

CE/Sp. Proj./MNRE-Phase-II RTS/No. 21653

Date: - 18/8/2022

To,  
All Superintending Engineers,  
MSEDCL O&M Circles.

**Sub:** Authorization of AE(QC) of subdivision Subdivision/Division Offices having meter testing facility to test Whole Current Meter and installation up to 20 KW under Roof Top Scheme (RTS).

Letter of Empanelment for Design, supply, erection, testing and commissioning including warranty, comprehensive operation & maintenance of Grid-Connected Rooftop Solar Plant of various capacities for Residential consumers aggregating to 50MWp under the Phase-II of Grid Connected Rooftop Solar Scheme of MNRE in MSEDCL jurisdiction of Maharashtra are issued by MSEDCL.


The progress of installation of RTS is not as per expected. The installation & commissioning of RTS is taking exceptionally long time. Time required for testing of meters and inspection of premises for connection release is among the reasons for delay. Considering the issues, the Competent Authority has accorded approval for authorizing AE QC of subdivision / division to test Whole Current Meter under Roof Top Scheme (RTS) & to visit site for checking the installation and release connections up to 20KW in consultation with SDO.

Accordingly, Executive Engineer, Testing Division will arrange training of AE(QC) to follow the procedure of checking installation & release connection as per the detailed checklist prepared for the same at HO level.

The above instructions have been already issued by Director (Projects) in RD / CE review meeting dtd. 10.08.2022. All SE (O&M) had joined the meeting through V.C.

All are requested to follow the approved procedure for speedy progress of Roof Top Solar connections.

Encl.: Pre commissioning testing procedure for AE (QC) of subdivision Subdivision/Division Offices

  
(C.R.Mishra)  
Chief Engineer (SPD)

Copy s. w.rs. to:

1. Director (Projects), MSEDCL Corporate Office, Mumbai.

Copy f.w.cs to:

1. All CE, MSEDCL O&M Zone.

Copy to :

1. SE (TQA), Kalyan/Pune/Aurangabad/Nagpur.
2. Executive Engineer, All Testing Divisions – For N.A. as above.

## Pre-commissioning Testing procedure for AE (QC)

**Scope :** AE(QC) of Sub-division office are proposed to carry out Pre-Commissioning Testing of Roof Top Solar Connection

### (1) Checking of Eligibility Criteria :

S.N	Points to be checked	Observation
1	The Consumer sanctioned load shall be atleast 1 KW but not exceeding 20 KW **	Yes/No (Connected/Sanction Load : ___)
2	Nos of Solar Module Installed & Capacity of each Module	---- Nos/ --- Kwp
3	The Solar Roof Top Capacity in DC	--- KWp
4	Solar Roof Top Capacity in AC	--- KW
5	Whether AC capacity less than equal to Sanctioned load	Yes/No
6	Is consumer is in arrears	Yes/No
7	Single line schematic diagrams in respect of its system facility	Submitted Yes/No
8	<del>Equipment Layout and Wire Routing Diagram</del>	<del>Submitted Yes/No</del>
9	Earthing Layout Diagram with Detailed Specification	Submitted Yes/No
10	List of equipment installed along with detailed specifications duly signed by the licensed electrical contractor/ Solar PV installer Inventor, Battery, Isolation Transformer, Module Mounting structure, AC Distribution Box with Components DC Cable(s) AC Cable(s) Lightning Arrestor etc	Submitted Yes/No
11	Certificate/Undertaking towards proper working of islanding system, electrical safety of the system & responsibility in case of back feed to the de-energized grid	Submitted Yes/No

#### Note :

- If consumer fails any of the eligibility criteria, then no further pre-commissioning procedure shall be done till correction of default. (Letter to the consumer mentioning defects shall be intimated to consumer by AE(QC) through SDO).
- In case, consumer is enhancing its Roof Top Solar capacity, in such case also above points to be checked.
- \*\* In case, consumer sanctioned load is more than 20 KW, the said case shall be referred to Testing Division of circle.
- Once above Eligibility criteria is comply by consumer, then pre-commissioning Inspection and Testing shall be done at actual site

