TECHANICAL SPECIFICATIONS
OF THE
SOLAR SYSTEM COMPONENTS

REQUEST FOR QUOTATION: No. PAKIS/RFQ/24/039

FOR SOLARIZATION OF DHQ ALPURI, SHANGLA, KHYBER PAKHTUNKHWA

Technical Specifications of the Solar Equipment

Scope

- Major solar equipment i.e., Solar Panels, Inverters, Batteries shall be provided by UNHCR.
- 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.

Technical Specifications

Panel Mounting Structure

a) 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.
b) 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.
c) 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.
d) 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.
e) 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.
f) 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.
g) The Surface azimuth angle of PV Module 180° ±30° and the Tilt angle (slope) of PV Module should be 25° ±10°.
h) 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.
i) 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.
j) Array fasteners (nut/bolts/washers) between PV Module and Structure shall be stainless steel. Washers should be installed on both sides of Module frame.
k) The minimum space between two PV Modules should be 2.54 cm (1 inch), to avoid air push over PV Modules.
l) 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.
m) All other array fasteners Structure shall be stainless steel or galvanized steel that provides the required mechanical strength.
n) 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.
o) In case of south facing of shutter rooftop PV Azimuth and Tilt is subject to shutter orientation. Whereas, in case of non-availability of true South shutter rooftops, structure has to be mounted on the Eastern or Western side of the shutter rooftop and in order to maximize solar exposure, the structure has to be lifted around 15-35 degrees towards the Southern direction.

Cables and Wiring

a) The AC / DC cables should be made of 99.9% copper strands and Flexible.
b) b. DC Cable from PV Module to Junction Box / Inverter for each string should be minimum size 6 mm^2.
c) From PV Panel to Junction Box, XLPE or XLPO insulated and sheathed, UV stabilized single core stranded / flexible cables (Conforming preferably to TUV 2PfG-1169 PV1-F) be used.

d) From DC Combiner to Inverter, XLPE or XLPO Cable, Non-Armored, 3 Core should be installed (3 feet deep) for underground wiring for transmission underground suitable for minimum 1000 Vdc.
e) From Inverter to batteries, the DC cable can be single insulated, Single Core and suitable for minimum 300 Vdc transmission.
f) DC circuit breakers (not fuse) of at least 800V and suitable ampere rating must be installed between PV modules and controller/inverter.
g) AC Circuit Breaker(s) of suitable rating must be installed between Controller / Inverter to Load and Grid to Controller / Inverter.
h) AC/DC breakers should be marked with the manufacturer model number, rated voltage, ampere rating and batch / serial number.
i) 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).
j) DC Breaker, AC Breaker & Change overs should be placed in an enclosure of at least IP54 standard.
k) Cables shall be clearly labelled with essential electrical parameters including manufacturer name, Voltage Range, standards etc.
l) All wiring shall be aesthetically neat and clean, over all wiring/connection losses shall not exceed 1% of the total rated output power.
m) All connections / socket outlet among array, controller, inverters, batteries and load etc must be made in junction boxes of adequate protection level.
n) New AC wiring (Neutral and Phase) for load connected should be provided by contractor, along with breakers, sockets, buttons etc.
o) The DC Combiner Junction Box should be properly earthed including earthing of door as well.
p) The DC Combiner should contain proper bus bars of adequate size each for Positive, Negative and Earthing.
q) The Inverter Junction Box should be properly earthed.
r) All wiring should be in proper conduit of capping casing. Wire should not be hanging loose.
s) All wires should be terminated properly by using lugs / thimble connectors/sleeves.
t) Distribution board must be installed with proper screws.
u) Following lab tests are mandatory; Conductor resistance test, Insulation resistance test, Pressure test, Spark test.
v) Electrical Hazards Safety Labels should be pasted on DC Combiner / Inverter Enclosure/ Charge Controller /Battery Enclosures.
w) AC Combiner Box made of 18 SWG, Powder Coated, and Separate Bus Bar for each Phase, Neutral and Earth Connection. All circuits must be properly tagged as per site installations.

Earthing/ Lightning Protection

a) 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.
b) The Sizing of Earthing conductor will be done as per NEC Table 250:122.
c) The grounding conductor should be 99% Copper, PVC insulated/ Bare Copper.
d) Panel, Inverter, Battery/Battery Box (if required), Main Distribution Board should be connected to an adequate earth contact / Grounding.
e) Ground enhancement material (GEM) shall be used below and above the Earthing plate for proper grounding. Gravel or coarse sand shall be pour along with soil the pit.

f) Grounding/Earthing plate should be made of Copper plate of 4mm thickness & Size minimum 1.0 x 1.0 ft.
g) Grounding/Earthing conductor should be connected to the copper plate by proper connector of minimum depth of 6 feet.
h) All nut/bolt and Earthing clamp shall be stainless steel or galvanized steel.
i) Proper Earthing will be checked on site by Earth Test Meter.

AC Distribution Boards

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

Box / Stand for Batteries, Inverter

a) 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.
b) A mechanism to prevent opening and entry of the battery should be provided
c) This compartment should be manufactured of mild steel of at least 16 SWG.
d) The compartment should be powder coated paint.
e) 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) A product of good quality standard material with suitable size to be used.
b) Ducting must be done with proper steel nails and clips.
c) All ducting (wiring) must be align.

Flexible PVC Pipe

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

Civil Work

a) 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.