MALAWI – FEASIBILITY STUDY FOR A 40MW SOLAR PLANT IN SALIMA

Request for Proposal

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Abbreviations

EPC  Engineering, Procurement, and Construction
ESCOM  Electricity Supply Corporation of Malawi Limited
ESIA  Environmental and Social Impact Assessment
GCA  Grid Connection Agreement
ProjectCo  ProjectCo Matswani Solar Corp Limited
IFC  International Finance Corporation
IPP  Independent Power Producer
MERA  Malawi Energy Regulatory Authority
MNREM  Malawi Ministry of Natural Resources, Energy and Mining
NTS  Non-Technical Summary
O&M  Operation & Maintenance
OPP  Operating Policies and Procedures
PDL  Preliminary Design Layout
PPA  Power Purchase Agreement
PV  Photovoltaic
SPV  Special Purpose Vehicle
The Consultant  Firm to perform the feasibility study
The Project  40MW AC Malawi solar PV project in the District of Salima
The Study  Feasibility study
The Work Plan  Detailed work plan based on Terms of Reference
TMY  Typical Mean Year
ToR  Terms of Reference
Dear Sir/Madam:

JCM Matswani Solar Corp Limited (ProjectCo) requests a competitive proposal to conduct a Feasibility Study for a large-scale solar photovoltaic (PV) project in Salima, Malawi. ProjectCo is a limited liability corporation in Malawi owned, developed and managed by a consortium composed of InfraCo Africa Limited, JCM Power and Matswani Capital (PTY) Limited. ProjectCo has set out to develop, finance, build, own and operate a 20-40MW AC solar PV in Salima, Malawi (the Project) on an 80-hectare site within 4km of the Salima (Nanjoka) substation in Malawi. The estimated coordinates of the center of the site are -13.709444, 34.326576 (Note: the official coordinates of the site boundary are currently being finalized with the local authorities). The coordinates of the center of the Salima (Nanjoka) substation are -13.753804, 34.331411.

Enclosed is the Project Background and Scope of Work for the ToR.

Please confirm via e-mail within two (2) business days whether a proposal will be submitted by your company. Proposals must be received by ProjectCo no later than November 3rd, 2017. Please provide proposals electronically via e-mail at pgodfrey@jcmpower.ca and jrichard@jcmpower.ca. Award notification is envisaged no later than November 17th, 2017, subject to ProjectCo’s management committee approval.

ProjectCo’s preference is to have a single contract that covers the complete Scope of Work and bidders are encouraged to include sub-contractors to fulfill the Scope of Work as needed. However, ProjectCo reserves the right to contract separately. Given the nature of project development in Malawi, ProjectCo reserves the right to suspend or terminate the work at any time.

All information presented herein should be considered and treated as confidential.

Sincerely,

Patrick Godfrey
Project Developer
JCM Matswani Solar Corp Limited
1 The Project Company, Sponsor Group and Background

ProjectCo is a Malawi special purpose vehicle (SPV) incorporated to develop, finance, build, own and operate solar energy projects. The SPV shareholders include:

- JCM Power (Project Sponsor – a Canadian company), InfraCo Africa Limited (Co-development Funder/Partner – incorporated in England and Wales) and Matswani Capital (Co-development Partner – incorporated in South Africa)

JCM Power and InfraCo Africa Limited will provide the development capital to bring the project to financial close, while Matswani Capital, through a separate services agreement, provides development services to the ProjectCo in Malawi.

1.1 About JCM Power

JCM Power is an experienced Canadian solar power developer transitioning to become an independent power producer, focused on renewables (primarily solar PV) in high growth markets that are critically short of power supply.

With a successful track record of developing solar PV projects and a transmission link in North America, JCM Power’s focus is to develop projects in Sub-Saharan Africa, Latin America and Southern Asia.

JCM Power executives have over 160 years of cumulative power, development and emerging markets experience, achieved through senior level positions at Enel, Engie, Gas Natural Fenosa, IFC/World Bank, OPG, Recurrent Energy and Vestas.

JCM Power currently has 12 projects under development (seven in sub-Saharan Africa, three in Latin America, one in Pakistan, one in Canada/USA) and, to-date, has secured over $115 million to develop and construct its current portfolio of diversified clean power projects, including over $60 million grant funding, concessionary loans and development co-investment capital from DFIs.

