Technical Standard
for
IDCOL Solar Roof-top Projects

Technical Standard Committee

July 2021

INFRASTRUCTURE DEVELOPMENT COMPANY LIMITED

UTC Building, Level-16, 8 Panthapath, Kawran Bazar, Dhaka-1215, Bangladesh T 9102171-8, 09666743265 F +880-2-8116663 W www.idcol.org

Technical Standard

The proposed project must comply the technical specifications given below:

1. Solar Photovoltaic Module:

1.1. Panel must be enlisted by IDCOL TSC according to IDCOL PV Panel Enlistment Process.

1.2. The following are applicable standards for PV modules:

a) IEC[1] 61215:2016: Terrestrial photovoltaic (PV) modules - Design qualification and type approval [2]

b) IEC 61701 Ed 3.0: Salt mist corrosion testing of PV Modules.

c) IEC 61730 for safety equipment.

d) PID test certificate (IEC 62804 or equivalent)

1.3. The photovoltaic module should have a peak power output of at least 350 Wp.

1.4. All modules must be product tested and certified from IEC accredited laboratories. IEC 61215:2016 and IEC 61730 are mandatory for PV modules. IEC 61701 will be applicable for PV module installation in coastal areas.

1.5. Each module must be factory equipped at least IP65 junction box with terminal strip that allows safe and long lasting wiring connection to the module. Where applicable, protective diodes should be used to avoid the effect of partial shading. Factory test report of the PV module must be provided during supply of product.

1.6. Only PV modules with bypass diodes shall be used.

1.7. Each module must have permanent labeling indicating at a minimum: Manufacturer, Model Number, Serial Number, Peak Watt Rating, Voltage and Current at peak power, Open Circuit Voltage, Short Circuit Current and Cell Efficiency of each module.

1.8. Power tolerance must be positive for each of the PV modules.

1.9. Module Efficiency (η %) should be minimum 17.5% at STC.

1.10. Fill Factor (FF) should be more than 70%.

1.11. Warranty:

a) Ten (10) year limited PV module warranty

PV Modules(s) should be warranted to be free from the defects and/or failures specified below for a period not exceeding ten (10) years from the date of sale to the original customer:

i. Defects and /or failures due to manufacturing;

ii. Defects and/or failures due to materials;

[1] IEC= International Electrotechnical Commission

[2] IEC 61215:2016 includes IEC 61215-1:2016, IEC 61215-1-1:2016/IEC 61215-1-2:2016/IEC 61215-1-3:2016/IEC 61215-1-4:2016 and IEC 61215-2:2016.

iii. Cracking of the front glass surface due to foreign objects inside the glass; or

iv. Non-conformity with specifications due to faulty manufacturing and/or inspection processes.

If the PV Module(s) fails to conform to this warranty, PV module(s) should be immediately replaced.

b) Limited power output warranty

Limited power output warranty must be linear for 25 years, where not more than 2.5% degradation in the first year, the power output must be above 90% of the rated power specified at the time of sale within ten (10) years and the power output must be above 80% of the rated power specified at the time of sale within twenty five (25) years. If this standard is not met manufacturer will repair, fix (by putting additional panel) or replace the PV Modules(s) at their own cost or refund the Purchase Price taking into a count a yearly depreciation of five percent (5%) of the panel price. In case of the refund of the depreciated price of the panel, the panel will remain with the user and company will not take it from him/her. The period of power output warranty for these replaced modules(s) will be equal to the remaining warranty period of the originally supplied module(s).

1.12. Final test before installation:

a) The EPC contractor needs to flash test the PV module according to the following manner before installation and the test results will be verified by TSC, IDCOL.