## Inspection Report on checking of Roof Top Solar System with Associated Equipment

1	Details of Inspecting Office ( Name, Designation, Subdivision)	
2	Date and Time of Inspection	
3	Name of the Consumer:-	
4	Address of Consumer:-	
5	Consumer No.:-	
5.A	Name of Billing Unit :	
6	MSEDCL Existing Sanction & Connected Load(AC in Kw):-	
7	Type of connection ( 1Ph/3Ph)	
8	Consumer Tariff Category	
9	Installed Solar Roof Top System(AC Cap):-	
9.A	Whether Point of Supply Drawing submitted	Yes/No
<b>Checking of Earthing System</b>		
10	Separate Earthing provided for LA Earthing	Yes/No
11	Separate Earthing provided for Solar Panel Structure	Yes/No
12	Earthing provided DCDB Earthing	Yes/No
13	Earthing provided ACDB Earthing	Yes/No
14	Separate Earthing provided Grid Inverter in Built(AC side Earthing)	Yes/No
15	Earthing provided to Metering cubicle	Yes/No
16	All Metallic body Parts earthed	Yes/No
<b>Checking of Protection Switchgear</b>		
16	DC Fuses provided after Solar Modules	
17	AC Junction Box provided with Built in Surge protector device	
18	Separate Lightning Arrestor provided before Solar Panel	
19	Internal Protection provided after Grid –tie Inverter with MCC/MCB	Yes/No, If Yes Rating- : Amp Capacity
20	ACDB provided with Built in Surge Protector	
21	Manual Operated Isolation switch of rated Capacity provided for protection, If Yes 1. Whether switch has visible verification that separation has been accomplished 2. Whether switch clearly indicate Open/Close Position 3. Whether switch has facility of locking in open	Yes/No

	position	
22	MCB Provided before Load side	Yes/No, If Yes Rating- : Amp Capacity
23	Net Metering cabinet with ELCB/RCCB protection of rated capacity with Sealing arrangement for 3ph	Yes/No, If Yes Rating
23 A	Net Metering with ELCB/RCCB protection for 1 ph	Yes/No, If Yes Rating
<b>Checking of Islanding Mode of Operation</b>		
24	Checking of Islanding mode of Solar System by disconnecting from grid supply and also with Single phasing of Grid (in case of 3phase power supply to consumer)	Checked Yes/No, If Yes working satisfactory Yes/No
25	In case of Solar Inverter with Storage Battery or DG as standby source to Solar Inverter, please check whether separate wiring done & change over switch is provided	Provided Yes/No If Yes, Please check Operation to ensure that no reverse power fed into Grid in case of switching of Operation of Solar Inverter with Reference voltage from Storage battery/DG
<b>Net Metering System Details</b>		
26	Net meter Installed in Grid/Network system at the time of Joint Inspection	Yes/No
27	Net meter is Tested at MSEDCL Testing Division Lab	Yes/No , If Yes, Testing date & Seal Nos
28	Meter make	
29	Meter Type	
30	Meter Serial No	
31	Meter Class of Accuracy	
32	Meter Capacity	
33	Meter Constant	
34	Meter Initial Reading	
35	Location meter easily assessable for meter reading	Yes/No
<b>Generation Meter Details</b>		
36	Generation meter Installed for recording Solar Generation	Yes/No
37	Meter is Tested at MSEDCL Testing Division Lab	Yes/No , If Yes, Testing date & Seal Nos
38	Meter make	
39	Meter Type	
40	Meter Serial No	
41	Meter Class of Accuracy	
42	Meter Capacity	
43	Meter Constant	
44	Meter Initial Reading	
45	Location meter easily assessable for meter reading	Yes/No



<b>Solar System Equipment Details</b>		
46	Grid Tie Inverter Make:-	
47	Invertors Capacity(AC Kw/Kva)	
48	PV Module make:-	
49	PV Module Nos	
50	PV Module serial Nos	
51	No. of strings:-	
52	Rating of Each PV modules & total Capacity	
<b>Checking of connection of Meter</b>		
53	Generation Meter connection	
54	Net Meter connection	
<b>Overall Observation</b>		
55	<b>Found that Inverter is working in Healthy condition (Yes/No)</b>	
55 A	Islanding of Solar System working Satisfactory	<b>Yes/No</b>
56	The Above inspected Solar Invertors system with associated equipment & Metering system can be taken into system <b>(Yes/No)</b>	
57	If, No , Discrepancies to be attended by consumer (Please mention Serial Nos of Points to be complied by consumers)	
Consumer representative	<b>Contractor Representative</b>	AE(QC)

**Remarks:-**

- In the presence of backup inverter an arrangement should be made in such way that the backup inverter supply should never be synchronised with solar inverter to avoid any electrical accident due to back feeding. **If Islanding is not working satisfactory then connection should not be released by AE(QC) and agency should be instructed to solve the islanding issue.**
- In case of DG synchronisation , synchronised panel protection, uv and frequency should be verified
- Please refer "Sample detailed specification of typical rooftop photovoltaic system" and MSEDCL commercial circular No-322 dated 21-01-2019 regarding "connectivity to the Distribution network of MSEDCL for eligible consumers installing Rooftop Renewable Energy Generating Systems in his premises under MERC (Grid Interactive Rooftop Renewable Energy Generating Systems) Regulations, 2019——- Procedure for Application, methodology for Metering & Billing, etc."

