

(ANNEX-5)

Technical Specification of PV System

1. PV Module

- (1) Type : Crystalline
- (2) Capacity : Rated capacity of PV module is specified by manufacturer
- (3) Performance : The modules supplied are required to be tested at Standard Test Condition (STC). The copy should be supplied with the modules.

The following data should be available in the module report.

- maximum power
- open circuit voltage
- short circuit current
- maximum power voltage / current

(STC: Surface temp.:25 degree Celsius, Air mass:1.5, Radiation 1000W/m²)

2. PV Array

(1) Tilting Angle and Azimuth Direction

- : The tilting angle is 20 degrees
- : The azimuth direction is the South

(2) Layout

Sufficient number of modules in series and parallel will be used to obtain the required PV array current, voltage and power output. The designed total capacity of the PV array shall not less than 300kWp.

(3) Lightning Surge Protection

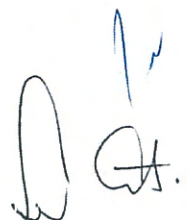
: Lightning surge protection must be provided for the PV array.

3. Structure

The frame of support structure of PV array shall be hot dip galvanized steel. The bolts and nuts for the support structure shall be stainless steel. The structure must be designed to withstand wind speed at 60 meters per second.

4. Junction Box

- (1) A diode for reverse power protection shall be provided for each DC input circuit.
- (2) The protection system for induced lightning shall be provided in the junction box.
- (3) The box shall be both waterproof and dustproof



5. Power Conditioner

- (1) Capacity : 300kW
- (2) DC Input : Specified by manufacturer.
- (3) AC Output : AC 400V
- (4) Power Factor : Over 90%
- (5) Conversion Efficiency : Over 90%

(6) Protection System

The protection system must be provided the following functions.

- > Monitoring function of voltage and frequency
- > Control function of output voltage
- > Islanding operation prevent function
- > Control function of automatic voltage

(7) Protection Device

The protection device must be provided the following relays.

- > Over Voltage Relay (OVR) , Under Voltage Relay (UVR)
- > Under Frequency Relay (UFR) , Over Frequency Relay (OFR)
- > Island operation detector (IOD)

6. Insulating Transformer

AC400V/AC400V with contact preventing plate

7. Data Logging System

(1) Personal Computer

Monitor, Hard disk, Data logger, UPS

(2) Meteorological data

Solar irradiation, Ambient temperature

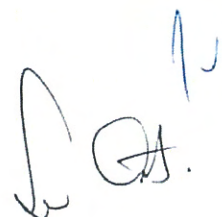
(3) System data

Power output (kW), DC current / voltage, AC current / voltage

8. Monitoring Display Panel

Display: Solar irradiation (kW/m²), Power output (kW), Temperature (degree Celsius)

Solar power generation (kWh/Day), Amount of reduction value of CO₂ (kg-C)



(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 1st, 2009 in the 2nd 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.

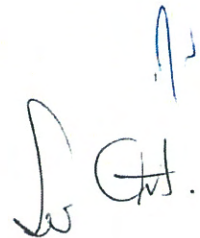
Over Voltage Relay (OVR) , Under Voltage Relay (UVR)

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 60mm² 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.

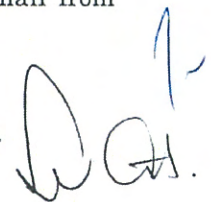
9. Licensed electrician :

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 ·