Project Capacity	**Number of panel to be tested**
Less than 500kWp	4
500kWp or more	6

b) Sampling will be done by IDCOL.

c) All sample panel must be passed in the test. Otherwise the whole lot, from where the sample is collected, will not be acceptable for installation.

d) The supplier will submit factory test report for every module of a lot from manufacturer.

e) If existing testing facilities in Bangladesh cannot support flash test of the proposed PV module, the supplier will submit the factory test report only until the local testing facilities will develop/upgrade.

f) In case of any deficiency between the test results and the rated output of the PV panel:

i. The suppliers are required to replace PV panels or;

ii. In case the supplier is unable to replace PV panels due to constraints associated with system design and integration with other equipment, the deficiency in the power output might be balanced by deducting from the disbursement of the supplier. Cost per Wp of PV panels as submitted by the suppliers during the evaluation of quotations will be considered as the base of deduction.

2. Inverter

2.1. For IDCOL SRT project, grid-tied inverter can be used only.

2.2. All inverter must comply IEC 62109-1:2010, IEC 62109-2:2011, IEC 61727:2004 and IEC 62116:2014.

2.3. Typical technical features of grid-tied string inverter are as follows:

Aspect	**Recommended Requirements for String Inverter**
Total output power (AC)	To match solar PV plant capacity while achieving optimum system efficiency
Input DC voltage range	As required for the solar grid inverter DC input
Nominal output voltage (AC)	230 V / 400 V
Rated grid frequency	50 Hz
AC frequency range	50 Hz ± 6%
Maximum Power Point Tracker (MPPT) option	Must be available
Maximum input voltage (DC)	≥ 1000 V
Power factor at rated power	> 0.90
Maximum efficiency	≥ 98%
DC surge arrester	Type II arrester must be integrated (even if LPS-Lightning Protection System is there)
DC side disconnection device	Must be available
Ground fault monitoring	Must be available
DC reverse polarity protection	Must be available
AC short circuit current protection	Must be available
Degree of protection	At least IP 65 (outdoor) / IP 31 (indoor) or above
Operative ambient temperature range	-20°C to 60°C
Noise emission	< 60 dB (Equivalent to a noise created by a large transformer at 100 ft)
Total harmonic distortion (THD)	< 3%
Maximum relative humidity	100%
Communication	RS485, USB or any other communication port

Data access	Voltage, current, power, frequency and other basic information must be accessible either by a LCD/LED display with power saving mode or wireless communication
Others	Must be scalable (Provision for further expansion)

2.4. Typical technical features of grid-tied micro-inverter are as follows:

Aspect	**Recommended Requirements for Micro-Inverter**
Total output power (AC)	To match solar PV plant capacity while achieving optimum system efficiency
Input DC voltage range	As required for the solar grid inverter DC input
Nominal output voltage (AC)	230 V / 400 V
Rated grid frequency	50 Hz
AC frequency range	50 Hz ± 2%
Maximum Power Point Tracker (MPPT) option	Must be available
Power factor at rated power	> 0.95
Maximum efficiency	≥ 95.5%
Ground fault monitoring	Must be available
DC reverse polarity protection	Must be available
AC short circuit current protection	Must be available
Degree of protection	IP 65 or above
Operative ambient temperature range	-20°C to 60°C
Total harmonic distortion (THD)	< 3%
Maximum relative humidity	100%
Communication	Must be available
Data access	Voltage, current, power, frequency and other basic information must be accessible

2.5. Warranty: Minimum of 10 years from manufacturer.

2.6. Inverter must be installed in a place where a faultless operation is guaranteed and easily accessible. Inverters should never be installed in dusty or fire-prone rooms. Furthermore, it is not allowed to mount inverters on flammable materials (e.g. wooden boards).

2.7. Number and date of approval for Inverter under NEM Guideline will be availed before commissioning.

3. Mechanical Design:

Mechanical design includes module mounting structure, walkway and other support structures.

