances of the demand and estimate the peak demand over the 24-hour cycle and predict the shape of the demand curve on a short, medium and long term.

#### **4. DSM and Energy Efficiency**

The consultant shall

- (i) Identify the DSM measures as planned and mentioned in the Energy Policy.
- (ii) Make assumptions on the future DSM measures which would be implemented by the Government.
- (iii) Estimate the impact of DSM measures on the Electricity demand.
- (iv) Adjust the demand forecast as in (3) by offsetting the anticipated savings through DSM policies.

#### **5. Existing & committed power system**

The consultant shall

- (i) Identify the existing power plants and establish their base line information including installed capacity, date of refurbishment/maintenance records, electricity generation profile, fuel used, retirement dates etc.
- (ii) In case of any large-scale grid connected solar plant or wind mills exists similar data should be collected for the same.
- (iii) Map and analyze the existing transmission system (33kV/11kV) and identify the geographical areas served by them.
- (iv) Map the distribution system of low voltage feeders (440 V), including the substations, distribution transformers, load on each transformer, feeder length, underground cables.
- (v) Review and assess existing power system software models
- (vi) Undertake fault level calculations of the existing power systems
- (vii) Analyze the protection settings of the existing power systems on Mahé, Praslin and La Digue.

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## 6. Future development options

The consultant shall

- (i) In discussion with PUC, enumerate technically feasible sources of renewable energy which can be used to produce both grid connected and off grid electricity. This includes solar, wind, floating solar, micro hydro etc. For each of the sources identified the consultant would identify projects with technical operational parameters and cost and performance parameters.
- (ii) In discussion with PUC, and as per the Energy Policy, identify fuel options for thermal power plants including Heavy Fuel Oil, Light Fuel Oil and LNG. Based on existing economic models used to predict the fuel prices over a 30 year period, develop a price forecast.
- (iii) Enumerate 2-3 efficient power plant technologies based on oil and gas in discussion with PUC. Options to be as follows:
  - a. Four stroke reciprocating engines based on LNG
  - b. Four stroke reciprocating engines based on fuel oil with Waste Heat Recovery

For each of the sources identified the consultant would identify projects with technical operational parameters, and cost and performance parameters.

- (iv) Develop a screening curve to form an idea of the likely competitiveness and role for the principal power plant options.

## 7. Generation planning

The Consultant shall:

- (i) Based on data collected in points (1)-(6), assess the technical feasibility of the generation options and include them in the development of the optimum least-cost plan.
- (ii) Revise the estimated costs of supply-side options to January 2018 price levels.
- (iii) Assess scope and indicative costs of rehabilitation of present generating thermal units including the possible conversion of existing thermal units to other fuels (ex. natural gas).
- (iv) Select a software to develop different models and scenarios and develop and undertake a step by step approach to analyze the least-cost supply-side options and to identify the best power options available to meet load forecast, taking into consideration the multi-purpose nature of some of the available options.

## 8. Transmission and Distribution planning

The Consultant shall, on the basis of data collected and analyzed from points (1) to (7)

- (i) Select a software for network modelling and assessments.
- (ii) Estimate system losses and develop different scenarios with different voltage systems in line with the requirement of the grid codes.
- (iii) Estimate the technical losses and technologies to mitigate the technical losses.

- (iv) Evaluate and design distribution network reinforcement options
- (v) Develop 10-year transmission and distribution network expansion plans including ongoing additions and reinforcement to the existing systems; take into consideration future upgrade to 66kV transmission system
- (vi) Develop concept design of SCADA system for network monitoring and control
- (vii) Develop a new protection scheme for the transmission and distribution network
- (viii) Develop options to integrate high end technologies like net metering and demand controllers in the distribution systems

## 9. Isolated systems

The consultant for the three isolated system of Praslin, La Digue and Inner Islands shall develop:

- (i) Demand forecast
- (ii) Generation plan
- (iii) Distribution plan
- (iv) Protection scheme for electricity system