1.2 About InfraCo Africa

InfraCo Africa Limited (InfraCo) seeks to alleviate poverty by mobilizing investment into sub-Saharan infrastructure projects. InfraCo does this by funding teams of experienced project developers or by investing directly into projects which need the financial commitment and leverage that InfraCo can bring.

InfraCo is part of the Private Infrastructure Development Group (PIDG). Established in 2004, InfraCo is managed as a private company although funded by the governments of Austria (ADA), the Netherlands (DGIS), Switzerland (SECO) and the UK (DFID). InfraCo’s projects have mobilized over US$2 billion of investment and provided new infrastructure for approximately 13 million people, improving living standards and powering economic growth in sub-Saharan Africa.
1.3 **About Matswani**

Johannesburg-based Matswani Capital (PTY) Ltd. (‘Matswani’), a company specializing in the development of several types of projects within sub-Saharan Africa, is acting as the project’s regional developer. While Matswani is headquartered in South Africa, it also has a full-time presence in Malawi and Mozambique.

1.4 **Background**

ProjectCo is developing a 20-40MW AC solar PV power project in Salima, Malawi. ProjectCo is in the process of finalizing a grid study which will determine the maximum size of the Project. The grid study report will be made available to the Consultant to assist with its work. The Project is in mid-stage development, having concluded prefeasibility studies, initial permitting and recently being awarded preferred bidder status for two sites – one in the District of Salima and the other in the District of Golomoti – through ESCOM’s competitive tender (December 12th, 2016 to May 12th, 2017) for the supply of solar PV power in Malawi. ESCOM will purchase the power generated from each system via 20-year power purchase agreements (‘PPA’).**Note:** ToR for the Salima project only.

The objective of the feasibility study (the “Study”) is to assess and plan all aspects of the development of the Project for ProjectCo. ProjectCo wishes to appoint a consulting firm to perform the Study (the “Consultant”) in accordance with the OPPs of InfraCo and the PIDG and JCM Power’s policies and procedures on anti-corruption and bribery.

![Figure 1: Project Site Boundary in Red](image-url)
2 General Requirements for Deliverables, Documentation and Reporting

The Study shall consist of discrete tasks and task deliverables as outlined in the ToR below.

All task deliverables and documents shall be submitted in draft form to ProjectCo for review and comment prior to finalization. The interim deliverables specified in the ToR shall serve to keep ProjectCo informed about the Consultant’s work on the Study and to ensure that the Consultant’s work is performed satisfactorily at various stages of progress. The Consultant shall submit formal progress reports to ProjectCo every two (2) weeks.

The Study shall culminate in a final report which shall consist of final task reports with an overarching executive summary, including conclusions and recommendations.

The Consultant shall undertake a quality control review process, including a technical and editorial review of all deliverables and documents submitted to ProjectCo to ensure readability, accuracy, and consistency.

All reporting, information and communication are to be in English.

3 Tasks

3.1 Task 1: Kick-Off Meeting, Site Visit and Information Gathering

3.1.1 Scope of Work

The Consultant shall hold a kick-off meeting with ProjectCo in Lilongwe, or at a separate location in Malawi determined by ProjectCo, within two (2) weeks of contract award to review the ToR, in conjunction with the Consultant’s proposal, with ProjectCo and develop a detailed work plan, including a communication plan, based on the needs of the Project (the Work Plan).

The Work Plan shall detail the Study timeline and milestones, and shall form the basis for assessing the Consultant’s progress. During this kick-off meeting, the Consultant shall establish ProjectCo’s desired reporting formats and timing for reporting updates. Points of contact and key members of the Study team shall be identified and roles and responsibility of each member established. The Consultant, with assistance from ProjectCo, shall identify the key Project stakeholders such as, but not limited to:

- Ministry of Natural Resources, Energy & Mining (MNREM);
- Ministry of Lands, Housing and Urban Development (MLHUD);
- Malawi Energy Regulatory Authority (MERA); and
- Electric Supply Company of Malawi (ESCOM);

and review their interest and influence on the implementation of the Project.

As part of the Study, the Consultant shall specifically address the role and requirements of ESCOM as the primary off-taker for the Project in line with the PPA and Grid Connection Agreement (GCA) between ESCOM and ProjectCo.

ProjectCo shall provide the Consultant with any relevant and existing reports, including previous studies, solar radiation data collected, site surveys, environmental and social studies, and electricity infrastructure
drawings. The Consultant shall review this material, identify gaps and develop a plan for collecting missing information. The Consultant shall discuss with ProjectCo the required access to the Project site and the approach for collecting data from various sources.

