



TECHNICAL SPECIFICATIONS  
FOR THE SOLARIZATION  
PROJECTS

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## Scope

- **Major solar equipment i.e., Solar Panels, Inverters, Batteries shall be provided by UNHCR. Successful bidders will receive training (free-of-cost) for installing the solar equipment optimally.**
- The provided specifications shall be followed for each item as applicable. Any deviation from the specifications shall be highlighted in the technical proposal.
- The latest versions of international standards and local codes shall be applicable for the material and equipment specified herein and for installation work. In case the specifications laid down herein differ from those given in the standards/ codes, then the equivalent or better specifications shall govern.
- The Bidder shall also be responsible to supply any other accessories not specifically mentioned in the BOQ/ specifications, but which is necessary for proper operation of the works/system included in the scope of this ITB.

## Technical Specifications

### Panel Mounting Structure

- The panel mounting and structure should be made of hot dipped (80 microns Average) galvanized steel of minimum thickness of 12 SWG Channel / Pipe or 8 SWG Angle.
- A sketch of the mounting frame (As per Actual Site Requirements) showing dimensions of the frame parts should be provided at the time of supply.
- PV to ground clearance must not be less than 1.5 feet. The height of the upper edge of the structure should not exceed 10 feet above the ground and 6 Feet for Roof Top Installations.
- To avoid Shading, Distance between two rows of PV panels and from walls or any structure should be maintained at a minimum of 1.6 times the height of structure/walls.
- The pit size for concrete works should be minimum 1.5x1.5x2 feet for each individual leg or 1.5x2.5x2 for double leg and the concrete should be extended at least 1 foot above the ground. The concrete ratio should be 1:2:4.
- For rooftop PV structure the pit size for concrete works should be minimum 1x1x1 feet for each individual leg or 1.5x1.5x1 for double leg and the concrete should be 1:2:4.
- The Surface azimuth angle of PV Module and the Tilt angle (slope) of PV Module shall be as per the design reports.
- The PV modules will be mounted on metallic structures of adequate strength and appropriate design, which can withstand load of modules and high wind velocities up to 150 km per hour.
- Due to land non-availability or any other problem, Structure design can be modified as per site requirement. Pole Mounted or manual Tracker Structure can be provided.
- Array fasteners (nut/bolts/washers) between PV Module and Structure shall be stainless steel. Washers should be installed on both sides of Module frame.
- The minimum space between two PV Modules should be 2.54 cm (1 inch), to avoid air push over PV Modules.
- Mechanism / arrangement for cleaning of PV Panels should be provided. i.e, Space and ladder between panels or at the back side of structure, so that the operator can safely climb and clean the panels.
- All other array fasteners Structure shall be stainless steel or galvanized steel that provides the required mechanical strength.
- The PV modules will be mounted on metallic structures at the inner holes for cantilevered installation, which will evenly distribute the load of the panel around the support structure on both sides and in the middle.

### Cables and Wiring

- From PV Panel to Junction Box: XLPE or XLPO insulated & XLPE/PVC Sheathed, UV stabilized single core, Double Insulated. Stranded /flexible cables (Conforming preferably to EN 50618 or IEC 62930 or equivalent) be used. DC Cable from PV Module to Junction Box / Inverter for each string should be minimum size 6 mm<sup>2</sup>.
- From Junction Box to Inverter: the DC cable must be, XLPE or XLPO Cable, Non-Armoured Single/Multi Core, double insulated and suitable for minimum 1000 VDC transmission.
- From Inverter to Battery: the DC cable can be single insulated, Single Core and suitable for minimum 300 V<sub>DC</sub>.
- The AC / DC cables should be made of 99.9% copper strands and Flexible.
- AC/DC breakers should be marked with the manufacturer model number, rated voltage, ampere rating and batch / serial number.