### **Commissioning of Roof Top Solar System**

- If there is any compliance is pending from consumer end, then same to be comply by consumer and thereafter AE(QC) will verify compliance and submit pre-commissioning report to concern SDO.
- The concerned O&M authorities shall issue release order and commission the net metering arrangement only after receipt of the Pre-commissioning report in above format and compliance of any pending work/observation from AE(QC).

### **protection and islanding. Post Commissioning Inspection:**

- Post Commissioning, it shall be checked that both meter (Generation & Net meter) is recording properly using Accucheck
- The voltage & current at Meter Terminal shall be checked using Digital High Accuracy Mutlimeter and same to be compared with those shown on meter display

Sample detailed specification of typical rooftop photovoltaic system

S.N	Equipment/Item	Specification
1	General	<ul style="list-style-type: none"> <li>• Grid-connected PV systems shall always conform to Central Electricity Authority's (CEA)(Technical Standards for Connectivity of the Distributed Generation Resources)Regulations, 2013.</li> <li>• Grid-connected PV systems shall be guided by the latest edition of IEC 60364, "Electrical installations of buildings — Part 7-712, Requirements for special installations or locations -Solar photovoltaic (PV) power supply systems".</li> <li>• The PV system and all components shall always comply with the latest relevant standards, as amended from time to time.</li> </ul>
2	PV Modules	<ul style="list-style-type: none"> <li>• The PV modules used shall qualify to the latest edition of IEC PV module qualification test or equivalent BIS standards.</li> <li>• PV modules shall comply with one of the following three certifications;</li> <li>• Mono- and Poly-crystalline silicon solar cell modules shall conform to IEC 61215, 2nd Ed. (2005-04), "Crystalline silicon terrestrial photovoltaic (PV) modules — Design qualification and type approval".</li> <li>• Thin-film PV modules shall conform to IEC 61646, 2nd Ed. (2008-05), "Thin-film terrestrial photovoltaic (PV) modules — Design qualification and type approval".</li> <li>• Concentrator photovoltaic (CPV) modules and assemblies shall conform to IEC 62108, 1st Ed. (2007-12), "Concentrator photovoltaic (CPV) modules and assemblies-Design qualification and type approval".</li> <li>• In addition to one of the above three certifications, the PV modules shall also conform to IEC 61730-1, Ed. 1.2 (2013-03), "Photovoltaic (PV) module safety qualification — Part 1: Requirements for construction" and IEC 61730-2, Ed. 1.1 (2012-11), "Photovoltaic (PV) module safety qualification — Part 2: Requirements for testing".</li> <li>• For solar PV installations in saline marine and/ or corrosive environments, the PV modules shall conform to IEC 61701, 2<sup>nd</sup> Ed. (2011-12), "Salt mist corrosion testing of photovoltaic(PV) modules".</li> <li>• All PV modules shall have performance warranty of 90 percent and 80 percent for the first 10 (ten) years and then subsequent 15 (fifteen) years, respectively.</li> <li>• All PV modules shall have a workmanship warranty for at least 5 (five) years.</li> </ul>
3	Inverter	<ul style="list-style-type: none"> <li>• The inverter may be (i) grid-connected without batteries or (ii) hybrid with batteries.</li> <li>• Inverters shall comply with CEA's (Technical Standards for Connectivity of the Distributed Generation Resources) Regulations, 2013.</li> <li>• Grid-connected inverter shall comply with IEC 61727, "Photovoltaic (PV) systems — Characteristics of the utility interface".</li> <li>• All inverters shall conform to IEC 62116, 2<sup>nd</sup> Ed. (2014-02), "Utility-interconnected photovoltaic inverters — Test procedure for islanding prevention measures".</li> </ul>