The Consultant and ProjectCo shall undertake a site visit together with key Project stakeholders to identify key points of concern and planning related to the Study and the Work Plan.

### 3.1.2 Deliverables

The Consultant shall provide ProjectCo with a report that contains all findings and provides a detailed account of all work performed under Task 1, including:

1. a review of Project materials and existing reports, identification of information gaps, and plan for obtaining necessary information; and

### 3.2 Task 2: Technical Analysis and Feasibility Study

#### 3.2.1 Subtask 2(a): Topological Survey

##### 3.2.1.1 Scope of Work

The Consultant shall carry out or procure a topological survey at the proposed plant site using the services of a Malawian licensed surveyor. The survey shall identify, at minimum, the following:

1. The perimeter boundary survey coordinates;
2. The limits of administrative and communal boundaries;
3. All roads, surface waters, major landmarks, dense vegetation, isolated trees, fences, gates, any material property line, bridges, existing networks, ruins, shrub lands, settlements, dwellings or any other element present on the surface or observable sub-surface of the site that may impact development and construction; and
4. Underground and overhead utility systems, including water supply wells and lines, drainage channels and culverts, sewerage, cables, drains, gas lines, telephone lines and poles, electrical lines and poles;
5. Drone imagery of the site to overlay on the topographic survey.

#### 3.2.1.2 Deliverables

The Consultant shall provide a topographical map including and conforming to:

1. The map shall be at a scale of at least 1:1,000
2. Coordinates linked to Arc 1950 / UTM zone 36S
3. Shapefiles, KMZ and a .DWG map with 3D dimensions;
4. Onsite features identified in the site survey;
5. Contour lines at intervals of a maximum 0.5m;
6. The limits of administrative and communal boundaries;
3.2.2 **Subtask 2(b): Hydrological Study**

### 3.2.2.1 Scope of Work

The Consultant shall carry out or procure a hydrological study to produce the necessary inputs for accurate and binding Engineering, Procurement, and Construction ("EPC") and Operation & Maintenance ("O & M") quotations. The purpose of the hydrological assessment is to determine ground water availability and assess the flood risk of the site. The ground water study shall inform the availability and quality of water for construction and operation periods including the suitability of water for module washing. The flood risk assessment shall inform the plant layout, drainage infrastructure and storm water management plan. All local results must be based on the output and reference system of the topographic survey.

The Consultant will conduct a two-phase ground water survey:

**Phase 1: Desktop feasibility assessment using existing maps and studies to determine:**

- The existence of ground water resources within the vicinity (<10km) of the site;
- Estimated sustainable flow rates;
- Seasonal and long-term effects on water resources;
- The likely chemical composition and pH of the water;
- Depth of water resources; and
- Existing infrastructure to extract the water resources.

**Phase 2: Onsite pumped assessment:**

Should feasible ground water resources be identified, onsite pumped tests shall be conducted to confirm sustainable flow rates and water chemistry. These tests shall be agreed after the completion of Phase 1. The Consultant is to provide capabilities and indicative costs of conducting pumped tests.

The Consultant shall determine and assess flood risks associated with:

- Rainfall;
- Surface flows (occurring onsite and upstream);
- Ground water flows;
- Seasonal and long-term affects;
- Behaviour of aquifers;
- Water stagnation;
- 1:10 and 1:100-year flood lines; and
- Any potential risk to arise from the study.

### 3.2.2.2 Deliverables

The Consultant shall produce:

- A map of flood features identified above to be referenced according to the topographic study developed in Task 2(a);
A risk assessment study describing:

a. all methods, sources and assumptions used to determine the above and recommendations in terms of flood management solutions;
b. Recommended flood mitigation methods and infrastructure;
c. Contribution of flooding to the environmental impact of the Project in relation to the environmental management plan; and
d. Impact on the design considerations of the plant.

A map of the site showing depth and velocity of flow.

3.2.3 Subtask 2(c): Geotechnical Study

3.2.3.1 Scope of Work

The Consultant shall carry out or procure a geotechnical study at the proposed plant site. The study will be used to determine the recommended type of foundations for PV module mounting structures, buildings and roads to receive accurate and binding EPC quotations. All results must be based on the output and reference system of the topographic survey.