## 10. Review of tariff with emphasis on gross feed-in for renewable energy

The Consultant shall:

- (i) Review existing and historic tariffs for different categories of customers including an assessment of the extent and reasons for previous non-payment of bills to determine the basis for tariff setting, any cross-subsidies and subsidies given, the relationship between tariffs and costs (marginal vs. average), the tariff adjustment process and treatment of financial and social objectives.
- (ii) Analyze the investment, recurrent costs and tariff structures with and without the provision of grants and/or subsidies.
- (iii) Prepare an assessment of the adequacy of existing tariffs to cover estimated costs and support investment requirements.
- (iv) Assess the willingness and affordability to pay of targeted consumers together with the existing and future electricity needs, demand and tariff and formulate the optimum promotion policy for electrification making the tariff structure comfortable to pay by the consumers.
- (v) Design a tariff schedule that reflects the different customer categories to avoid cross subsidies and gain transparency and simplicity within the tariff structure. The tariff should take into consideration the consumers imposed costs on the electricity supply system namely, (i) capacity related costs, (ii) energy related and (iii) consumer related costs.
- (vi) Study and recommend appropriate feed-in tariff schemes (Net feed-in vs Gross feed-in) to ensure sustainable deployment of renewable energy in the country.
- (vii) Recommend business models of all proposed electrification methods, with and without the participation of private sector, community, elected bodies and NGOs.

## 11. Environmental and social considerations

The Consultant shall:

- (i) Identify the possible environmental and social impacts, both positive and negative from the planned electrification methods.
- (ii) Recommend appropriate mitigation measures to address the adverse impacts.
- (iii) Suggest strategies and actions for enhancing favorable impacts.
- (iv) Undertake detailed safeguarding analysis at pilot sites in line with international funding agency's safeguarding requirements.

## 12. Consolidation of the Master Plan

Based on policy and prioritization recommendations and the findings and results of other work streams, the Consultant shall:

- (i) Consolidate all data for electrification.
- (ii) Integrate all data, target sites/ settlements including relevant socio-economic parameters such as schools, health centers, police stations, information and communication centers, market centers into a GIS map and database.
- (iii) Prioritize electrification programs to achieve goals as in the energy policy by 2030.
- (iv) Identify the optimal electrification method for each of all un-electrified areas.
- (v) Prepare the overall master plan, including indicative cost estimates and economic and financial analysis.
- (vi) Through discussions with stakeholders and development partners, prepare an indicative financing plan for the master plan.
- (vii) Suggest institutional development and strengthening of existing organizations to implement the master plan.

## 13. Capacity Building

Strengthening the capacity of PUC and other institutions in master planning, least cost analysis, on- and off-grid designs, economic and financial analysis, safeguarding and business planning is a key part of the services. In this context the Consultant shall:

- (i) Review the existing status of and strategies and plans for capacity building of all key stakeholders.
- (ii) Identify the gaps and areas for capacity building needed to prepare, update and implement the master plan.
- (iii) Select capacity development initiatives for institutions and key individuals from short, medium and long-term perspectives.
- (iv) Prepare the plan of action including the details of the courses, budget, potential training of (HRD) institutions for the execution of the proposed capacity development initiatives.

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- (v) Ensure on-the-job skills transfer through the involvement of PUC counterpart staff in all aspects of master plan preparation.

## **2. Reporting Requirements and Time Schedule for Deliverables**

### **1. Reporting Requirements of Inception Report**

The Consultant shall provide an Inception Report as a reporting requirement. This Project Document shall meet the following requirements as minimum:

- Schedule of arrivals and departures of Key Personnel to the Seychelles (if any);
- List of Consultant's equipment to be used by the Consultant for the assignment (if any);
- Elaboration of methodology for the study and plan of work;
- Assessment of important issues and decisions to be taken for the work to progress.

