

(ANNEX-6)

**Revised Minutes of Meeting  
For  
The Project for Clean Energy Promotion Using Solar Photovoltaic System**

Date: Nov. 24, 2009 and Dec. 01, 2009, June 23, 2010

Place: BEL Head Office (3rd Floor), Dispatch Conference Room

Attendance:

BEL: Mr. Curtis Eck, VP Customer Care & Operations - Belize Electricity Limited

Mr. Jose Moreno, Planning & Distribution Department – Belize Electricity Limited

MOW: Attended on Dec. 01, 2009, Mr. David Novelo, Zone Engineer, Ms. N. Miki, JICA Architect

NK: Mr. Kobayashi, Mr. Egawa, Mr. Fujita, Mr. Kumasu, Mr. Herman,

Attended on Nov. 24, 2009 : Mr. Dei, Ms. Masaki,

The meeting was held on November 24, 2009 and December 1<sup>st</sup>, 2009 in the 2<sup>nd</sup> Preparatory Survey for The Project for Clean Energy Promotion Using Solar Photovoltaic System

Subjects and Results for MoM (Minutes of Meeting) for Technical Matters are as follows:

1. Connection point:

BEL has no objection to connect PV generating system in accordance with Drawings No. BZ-E-101 and BZ-E-102. (Ref. Annex 2 and 4) Proposed site is adjacent to UB Jaguar Building

Grid interconnection system conditions were agreed with both parties as follows:

1) The protection system shall be provided with the following functions.

- Control function of voltage and frequency
- Islanding detection & preventive operation function

2) Grid separation system

The measures of grid power failure are taken for reliability and security of PV system. PV system has no isolated operation basically.

PV generating system shall be separated from the grid when any abnormality is detected in the system by protection relays,

3) The protection device shall be provided by the following relays.

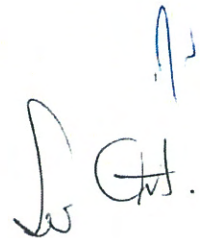
Over Voltage Relay (OVR) , Under Voltage Relay (UVR)

Under Frequency Relay (UFR) , Over Frequency Relay (OFR)

Islanding operation prevention device (IOD)

2. Grounding system:

Grounding resistance at neutral point of transformer is less than 5 ohm.



3. Rating of power cable:

In future BEL has a plan to step up distribution line from 11kV to 22kV. So, 25kV power cable was requested between high voltage cubicle and the distribution line connection point, the Project will provide 22kV rating power cable in accordance with Japanese standard.

4. Minimum size of power cable :

1/0 size(ANSI) of power cable is minimum size, so 60mm<sup>2</sup> copper conductor power cable rated for 22kV will be provided in accordance with Japanese standard.

5. Power cable:

Shrink type of termination for power cable will be provided. CV cable with PVC outer sheath will be provided. The terminal lug has two holes specified as NEMA for connecting to the switch terminal.

6. Phase color mark :

Red, Yellow and Blue shall be used for AC 3-phase. White will be used for the neutral of transformer, BEL confirmed.

7. Boundary point :

BEL will provide costing for manually operated pole mounted switch with fuse and load break switch. One HV span of 28 meters is also required for interconnection of PV system advised by BEL. A price quotation of this HV line extension will be requested by MOW. The 22kV power cable supplied by the Project shall be connected to the switch by the Contractor.

8. High voltage cubicle :

Circuit breaker of Vacuum type will be used and tests will be executed in accordance with IEC.

Specifications of BEL for DS, CT, PT and LA will be informed from BEL to the Consultant.

The reply from BEL on Dec. 2, 2009 mentioned that BEL expect to comply ANSI and IEC for all equipment.

Metal Oxide lightning arresters with voltage rating of 12kV(10.2 MCOV) will be recommended by BEL.

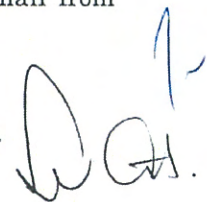
9. Licensed electrician :

Licensed Engineer and electrician shall be worked for the Project in accordance with the rule/regulation of Belize.

10. Information for the Tests before interconnection will be informed by e-mail from BEL.

11. Wind velocity : BEL design velocity is ;

For transmission line is Category 4, and for distribution line is Category 3.



Cat 3 means 49.6 ~58.5 m/sec and Cat 4 means 58.5 ~69.2 m/sec.

60m/sec will be applied for PV system.

12. Fluctuation range of 11kV voltage :  $\pm 5\%$ ,

Fluctuation range of frequency: 0.2 Hz

Power factor: More than 90 %

13. Specification of relay:

The specification of relay for ground fault of 11kV line is requested by BEL.

On the meeting Dec. 1, the Consultant explained the method and the details of ground fault relay in accordance with the reference documents provided by the Consultant

14. Watt-hour meter :

Two revenue Watt-hour meters will be provided in the high voltage cubicle.

One Watt-hour meter of dual type (selling and buying) will be provided by the Project, and other Watt-hour meter of dual type (selling and buying) will be supplied and installed by BEL. The Contractor shall provide the necessary space and support for Watt-hour meter of BEL. Instrument transformer (VCT) shall be used in common, so the rated burden of revenue meter will be informed from BEL.