3.2.3.1.1 Desktop Feasibility Study:

The Consultant shall undertake a desktop geotechnical feasibility study based on a site visit and topographic and hydrological studies considering:

- Site geomorphological survey to determine the nature and engineering properties of the soils/rocks underlying the site;
- Geological and hydrogeological mapping;
- Constraints definition; and
- Seismic risk.

3.2.3.1.2 Onsite Investigations:

The Consultant shall conduct or procure an onsite investigation of the surface and sub-surface geology and geotechnical conditions to determine properties such as excavability, ground bearing capacity, compatibility, gradability etc. consisting of at least:

- Backhoe test pits (at least 1 pit per 5 hectares) to determine refusal depths down to at least 4m below ground level;
- Photographs of test pits;
- Soil resistivity;
- Presence of groundwater in test pits, side wall collapse;
- Soil sampling testing and profiling (density, chemistry, sulphate content, cohesion, moisture content, conductivity, pH value, elastic/plastic modulus, direct shear strength, friction angle, grading, corrosivity, sieve analysis, Atterberg Limit and other engineering properties to international standards);
- Penetrometer tests at the proposed locations of substation and transformer buildings; and
- Representative number of pull-out and lateral testing of piled structures.
3.2.3.2 Deliverables

The Consultant shall produce:

(i) A feasibility report detailing:
   a. The methodology, results and conclusions/recommendations of the desktop assessment;
   b. Uncertainties in available information in determining the geotechnical conditions;
   c. Construction principals to be adopted;

(ii) Site investigation report detailing:
   a. The methodology, results and conclusions/recommendations of the onsite tests;
   b. Risks associated with construction;

(iii) A map referenced to the topographical survey developed in Subtask 2(a) indicating:
   a. Locations of test sites;
   b. Type of geology encountered;
   c. Refusal depths encountered;
   d. Soil pH;
   e. Recommended foundation types; and
   f. Soil parameters required for L Pile software.

3.2.4 Subtask 2(d): Preliminary Design Layout and Technical Specifications

3.2.4.1 Scope of Work

Using the data collected in Task 1 and Subtask 2(a) the Consultant shall propose suitable solar PV technologies to be agreed with ProjectCo and use these to develop a preliminary plant design layout drawing and technical specifications for use in subsequent Tasks.

The Consultant shall assess available solar PV technologies that may be used for each of the following components of the Project: solar PV modules, inverters, trackers, transformers, switchgear, meters, and balance of system components.

The Consultant shall collect, analyze, and consider the following factors in its assessment of each PV technology:

{ } Basic topography of the proposed site (Subtask 2(a));
{ } Geotechnical analysis for the proposed site (Subtask 2(c));
{ii} Site environmental considerations and climate;
{v} Interconnection with the national electricity grid;
{vi} Electrical evacuation alternatives;
{vii} Equipment required for construction and maintenance;
{vi} Performance, availability, and equipment warranties;
{viii} Operations and maintenance schedule and costs; and
{ix} Auxiliary power requirements during construction and operation.

Based on the Consultant’s technical analysis and conceptual design, the Consultant shall identify the factors and considerations for expanding PV capacity at the Project site and recommend options for layout of the Project site to best accommodate the addition of future solar PV capacity. The Consultant’s recommendations shall address additional infrastructure required for subsequent PV
installations (i.e., foundations; racks; and enclosures for modular components such as inverters, switchgear, and controllers; site electrical collection system backbone sizing; and sizing of grid interconnection equipment such as transformers, capacitor banks and their foundations, racks and enclosures) to ensure that expansion would not be constrained by the layout of the initial Project phase. The Consultant shall identify potential economies for investing in higher capacity site infrastructure during the first phase of the Project that could enable savings when implementing later Project phases.

3.2.4.2 Deliverables

The Consultant shall provide a Preliminary Design Layout ("PDL") and technical specifications for a 40 MWAC solar PV plant that include the following items:

(1) Site plan and layout;
(2) Electrical single line diagrams;
(3) Instrumentation and control systems;
(4) Major equipment list with sizing;
(5) Major equipment specifications; and
(6) Plant cost estimation (implementation and operation);

3.2.5 Subtask 2(e): Preliminary solar resource and yield

3.2.5.1 Scope of Work

The Consultant shall conduct a preliminary solar resource and yield assessment using the preliminary plant design provided in Subtask 2(d). The assessment shall include:

(1) Local climate and irradiance conditions and projections;
(2) The characteristic and performance of the technology applied;
(3) System power losses, including transmission/connectivity;
(4) Possible losses due to dispatch constraints;
(5) Soiling;
(6) Expected degradation over time;
(7) Manufacturer’s availability projections of production capacity;
(8) Uncertainties and deviations; and
(9) Prepare probability based forecasts for the expected power production in MWh (including P50, P75, P90 and P99 estimates based on the available data).