S.N	Equipment/Item	Specification
		<ul style="list-style-type: none"> <li>All inverters shall conform to IEC 62109-1, 1st Ed. (2010-04), "Safety of power converters for use in photovoltaic power systems — Part 1: General requirements" and IEC 62109-2, 1st Ed. (2011-06), "Safety of power converters for use in photovoltaic power systems — Part 2: Particular requirements for inverters".</li> <li>The PV inverter may be undersized compared to the rated PV module capacity without, however, compromising on the power (and energy) output of the PV system.</li> <li>Inverter shall have a warranty for at least 5 (five) years.</li> </ul>
4	Specific Safety and performance	<ul style="list-style-type: none"> <li>DC surge protection device (SPD) shall be used at the DC input of the inverter. If the DC SPD are not in-built into the inverter, then external DC SPDs shall be used by mounting them in the DC String Junction Box. DC SPD of appropriate specification shall be of Class 2 as per IEC 60364-5-53.</li> <li>Manual DC disconnectors (isolators or circuit breaker) shall be employed at the DC input of the inverter. If the DC disconnector is not in-built into the inverter, then external DC SPD shall be used by mounting it near the inverter. The DC disconnector switch shall be clearly labelled.</li> <li>DC overcurrent protection device (fuse or DC MCB) shall be employed between the strings of the PV modules and the inverter. If the DC overcurrent protection devices are not in- built into the inverter, then external DC overcurrent protection devices shall be used by mounting them in the DC String Junction Box. DC overcurrent protection devices shall be employed at both positive and negative terminals of the incoming DC inputs.</li> </ul>
5		<ul style="list-style-type: none"> <li>At all DC junction boxes and at the input of the inverter, a non-corrosive caution label shall be provided with the following text <div data-bbox="850 938 1602 1040" style="background-color: red; color: white; text-align: center; padding: 5px; margin: 10px 0;"> <b>WARNING: High Voltage DC Power SOLAR PHOTOVOLTAIC (PV) SYSTEM</b> </div> <p>The size of the caution label shall be 105mm (width) x 20mm (height) with white letters on a red background.</p> </li> <li>AC SPD of appropriate specification and Class 2 as per IEC 60364-5-53 shall be used at the output of the inverter.</li> <li>Earth leakage circuit breaker (ELCB) or residual current circuit breaker (RCCB) shall be used at the output of the inverter.</li> <li>Manual AC disconnectors shall be employed at the interconnection of the PV system in the AC distribution box. The AC disconnector switch shall be clearly labelled.</li> <li>If the grid voltage tends to sag or swell beyond the operating range of the inverter, then an isolation</li> </ul>



S.N	Equipment/Item	Specification
		<p>transformer of appropriate capacity, standards and specifications shall be used at the output of the inverter prior to interconnection in order to ensure that the inverter does not trip due to grid voltage issues.</p> <ul style="list-style-type: none"> <li>In addition to the standard caution and danger boards or labels as per Indian Electricity Rules, the AC distribution box near the solar grid inverter, the building distribution board to which the AC output of the solar PV system is connected and the Solar Generation Meter shall be provided with a non-corrosive caution label with the following text: <div data-bbox="921 441 1677 547" style="text-align: center; background-color: red; color: white; padding: 5px; border: 1px solid black;"> <p><b>WARNING: Dual Power Source</b> (i) Grid and (ii) Solar</p> </div> </li> </ul> <p>The size of the caution label shall be 105mm (width) x 20mm (height) with white letters on a red background.</p> <ul style="list-style-type: none"> <li>The PV system shall carry an overall warranty of at least 5 (five) years</li> </ul>
6	Junction Boxes and Enclosures (General)	<ul style="list-style-type: none"> <li>All junction boxes shall be IP65 or higher for outdoor applications, IP 54 or higher for outdoor applications under appropriate sheds, and IP 21 or higher for indoor applications</li> </ul>
7	Module Mounting Structure (MMS)	<ul style="list-style-type: none"> <li>All module mounting structures shall conform to IS:875 (Part 3)-1987, "Code for practice of design loads (other than earthquake) for buildings and structures".</li> <li>Important: For PV installations on tall buildings, the design should consider the 'height factor' as per IS:875 (Part 3)-1987, which quantifies higher wind loads on tall structures within the same wind zone.</li> <li>All fasteners shall be of stainless steel.</li> <li>Module mounting structures shall be carefully installed, without causing any physical damage to the terrace/ roof and without affecting the waterproofing of the terrace/ roof. In case fasteners are anchored in the terrace/ roof, it shall be ensured that waterproofing of the terrace/ roof remains secure</li> </ul>
8		<ul style="list-style-type: none"> <li>All cables shall be supplied conforming to IEC 60227/ IS 694 &amp; IEC 60502/IS 1554, Voltage rating: 1,100V AC, 1,500V DC.</li> <li>For the DC cables, XLPE or XLPO insulated and sheathed, UV stabilised single core flexible copper cables shall be used. Multi-core cables shall not be used.</li> <li>The total voltage drop on the cable segments from the solar PV modules to the solar grid inverter shall not exceed 2.0 percent.</li> <li>Cables and wires used for the interconnection of solar PV modules shall be provided with solar PV</li> </ul>