### **2. Reporting Requirements of Monthly Progress Reports**

The Consultant shall provide a Monthly Progress Report on a monthly basis as a reporting requirement. This Project Document shall meet the following requirements as minimum:

- Reporting on the progress of the program activities, the staffing and logistics, the cumulative amount of interim payment certificates to date, the problems encountered in implementation, and other relevant events during the program period;
- Reporting on the achievement of milestones, as defined in the previous Monthly Progress Reports, addressing potential risks which might influence the performance of the works, and defining the milestones to be achieved in the next reporting period;
- Presenting cost and progress information using tables and figures as much as possible.

### **3. Reporting Requirements of Completion Report**

The Consultant shall provide a Completion Report as a reporting requirement. This Project Document shall meet the following requirements as minimum:

- An Executive Summary as part of the report document and as concise as possible;
- Information as reported in the Monthly Progress Reports, including final evaluation;
- Details of the actual process of the study conducted, including specific information of the activities as actually completed;
- Technical and financial performance of the program, including explanations of any time extensions and any cost savings or over-runs;
- The Seychelles Electricity Masterplan, as outlined in the Scope of Work.

### **4. Reporting Schedule**

The Inception Report shall be submitted one (1) month after the commencement date.

The Monthly Progress Report shall be submitted every month thereafter.

The Completion Report shall be submitted on completion of the Electricity Masterplan.

After the submission of a Project Document as draft version, the Client will review the documentation and provide written comments to the Consultant within twenty-one (21) days. Within twenty-one (21) days after these Client's written comments are provided, the Consultant shall submit to the Client one (1) hard copy and two (2) electronic copy on CD-ROM of the Project Document as final version, which incorporate these Client's written comments accordingly, to the following address:

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Seychelles

If no written comments are provided by the Client within twenty-one (21) days after the submission of a Project Document as final version, then the submission is deemed approved by the Client.

All Project Documents shall have quantities expressed in metric units.

## 5. Consultative Meetings and Workshops

A sound consultation process will be implemented to support the development of an Electricity Master Plan. This consultation process will be managed by PUC, with the support of the consultant and be organized at two levels:

### 1. Consultative committee meetings

Consultative committee meetings with the main stakeholders will be the main forum for discussing the (interim) results of the study, in order to inform on and guide steering committee decisions.

PUC will lead these meetings which will be prepared jointly with the consultant, who will participate at the meetings, present (interim) results and points for discussion and prepare the minutes.

### 2. Public Meetings

Furthermore, public meetings will be organized to obtain a direct feed-back from the population. PUC will call for public meetings, which will be prepared with the support of the consultant, who will participate at the meetings, and prepare the minutes including implications of the discussions on scenarios and the master plan.

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## 6. Donors mobilization

Potential donors will be involved in the project as early as possible by sharing project progress and interim results bilaterally. The consultant will in coordination with PUC organize, and participate in, a final donor's conference at the end of the project.

## 7. Estimated Effort

While several aspects of the assignment will consist of desk work, the Consultant is also expected to spend as much time as deemed necessary in the field and with the counterparts from the Government of Seychelles. The total effort for this assignment has been estimated at between 10 and 12 men months. The total time duration shall be 5 months.

## 3. Team Composition & Qualification Requirements for the Key Experts

At a minimum, the consultant team must have sufficient competency and experience in power system engineering and economics, and must be well versed with the operation of small island power systems involving medium sized (8-12 MW) plants operating on HFO, LFO and LNG, and intermittent renewable energy (in particular, wind and solar).

The team leader shall be a person with good oral and written communication skills, and should be able to demonstrate a high level of management skills and leadership. He/she shall be educated to Master's level or above in a relevant field.

## 4. Client's Input

The Client will provide at no cost to the Consultant existing information, data, reports and maps as far as available, as well as meeting facilities including use of a projector. The Client will also assist the Consultant in obtaining other relevant information and materials from Government institutions and State authorities as far as possible. However, it is the Consultant's duty to check the quality and suitability of this information.

The Consultant shall keep all the provided information, data, reports and maps confidential, shall use them only for the purposes of this study, and shall not distribute them to any third parties.