3.2.5.2 Deliverables

The Consultant shall provide a report detailing the methodology, assumptions, inputs and results of the resource and yield assessment.

3.2.6 Subtask 2(f): Meteorological Station and Onsite Measurement Campaign

3.2.6.1 Scope of Work

The Consultant shall conduct or procure a bankable 12 month onsite solar irradiation measurement campaign. The Consultant shall:

(1) Procure, on behalf of ProjectCo, all equipment necessary to undertake measurements including shipping, transport, customs clearance, etc.;
Install the equipment in line with the manufacturer's requirements;

Maintain (cleaning inspection at a minimum of 1-5 day intervals) and provide security services for the equipment, through use of locals (consider Malawi Meteorological Services) to be trained by the Consultant, for the duration of the campaign;

Monitor, collect and store data **(Note: ProjectCo will coordinate with the Consultant to specify the level of precision, standards used, measurement units, etc., of the data expected during the work); and**

Inspect the site every 6 months (i.e. installation, month 6, month 12).

### 3.2.6.2 Deliverables

The Consultant shall provide:

1. A detailed description of the proposed equipment & standards/procedures/protocols;
2. A detailed commissioning report of the meteorological station (including calibration certificates); and
3. Monthly reports using onsite data collection **(Note: Consultant will ensure that onsite data collection can be done remotely or the local presence can download and circulate via email. The Consultant will implement the most practical solution for data collection).**

### 3.2.7 Subtask 2(g): Correlation Study and Final Yield Assessment

#### 3.2.7.1 Scope of Work

Following 12 months of onsite measurements, the Consultant shall correlate the onsite meteorological data with a bankable historical irradiation dataset. The preliminary yield assessment in Subtask 2(e) shall be updated using the correlated dataset.

#### 3.2.7.2 Deliverables

The Consultant shall provide:

1. A Typical Mean Year ("TMY") file;
2. A report on the correlation methodology, assumptions and results; and
3. An updated and bankable energy production assessment report incorporating the correlated data and providing the full resource and production assessment, including production profiles and uncertainties as per the preliminary report.

### 3.2.8 Subtask 2(h): Security Vulnerability Assessment and Report

#### 3.2.8.1 Scope of Work

The Consultant shall assess the physical security and cyber security needs of the site to prevent unauthorized access to secure areas and SCADA. The Consultant shall review existing security policies and regulations currently in place at other power plants in Malawi and conduct a review of the project layout, equipment and technology as they relate to security procedures/protocols. The assessment will include observations and considerations and a preliminary design for the following areas, where applicable:

1. Lighting
2. Security fencing
a. General specification
b. Motion and tamper detection
c. Anti-climb protections
d. Public safety requirements
e. Measures to allow animal passage in line with environmental requirements

(ii) CCTV cameras
a. Coverage
b. Thermal, day/night, motion detection
c. Zooming capabilities
d. Remote operation & monitoring
e. Uninterruptable power supply
f. Video analytics software

(ii) Other sensors
a. Photoelectric beams
b. Trip wires
c. Passive Infrared
d. Microwave
e. Motion
f. Interlinked digital signal processing

(iii) Warning devices
a. Signage
b. Horns/alarms
c. Pre-recorded messages

(iv) Security staffing
a. Remote alarm center
b. Local staff
c. Monitoring coverage
d. Response times

(v) Cyber Security
a. Network logic design
b. Software and services
c. Access control
d. Session management
e. Account management
f. Password authentication and management
g. Malware detection and prevention
h. Testing and documentation

(vi) Other Security measures

The assessment shall consider local standards and regulations, as well as industry best practices.

ProjectCo should ensure that the Consultant has sufficient access to the site needed to conduct the assessment.
3.2.8.2 Deliverables

The Consultant shall prepare and submit a Report to ProjectCo that summarizes the meetings and work conducted as part of Subtask 2(h), providing conclusions and recommendations. This report shall also note any pending documentation or other information that the Consultant requires to complete the subsequent tasks.

ProjectCo shall review and provide comments on the Report as well as provide requested information to the Consultant or reach agreement with the Consultant on how such information will be obtained.