3.1. Mounting Structure:

The PV modules shall be mounted on fixed metallic structures having adequate strength and appropriate design, which can withstand the load of the modules and high wind velocities. Detailed specification for the mounting structure are given below:

Particulars	**Specification**
Structure material	Hot dip galvanized (thickness of 120 microns) MS with 2-3mm thickness and hollow pole of 2-3 mm thickness and 3-4 inch of diameter or Anodized aluminum
Bolts, nuts, fasteners, panel mounting clamps	Stainless steel
Mounting arrangement for RCC flat roof	With removable concrete ballast made of pre-fabricated PCC (1:2:4), M15
Mounting arrangement for metal sheet roofs	Mounting directly on the sheet metal, ensuring stability and wind withstanding capacity, or penetrating the sheet metal and fixing to the substructure ensuring that the roof remains waterproof and ensuring stability and wind withstanding capacity
Mounting arrangement for elevated structures	The elevated structure has to be securely anchored to the supporting surface. Concrete foundations of appropriate weight and depth for elevated structures mounted directly on the ground; Bolted with anchor bolts of appropriate strength for elevated structures mounted on RCC surfaces.
Mounting arrangement for ground installations	With removable concrete ballast made of pre-fabricated PCC (1:2:4), M15; assuring enough ground clearance to prevent damage of the module through water, animals and other environmental factors; ensuring proper drainage system
Minimum distance between roof edge and mounting structure	1.2 m along with long side of the building and around 1.5 m along with narrow side of the building
Self-shading	No self-shading will be acceptable irrespective of seasonal variations.
Access for panel cleaning and maintenance	All solar panels must be accessible from the top for cleaning and from the bottom for access to the module junction box.
Others	Modules should not extend beyond the vertical and horizontal line of the building (e.g. roof edge, eaves and gables.)

3.2. Mounting structure must have the capacity to withstand wind speed of 200 km/hr. Also load due to wind tunneling effect, wind force applied to PV array must be considered and the building must have the capability to withstand the resulting forces. This must be IEB certified.

3.3. Module mounting arrangements and all other supporting structures must comply BNBC 2007, module manufacturer's mounting requirement and verified by an IEB affiliated structural engineer.

3.4. In mounting arrangement of modules, provisions must be taken for the maximum contraction/expansion of the module under expected operating temperature as well as manufacturer's recommendations.

3.5. The structures shall be designed for simple mechanical on-site installation.

3.6. Service walkway must be designed in a way that all panels can be easily accessible for maintenance and cleaning purpose.

3.7. Roofing material not to include carcinogenic materials such as Asbestos. Adequate corrosion protection for all installed components must be given. Electrochemical series to be respected. If necessary, materials shall be isolated with isolating material such as EPMD.

4. Hybrid Controller / Fuel Save Controller:

4.1. Inclusion of Hybrid Controller / Fuel Save Controller depends on a project's specific requirement and should be included in a project if the Independent Engineer (IE) of the project finds it necessary.

4.2. Hybrid Controller / Fuel Save Controller must be compatible with genset controller. Hybrid controller / Fuel Save Controller from manufacturer having collaborations with genset manufacturer are the preferred solution. If not, genset controller needs to be technically enhanced to allow smooth communication with other plant components. Proof of compatibility to be provided.

4.3. Hybrid Controller / Fuel Save Controller must be installed in hybrid PV systems with genset if PV penetration level =>20% based on state-of-the-art hybrid controller plant design. PV penetration level is inverter capacity (VA) divided by genset capacity (VA).

4.4. Recommended PV penetration level for PV genset hybrid systems =< 60% based on state-of-the-art hybrid controller plant design.

4.5. The controller rating (voltage, current, temperature, IP etc.) must comply with the system requirement and verified by IE.

5. Combiner Box:

5.1. There should be segregation between positive and negative conductors within combiner box to minimize the risks of DC arcs.