BEL recommend the following to the Project for Watt-hour meter provided by the Project;

«The specifications of BEL is,

Elster Alpha+ meter, Form 5S(35S), CL-20, 120-480V, 3 Wire, 60Hz,

Type-A1RLQ+(Store load profile reading and can be down loaded to Lap Top computer) or,

Type-A1D(Energy and demand readings only no storage of energy used)

The Project shall provide revenue class CT's and PT's with accuracy class 0.3 or better.

Power supply burden of meter is less than 3 Watts»

15. BEL information :

- 1) Low voltage of 208 / 120 V, 60Hz is used in Belize. The Project will provided 400/230 V for power conditioners and station service circuit only.
- 2) For monitoring of PV generating system, the Project will provide 4 points for 11kV side, such as Ampere, Voltage, kW and status of 11kV CB, and BEL can pick up these digital signals for monitoring.
- 3) BEL will confirm and inform protocol (DNP or ?) of SCADA used for reference. DNP 3 is recommended and will be used in BEL system.
- 4) Communication system will be provided by BEL.
- 5) Reclosing time of CB for feeder at Belmopan Substation will be informed by BEL.

BEL informed that reclosing time set for feeder breaker/recloser is 2 sec – 2 sec – 5sec (30sec to reset)

16. Commercial Agreement between Owner (MOF) and BEL :

BEL requested to make agreement between Owner of PV system and BEL for commercial matters. This request was informed to MOW on November 25, 2009 and also informed to MOF on November 30, 2009.

17. The capacity of the project has been increase. The capacity is expected to be 300 kWp. The power transformer is also expected to increase from 250 kVA to 400 kVA

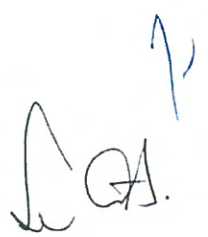
18. BEL will provide response if they can assist in the Technical side for the Operation and Maintenance of the project. This has to be liaised between MOF and BEL.

Reported on Dec. 02, 2009

Revised on Dec. 09,2009

Revised on June 23 2010

· End ·



(ANNEX-7)

## Plan of Operation & Maintenance

### (1) O&M Works

Operation and maintenance works are summarized as following three categories;

1) Daily O&M ( one time per day)

- Cleaning of Site and Array of PV system
- Visual checking of operation conditions, alarms and corrosion on Array, Power conditioner, 11 kV switchgear and transformer

2) Regular Service (every 2 month)

3) Repair and Replacement of Parts (depend on necessity)

### (2) Assignment Plan for Operation and Maintenance Staffs

Assignment plan for the operation and maintenance staffs is proposed as follows.

Table -1 Assignment Plan for O & M

Position	Number of O&M Staff	Organization
Management staff Engineer or Technician	2	MOW
Regular Service Hired Electrical Engineer or maintenance company	2	MOF (to contract out)
Daily O&M staff O&M	2	UB or MOW
<b>Total</b>	<b>6</b>	

1) Assignment plan for Daily Operation and Maintenance staffs

Two operators from UB or MOW are assigned for daily checking of operation conditions, alarms and cleaning of site and Array of PV system. If they find out any abnormality, they must inform of the situations to MOW staffs.

2) Assignment plan for Regular Service and maintenance staffs

Maintenance staffs conduct periodic inspection to PV Array, Power Conditioner, 11kV Switchgear, Transformer and Power Cables for maintaining PV system in good condition. MOF contract out to hired Engineers who have a main role for regular service. They must submit maintenance reports to MOW every two

months.

3) Contract out maintenance works

The maintenance works for the Government buildings are carried out by private contractors. GOB is going to take similar measure and also recruit a hired engineer from a private contractor for PV system.

4) Management staffs

Engineer or Technician shall be nominated from maintenance staff for traffic signal and road lighting in MOW. Engineer from MOW have role to safe guard operation and maintenance manual and manage the Operation and Maintenance works with UB (or MOW staff) and a contractor to be contracted out for sustainable maintenance.

**(3) Personnels resources are follows;**

- 1) Daily O&M (Visual Checking of one time per day and cleaning ) from UB or MOW
- 2) Regular Service (every 2 month) to be contracted out to private maintenance contractor
- 3) Repair and Replacement of Parts (depend on necessity) to be contracted out to private maintenance contractor
- 4) Management staffs from MOW

**(4) Operation and Maintenance Cost**

Equipment Maintenance Cost

Maintenance cost per year is estimated as 0.1 % of the equipment cost.

Employment Cost

As implementation organization, electrical engineers are limited in MOW. It is considered to layout two engineers or technicians from maintenance section of MOW. Also, O & M staffs from UB or MOW and maintenance staffs to be contracted out to private contractor are target for the technical training. And they will be trained as O&M staffs by the Contractor's Engineer during construction and test. On the other hand, technical training by the Consultant as a Soft Component shall be executed at the end of the construction period.

According to the above explanation, six staffs are required to layout for management and O&M of PV system. Therefore, employment cost may be required for contracting out and UB personnels.

Contract out Cost

It is necessary to take budget for regular maintenance works for PV system. Contract out cost are estimated by regular maintenance time (6 times per year).

Land leasing Cost

A lease agreement will be prepared including security matters between GOB and UB on approximately 2 Acres (8,000m<sup>2</sup>) premises at the UB Central Campus site in Belmopan. The cost will be mentioned in the agreement.

Management and other Cost

In general, the maintenance and the other cost are estimated as 1% of generated power (kWh). Cost of management and the others for new installed PV system are calculated in the same ratio. The O&M cost will be estimated based on the 1 % of the results calculation of multiply annual power output by unit power tariff.

