

## Quality Certification, Standards and Testing for Grid-connected Rooftop Solar PV Systems/Power Plants

Quality certification and standards for grid-connected rooftop solar PV systems are essential for the successful mass-scale implementation (in-order to achieve 40 GW of rooftop solar target under 'National Solar Mission' programme) of this technology. It is also imperative to put in place an efficient and rigorous monitoring mechanism, adherence to these standards. In-addition, a few standards which are still under development/draft need to be introduced in the ongoing rooftop solar PV programmes at the earliest. The relevant standards and certifications for a grid-connected rooftop solar PV system/plant (component-wise, upto LV-side) are given below: [currently, all applicable standards (International and Indian) are listed, and bifurcation of mandatory and advisory is done]

<i>Solar PV Modules/Panels</i>	
IEC 61215/ IS 14286	Design Qualification and Type Approval for Crystalline Silicon Terrestrial Photovoltaic (PV) Modules
IEC 61646/ IS 16077	Design Qualification and Type Approval for Thin-Film Terrestrial Photovoltaic (PV) Modules
IEC 62108	Design Qualification and Type Approval for Concentrator Photovoltaic (CPV) Modules and Assemblies
IEC 61701- As applicable	Salt Mist Corrosion Testing of Photovoltaic (PV) Modules
IEC 61853- Part 1/ IS 16170 : Part 1	Photovoltaic (PV) module performance testing and energy rating -: Irradiance and temperature performance measurements, and power rating
IEC 62716	Photovoltaic (PV) Modules - Ammonia (NH <sub>3</sub> ) Corrosion Testing <b>(Advisory - As per the site condition like dairies, toilets)</b>

IEC 61730-1,2	Photovoltaic (PV) Module Safety Qualification – Part 1: Requirements for Construction, Part 2: Requirements for Testing
IEC 62804 (Draft Specifications)	Photovoltaic (PV) modules - Test methods for the detection of potential-induced degradation (PID). IEC TS 62804-1: Part 1: Crystalline silicon <b>(Mandatory for system voltage is more than 600 VDC and advisory for system voltage is less than 600 VDC)</b>
IEC 62759-1	Photovoltaic (PV) modules – Transportation testing, Part 1: Transportation and shipping of module package units
<i>Solar PV Inverters</i>	
IEC 62109-1, IEC 62109-2	Safety of power converters for use in photovoltaic power systems Safety compliance (Protection degree IP 65 for outdoor mounting, IP 54 for indoor mounting)
IEC/IS 61683 <b>(For stand Alone System)</b>	Photovoltaic Systems – Power conditioners: Procedure for Measuring Efficiency (10%, 25%, 50%, 75% & 90-100% Loading Conditions)
BS EN 50530  (Will become IEC 62891) <b>(For Grid Interactive system)</b>	Overall efficiency of grid-connected photovoltaic inverters:  This European Standard provides a procedure for the measurement of the accuracy of the maximum power point tracking (MPPT) of inverters, which are used in grid-connected photovoltaic systems. In that case the inverter energizes a low voltage grid of stable AC voltage and constant frequency. Both the static and dynamic MPPT efficiency is considered.
IEC 62116/ UL 1741/ IEEE 1547	Utility-interconnected Photovoltaic Inverters - Test Procedure of Islanding Prevention Measures
IEC 60255-27	Measuring relays and protection equipment - Part 27: Product safety requirements
IEC 60068-2 (1, 2, 14, 27, 30 & 64)	Environmental Testing of PV System – Power Conditioners and Inverters
<b>IEC 61000- 2,3,5</b>	Electromagnetic Interference (EMI), and Electromagnetic Compatibility (EMC) testing of PV Inverters (as applicable)
<i>Fuses</i>	
IS/IEC 60947 (Part 1, 2 & 3), EN 50521	General safety requirements for connectors, switches, circuit breakers (AC/DC)
IEC 60269-6	Low-voltage fuses - Part 6: Supplementary requirements for fuse-links for the protection of

	solar photovoltaic energy systems
<i>Surge Arrestors</i>	
IEC 61643-11:2011 / IS 15086-5 (SPD)	Low-voltage surge protective devices - Part 11: Surge protective devices connected to low-voltage power systems - Requirements and test methods
<i>Cables</i>	
IEC 60227/IS 694, IEC 60502/IS 1554 (Part 1 & 2)	General test and measuring method for PVC (Polyvinyl chloride) insulated cables (for working voltages up to and including 1100 V, and UV resistant for outdoor installation)
BS EN 50618	Electric cables for photovoltaic systems (BT(DE/NOT)258), mainly for DC cables
<i>Earthing/Lightning</i>	
IEC 62561 Series( Part 1,2 & & ) (Chemical earthing)	IEC 62561-1 Lightning protection system components (LPSC) - Part 1: Requirements for connection components  IEC 62561-2 Lightning protection system components (LPSC) - Part 2: Requirements for conductors and earth electrodes  IEC 62561-7 Lightning protection system components (LPSC) - Part 7: Requirements for earthing enhancing compounds
<i>Junction Boxes</i>	
IEC 60529	Junction boxes and solar panel terminal boxes shall be of the thermo plastic type with IP 65 protection for outdoor use, and IP 54 protection for indoor use
<i>Energy Meter</i>	

IS 16444 or as specified by the DISCOMs	a.c. Static direct connected watt-hour Smart Meter Class 1 and 2 – Specification (with Import & Export/Net energy measurements)
<i>Solar PV Roof Mounting Structure</i>	
IS 2062/IS 4759	Material for the structure mounting

**Note-** Equivalent standards may be used for different system components of the plants. In case of clarification following person/agencies may be contacted.

- Ministry of New and Renewable Energy (Govt. of India)
- National Institute of Solar Energy
- The Energy & Resources Institute
- TUV Rheinland
- UL

## Guidelines Best Practices

### *Solar PV Roof Mounting Structure*

- Aluminum frames will be avoided for installations in coastal areas.

### *Solar Panels*

- Plants installed in high dust geographies like Rajasthan and Gujrat must have the solar panels tested with relevant dust standards (Applicable standard would be IEC 60068-2-68).

### *Fuse:*

- The fuse shall have DIN rail mountable fuse holders and shall be housed in thermoplastic IP 65 enclosures with transparent covers.

### *Cables:*

- For the DC cabling, XLPE or, XLPO insulated and sheathed, UV-stabilized single core flexible copper cables shall be used; Multi-core cables shall not be used.
- For the AC cabling, PVC or, XLPE insulated and PVC sheathed single or, multi-core flexible copper cables shall be used; Outdoor AC cables shall have a UV-stabilized outer sheath.
- The total voltage drop on the cable segments from the solar PV modules to the solar grid inverter shall not exceed 2.0%
- The total voltage drop on the cable segments from the solar grid inverter to the building distribution board shall not exceed 2.0%
- The DC cables from the SPV module array shall run through a UV-stabilized PVC conduit pipe of adequate diameter with a minimum wall thickness of 1.5mm.
- Cables and wires used for the interconnection of solar PV modules shall be provided with solar PV connectors (MC4) and couplers.
- All cables and conduit pipes shall be clamped to the rooftop, walls and ceilings with thermo-plastic clamps at intervals not exceeding 50 cm; the minimum DC cable size shall be 4.0 mm<sup>2</sup> copper; the minimum AC cable size shall be 4.0 mm<sup>2</sup> copper. In three phase systems, the size of the neutral wire size shall be equal to the size of the phase wires.