S.N	Equipment/Item	Specification
		<p>connectors (MC4 or similar) and couplers.</p> <ul style="list-style-type: none"> <li>• All cables and conduit pipes shall be clamped to the rooftop, walls and ceilings with thermo-plastic clamps at intervals not exceeding 50 cm.</li> <li>• The DC cables from the SPV module array shall run through a UV stabilised PVC conduit pipe of adequate diameter with a minimum wall thickness of 1.5mm. Alternatively, a cable tray on the ground with sufficient clearance for passage of water and a cover may be used.</li> <li>• The minimum DC cable size shall be 4.0 mm<sup>2</sup> copper.</li> <li>• The following colour coding shall be used for DC cable: <ul style="list-style-type: none"> <li>○ Positive: Outer PV sheath shall be Red OR Black with a red line marking</li> <li>○ Negative: Outer PV sheath shall be Black</li> <li>○ Earth: green</li> </ul> </li> <li>• For the AC cables, PVC or XLPE insulated and PVC sheathed single or multi-core flexible copper cables shall be used. Outdoor AC cables shall have a UV-stabilised outer sheath.</li> <li>• The total voltage drop on the cable segments from the solar grid inverter to the building distribution board shall not exceed 2.0 percent.</li> <li>• 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.</li> <li>• The following colour coding shall be used for AC cable: <ul style="list-style-type: none"> <li>○ AC single phase: Phase -Red; Neutral- Black</li> <li>○ AC three phase: Phases -Red, Yellow, Blue; Neutral: black</li> <li>○ Earth: green</li> </ul> </li> <li>• Cables and conduits that have to pass through walls or ceilings shall be taken through aPVC pipe sleeve.</li> <li>• Cable conductors shall be terminated with tinned copper end-ferrules to prevent frayingand breaking of individual wire strands. The termination of the DC and AC cables at the inverter shall be done as per instructions of the manufacturer.</li> </ul>
9	Earthing	<ul style="list-style-type: none"> <li>• All earthing shall be as per IS:3043-1987 (Reaffirmed 2006), "Code of Practice forEarthing".</li> <li>• AC, DC and body earthing of the PV system may be connected to the same earth, while the earthing of the lightning arrestor shall be isolated from the rest of the PV system.</li> <li>• At least 2 (two) numbers of earth pits shall be used at a time for earthing.</li> </ul>
10	Metering	<ul style="list-style-type: none"> <li>• An energy meter shall be installed in between the inverter and the AC distribution box to measure gross solar AC energy production (the "Generation Meter"). The Generation Meter shall be of the same accuracy</li> </ul>

S.N	Equipment/Item	Specification
		class as the Applicant's (i.e. Consumer's) service connection meter. <ul style="list-style-type: none"> <li>• Net Meter shall be installed at MSEDCL supply end i.e point of supply</li> <li>• Meter shall be as per MSEDCL Latest specification &amp; MSEDCL approved make</li> </ul>
11	Documentation	<ul style="list-style-type: none"> <li>• Grid-connected PV systems shall be guided by the latest edition of IEC 62446, "Grid connected photovoltaic systems — Minimum requirements for system documentation, commissioning tests and inspection".</li> <li>• The documentation of the rooftop PV shall consist of the following:               <ul style="list-style-type: none"> <li>○ System description with working principles</li> <li>○ Single Line Diagram</li> <li>○ Equipment Layout and Wire Routing Diagram</li> <li>○ Earthing Layout Diagram with Detailed Specification</li> <li>○ Datasheets, drawings and/ or specifications (PV module, inverter, junction box and components, MMS, cables, battery, transformer, lightning arrestor, etc.)</li> <li>○ IEC and other test certificates of PV modules and inverters</li> <li>○ Warranty cards of equipment and complete PV system</li> <li>○ Operation and maintenance manual</li> <li>○ Maintenance register</li> <li>○ Contact information of Installer and/ or Service Technician</li> <li>○ Photographs of installed PV system</li> <li>○ All statutory and other approvals received</li> </ul> </li> </ul>

**Note :** Source of above document is based on "Best Practices Manual for Implementation of State-level Rooftop Solar Photovoltaic Programmes in India"