5.2. Combiner box must be water and vermin proof.

5.3. The IP rating of the enclosure cabinet shall be IP 65 (outdoor) / IP 31 (indoor) or higher.

5.4. All combiner boxes must be adequately closed with all cable glands sealed.

6. Energy Meter:

6.1. Energy meter rating must comply with the system requirement and verified by IE.

6.2. Energy meter must comply with IEC-62053-21-2013.

6.3. Energy meter must be calibrated.

6.4. CT attached with the system must be calibrated.

7. Fuses and Circuit Breaker:

7.1. Fuses and circuit breaker rating must comply with the system requirement and verified by IE.

7.2. String fuses in PV arrays must be rated for DC and rated to interrupt fault currents from the PV arrays.

7.3. Fuse holders must have a current rating equal or greater than the corresponding fuse and provide protection suitable for the location.

7.4. String fuses and MCB must be installed inside the DC combiner boxes.

8. Cables:

8.1. DC cables shall comply IEC 62930: Electrical cables for photovoltaic system with a voltage rating of 1.5kV DC. (Single-core cross-linked insulated power cables with cross-linked sheath).

8.2. AC cable must comply with national standard.

8.3. Cable rating, size and length must be as per system design requirement and verified by IE.

8.4. Length and size of the cables shall be selected to keep the voltage drop (power loss) of the system minimum. Maximum allowable voltage drop is 2.5% from the panel up to inverter end.

8.5. Cable must be compatible up to the life of the solar PV modules.

8.6. DC PV module cables must be:

- Suitable for a wide temperature range (e.g. -40 to 100°C)

- Single core and double insulated in general

9. Connectors:

9.1. Connectors in PV system shall comply IEC 62852.

9.2. Cable connectors with minimum IP 67 protection to be used

10. Central Shutdown Device:

10.1. IDCOL solar rooftop projects shall include a Central shutdown function to reduce shock hazard for emergency responders if IE recommends.

10.2. DC main isolator switch to be installed on the DC side before the inverter.

10.3. AC main isolator switch to be installed on the AC side after the inverter.

11. Cable Management:

11.1. All PV wiring and components must be fit for purpose and installed to minimize exposure to detrimental environmental effects and are protected from abrasion, tension, compression & cutting forces.

11.2. All over ground cable / wires must be properly routed and secured using hot dip galvanized cable tray, UV resistant cable ties (usually black) and suitably tagged with proper manner so that the cables are easily identified.

11.3. Cables must be protected from direct sunlight, standing water.

11.4. Only UV and weather resistant cables and cable conduits to be used. Outdoor exposed ca-bles to be covered by PVC conduit for instance.

11.5. The solar array to inverter solar DC cables within buildings must be in heavy duty conduit.

11.6. Outdoor exposed cable shall be covered by UV resistant PVC conduit.

11.7. In case where wiring of PV strings between modules is not protected by conduit or any other enclose, cable must be clamped to relieve tension in order to prevent the conductor from coming free of the connection and also protected from any mechanical damage.

11.8. Length of cable must be as short as possible.

11.9. Wiring of the project shall be undertaken in such a way that the possibility of line-to-line fault and line-to-ground fault is minimized.

11.10. Wiring must comply with the national standards.

11.11. All connections must be examined for tightness and polarity during installation to reduce the risk of faults and possible arcs.

11.12. All cable entries in combiner box must maintain the IP rating of the box.

12. Bypass Diodes:

12.1. If required, external bypass diodes may be installed to prevent PV modules from being reverse biased and consequent hot spot heating.

12.2. Bypass diodes, if used, must comply with IEC 62548:2016.

13. Blocking Diodes:

13.1. If required, blocking diodes may be installed to prevent reverse current of PV array.

13.2. Blocking diodes, if used, must comply with IEC 62548:2016.

14. Earthing:

14.1. The panels, structure, cable tray and all metal parts in the DC side must be connected to the earth as per National Electrical Code (NEC).

14.2. In case of bimetallic connection between the structures and the earthing cable, bimetallic lug / WEEB (washer, Electrical Equipment Bond) must be used.