- To prevent solar panels from damage an appropriate size of DC Breaker should be installed for each PV string and Surge Protection should be installed for combined Array (before Main DC Breaker/Inverter).
- DC Breaker, AC Breaker & Change overs should be placed in an enclosure of at least IP54 standard. All Enclosures / Junction boxes should be made from Hot Dipped Galvanized Sheets of minimum 16 SWG. All enclosures/ junction boxes shall be properly earthed.
- Cables shall be clearly labelled with essential electrical parameters including manufacturer name, Voltage Range, standards etc.
- All connections / socket outlet among array, controller, inverters, batteries and load etc. must be made in junction boxes of adequate protection level.
- New AC wiring (Neutral and Phase) for load connected should be provided by contractor, along with breakers, sockets, buttons etc.
- The DC Combiner Junction Box should be properly earthed including earthing of door as well.
- The DC Combiner should contain proper bus bars of adequate size each for Positive, Negative and Earthing.
- The Inverter Junction Box should be properly earthed.
- All wiring should be in proper conduit of capping casing. Wire should not be hanging loose.
- All wires should be terminated properly by using lugs / thimble connectors/sleeves.
- Distribution board must be installed with proper screws.
- Electrical Hazards Safety Labels should be pasted on DC Combiner / Inverter Enclosure/ Charge Controller /Battery Enclosures.
- AC Combiner Box made of 16 SWG, Powder Coated, Separate Bus Bar for each Phase, Neutral and Earth Connection. All circuits must be properly tagged as per site installations.
- DC circuit breakers (not fuse) of  $\geq V_{oc}$  of String Voltage – at least 800 V - and suitable ampere rating (1.25-1.5 x Rated Current of all strings connected) must be installed between PV modules and controller / inverter)
- AC Circuit Breaker (s) of suitable rating (1.25-1.5 x Connected Load) must be installed between Controller / inverter to Load and Grid to Controller /Inverter
- AC / DC breakers should be marked with the manufacturer model number, rated voltage, ampere rating and batch/serial number.
- Notwithstanding the ISO /IEC requirements, all wires must be verified accordingly to keep line voltage losses to less than 3% between PV generator and battery, less than 1% between battery and charge regulator, and less than 3% between battery and load, all of them at the maximum current conditions.
- All wiring shall be color-coded and/ labeled and shall be aesthetically neat and clean.
- All supplied wires must be in UV-resistant conduits or be firmly fastened to the building and/or support structure. Cable binders, clamps and other fixing material must also be UV-resistant, preferably made of polyethylene. Wire should not be hanging loose.
- All wires should be terminated properly by using lugs / connectors /sleeves.

### Earthing/ Lightning Protection

- The PV Panel frame and structure should be connected by the shortest practical route to an adequate earth contact (of Less than 5 Ohms Resistance) as per requirement of equipment manufacturer and site earth conditions, using an uninterrupted conductor.
- The Sizing of Earthing conductor will be done as per NEC Table 250:122.
- The grounding conductor should be 99% Copper and PVC insulated / Bare Copper if installed underground along a defined path.

- Grounding/Earthing plate should be made of Copper plate of 4mm thickness & Size minimum 1.0 x 1.0 ft.
- Grounding/Earthing conductor should be connected to the copper plate by proper connector of minimum depth of 6 feet.
- Copper air terminal/ lightning rod shall be installed to provide lightning protection.
- Inverter, Battery / Battery Box (if required), Main Distribution Board should be properly grounded/ connected to earth.
- All nut / bolt and Earthing clamp shall be stainless steel or galvanized steel.
- Proper Earthing will be checked on site by Earth Test Meter.

### AC Distribution Boards

- AC Distribution Board (ACDB) shall have minimum IP 41 ingress protection with Form 2b, Type 2 construction.
- ACDB shall have a rated service short circuit breaking capacity (Ics), conforming to IEC 60947-2
- ACDB shall be provided with adequate clearance from live parts so that the flashovers cannot be caused by switching, vermin, pests etc.
- It shall have incoming and outgoing cable termination arrangement, terminal block/line up terminals.
- It shall be provided with stainless steel name plate on the front side of door.
- Indicating lamps shall be provided for each incoming phase.

### Box / Stand for Batteries, Inverter

- The batteries should be housed in a vented compartment/stand that prevents users from coming in contact with battery terminals. This compartment/stand should be strong enough to accommodate the weight of the battery.
- A mechanism to prevent opening and entry of the battery should be provided.
- This compartment should be manufactured of mild steel of at least 16 SWG.
- The compartment should be powder coated paint.
- The entire enclosure / stand must be constructed to last at least twenty years without maintenance and should be protected against corrosion. The enclosure should have a clean and neat appearance Battery Box /stand should be installed at a place in accordance with user's preference.

### PVC Channel Ducts & Pipes

- A product of good quality standard material with suitable size to be used.
- Ducting must be done with proper steel nails and clips.
- All ducting (wiring) must be aligned.

### Flexible PVC Pipe

- The flexible PVC pipe should be of good quality material with suitable size should be used.

### Civil Work

- The Civil Works should be carried out for roof-top and ground installation of PV Modules/mounting structures. Also, Civil work for earthing system as per the statutory requirements.