14.3. Earthing or bonding connections must be arranged so that the removal of a single module earth connection will not affect the continuity of the earthing or bonding connections to any other module.

14.4. Earthing and grounding layout to be prepared by the EPC contractor.

15. Lightning Protection System (LPS) and Surge Protection Devices (SPDs):

15.1. LPS and SPDs to be designed and installed in accordance with the NEM Guideline requirements. SPDs from inverter are not sufficient Design and installation to be verified by the IE.

16. Monitoring System:

16.1. Real time data monitoring and data collection through Online Monitoring System must be ensured by EPC contractor for every solar rooftop project.

16.2. As a minimum, the following parameters must be accessible via online monitoring system

a) AC voltage

b) AC output current

c) Output power

d) Power factor

e) DC input voltage

f) DC input current

g) PV energy

h) Ambient Temperature

i) Solar Irradiance measured as the same tilt angle of the panel.

j) Performance Ratio

16.3. Data must be accessible over internet using a web browser through secure login.

16.4. Data file must be MS excel compatible.

16.5. Data must be represented in both tabular and graphical form.

16.6. Data shall be acquired by the site data logger also and EPC contractor shall provide the operation manual regarding this.

17. System Design:

17.1. The ratio of total PV module power to total inverter power in each sub-system must be less than 1.35. Allowable inverter design parameters shall not be exceeded. Some inverter manufacturer also determined maximum DC/AC oversizing ratio. These shall not be exceeded, if available. Contractor to consult with inverter manufacturer if such limits do exist and if de-signed ratio is feasible, if ratio above 1.2 is chosen.

17.2. Unused roof space/land space excluding the requirement amount of free space under building code can be used for installation of PV module. The plant area should not be exposed to any kind of shading from surroundings.

17.3. Engineering, procurement and construction of system by company that is certified in accordance to ISO 9001, ISO 14001 and OHSAS 18001 / ISO 45001 or comparable.

17.4. In case the credit applicant wishes to use NEM scheme in place, the following Capacity and Energy Limit exports need to be respected when designing the PV plant, in accordance to existing NEM Guideline:

- The cumulative output AC capacity (VA) of inverter can be a maximum of 70% with respect to the consumer's sanctioned load, in accordance to net metering guidelines. In other word 70% on the customer's sanctioned load is specified as the maximum permissible generator size (installed output AC capacity).

- The maximum output AC capacity of the inverter for NEM cannot be more than 10 MW (VA).

- In case of a medium-voltage (MV) consumer, the installed capacity of the renewable energy system cannot be more than 70% of the rated capacity of the distribution transformer or, cumulative capacity of the distribution transformers. The MV consumer needs to fulfil the first three clauses.

17.5. System DC voltage must not exceed 1000V.

17.6. Tilt angle should be determined as per plant requirement and verified by IE.

17.7. The DC system should be designed, specified, and installed to the requirements of IEC 60364 and IEC TS 62548:2013. System design will be verified by IE.

18. Design Simulation:

18.1. Simulation of the total project must be done using PVSyst/Helioscope/SAM.

18.2. Simulation results must reflect probability based energy yield forecast with uncertainty analysis and/or realistic energy yield.

18.3. Realistic estimation of loss parameter should be used in simulation calculation is necessary to estimate different loss parameter used in.

18.4. Near and far shading analysis is required if necessary. If no shading analysis is done, justification must be given by EPC and IE will verify it.

19. Signage:

19.1. Due to safety of various operators like maintenance, inspectors, personnel, local distribution network etc., it is necessary to indicate the presence of a PV installation on a site.

19.2. A sign, such as shown in Figure 1 shall be fixed at the origin of the PV installation and at the consumer unit or distribution board to which the supply from the inverter is connected.

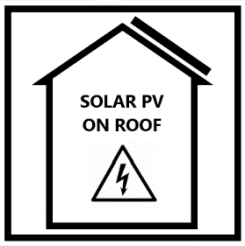

Figure 1: Sample sign for identification of PV on a site.

19.3. A sign, such as shown in Figure 2 shall be attached to PV combiner boxes and switches.

Figure 2: Sample sign for live parts.

19.4. Disconnection devices must be marked with an identification name / number according to the PV array wiring diagram.

19.5. All types of switch must have the ON and OFF positions clearly indicated.

19.6. PV module rows, cables and combiner boxes must be labelled.

19.7. PV array DC isolator / switch disconnector must be identified by sign. If multiple disconnection devices are used that are not ganged, signage must be provided warning of multiple DC sources and the need to turn off all switch disconnectors to safely isolate equipment. Sample signage is shown in Figure 3 and 4.

Figure 3: Sample sign required adjacent to PV array D.C. isolator / switch-disconnector

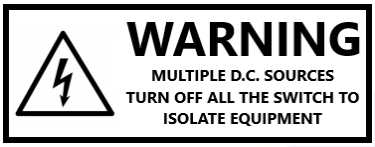

Figure 4: Sample sign required where multiple isolator / switch-disconnector devices are used

19.8. Central shutdown system must be indicated by sign such as shown in Figure 5.

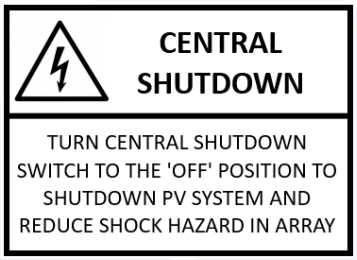

Figure 5: Sample sign for rapid shutdown device

20. Spare Parts:

20.1. List of spare parts of the project provided by EPC contractor must be elaborately described to IDCOL and the Client.

21. Net Metering System:

21.1. If required, net metering system shall be included as per 'Net Metering Guideline Bangladesh-2018**.**

21.2. Fulfilment of net metering requirements to be checked by the IE.

21.3. Grid connection and evacuation of electricity has to be provided before construction work and has to be assured before commissioning.

22. Commissioning Test:

The following tests should be done during commissioning:

22.1. **Continuity and resistance testing** verifies the integrity of grounding and bonding systems, conductors, connections and other terminations.

22.2. **Polarity testing** verifies the correct polarity for PV dc circuits, and proper terminations for dc utilization equipment.

22.3. **Voltage and current testing** verifies that PV array and system operating parameters are within specifications.

22.4. **Insulation resistance testing** verifies the integrity of wiring and equipment, and used to detect degradation and faults to wiring insulation.

22.5. **Performance testing** verifies the system power and energy output are consistent with expectations. These tests also require measurements of array temperature and solar irradiance.

22.6. **Earth resistance testing**

22.7. **Test Reports**

Measurements and test results for PV systems should be clearly summarized in a test report that includes the following information:

a) System information.

b) Visual inspection record and observations.

c) Identification of circuits tested, tests performed, and record of measurements.

d) Interpretation and summary of results, identifying special maintenance needs or corrective actions.

e) Signatures of responsible person(s) and date(s) of tests.

23. Operation and Maintenance (O&M):

23.1. Detailed O&M manual must be provided to IDCOL and the client by EPC contractor.

23.2. O&M manual shall include, as a minimum, the following items:

a) Procedure for verifying whether the system is in correct operation.

b) Data collecting procedure from inverter / data logger / energy meter.

c) Operation and data collection procedure of online monitoring system.

d) In case of system failure, procedure to identify the type of fault and mitigation method.

e) Emergency shutdown / isolation procedures.

f) Maintenance and cleaning recommendations.

g) Considerations for any future building works related to PV array. For example: roof works.

INFRASTRUCTURE DEVELOPMENT COMPANY LIMITED

UTC Building, Level-16, 8 Panthapath, Kawran Bazar, Dhaka-1215, Bangladesh T 9102171-8, 09666743265 F +880-2-8116663 W www.idcol.org