PR No. 1000023288 (Rfx No. 6100000960)

Detailed Technical Specifications for Supply, Installation, Commissioning of Solar PV Array and Sub Systems at Mount Abu:

1. Scope of work

Supply, Installation and Commissioning of Roof Mounted/ Ground Mounted 2 x 10 kW_p Solar Photovoltaic (SPV) Array and Subsystems on turnkey basis with 5 Years warranty including spares and routine maintenance at Mount Abu, Rajasthan.

Scope of work shall include but not limited to the following.

i. Supply of the complete SPV Array of rating **2 x 10 kWp**, including all necessary components, sub-components, spares, tools, tackles etc. as per technical specifications given in this document

ii. Erection and commissioning of the system as detailed in work schedule (Table 1) and the associated cabling work

iii. Providing pedestals and foundation for the SPV panels

iv. Provision for water supply points at necessary parts of the PV array using full C class piping and accessories with array level supply points for panel cleaning and washing along with water discharge piping.

v. Civil engineering work in the control room associated with erection of the Power Converter Unit (PCU) and Battery

vi. Any other related work required as per site conditions

vii. All design drawings need to be approved from IITB (design calculations, cabling, terminations, layout etc.).

viii. Provide sustainable maintenance support.

ix. Pathway of minimum 60 cm wide to be provided in the array field for accessing all the solar panels.

x. AC power/ Water shall be provided free of cost at site.

xi. Lodging/ Boarding for 2-3 Engineers/ Supervisors shall be provided free of cost at site

Note: All the components of the system installed shall be graded for working in salty/humid coastal atmospheric condition

Price Bid for Supply, Installation, Commissioning of Solar PV Array and Sub Systems at Mount Abu

S.No	Item	Unit	Qty	Rate	Amount (Rs)
1	Supply, Installation of Solar Photovoltaic Array of capacity 10kWp (Voc max = 250 V) as per IEC 61215/ 61730/ 61701 of preferred make Vikram Solar/ WAAREE/ Tata Power Solar/ Adani Solar as per Technical Specifications 3.1 enclosed. Approval of Solar Array arrangement with approved make needs to be taken before going ahead with procurement.	No	2		
2	Supply, Installation of Array Mounting Structure as per IS 2062:1992, ASTM A-123 suitable for deployment of 10kWp capacity SPV array as per Technical Specification 3.2	No	2		
3	Supply, Installation of water supply points at necessary parts of the PV array using full C class piping and accessories with array level supply points for panel cleaning and washing along with water discharge piping.	LS	1		
4	Supply, Installation of Module Junction Boxes and Array Junction Boxes of preferred make ABB/ TYCO/ HENSEL/ SPELBERG with Cables and Connectors as per IEC 62208, IP 65 standard and as per Technical Specification 3.3 and as per design of Array.	LS	1		
5	Supply, Installation of DC Distribution Boards of preferred make ABB/ Siemens/ Scheider/ L&T/ Havells as per Technical Specifications 3.4	Set	2		
6	Supply, Installation of AC Distribution Boards of preferred make ABB/ Siemens/ Scheider/ L&T/ Havells as per Technical Specifications 3.5	Set	2		
7	Supply, Installation of Surge Protection as per IEC 60364-5-53 & NFEN of preferred make ERICO/ Harger as per Technical Specifications 3.7	Set	2		
8	Supply and Installation of Cables as per IEC 69947, IS 694, IS 1554, IEC 60189 of preferred make Havells/ Finolex/ Polycab as per Technical Specifcations 3.8	LS	1		
9	Supply, Installation of Earthing Pit & Earthing as per IS 3043-1987 as per Technical Specification 3.9	Set	2		

10	Supply, Installation of Lightning Protection as per IS 2309, IEC 62305 of preferred make ERICO/ Harger as per Technical Specifcation 3.10	Set	2		
11	Leveling of Ground/Civil work associated with foundation pedestals/Cable ducts/Cable trays/Foundation for PCU/ Pathway/ Fencing etc as per Technical Specification 3.11	LS	1		
12	Supply, Installation of Marking and Danger Boards as per Technical Specification 3.12	LS	1		
13	Supply of Tools and Spares as per Technical Specification 3.13	Set	1		
14	Supply, Installation of Fire Extinguishers, Sand Buckets as per Technical Specfications 3.16 - Portable fire extinguishers in the control room and SPV array field for fire caused by electrical short circuits - Sand buckets in the control room The installation of Fire Extinguishers should conform to TAC regulations and BIS standards.	LS	1		
15	Drawings/Manuals as per Technical Specifications 3.17	Set	2		
16	Onsite Warranty/Maintenance Contract for 5 Years	Year	5		
	Total (Rs)				
	GST	5%			
	Total with Taxes (Rs)				

2. General Technical Specification

The basic scheme for a Solar Photovoltaic (SPV) Power Plant is shown in Fig 1. In this scheme, the SPV array which generates electric power in the DC form, is converted to AC with magnitude and frequency matched with the grid, facilitating power export to grid.

The major works associated with the installation of the SPV Power Plant are listed below.

1. Roof mounted/ Ground mounted SPV array as per the specifications mentioned in section 3.1
2. Junction boxes for connecting the cables from the SPV modules/array as per the specifications mentioned in section 3.3
3. DC side Distribution Board as per the specifications mentioned in section 3.4
4. AC Distribution Board as per the specifications mentioned in section 3.5
5. Cabling to the DC Distribution board as per the specifications mentioned in section 3.8
6. Cabling associated with the SPV module/panel/array and Power Converter Unit (PCU) as per the specifications mentioned in section 3.8
7. Lightning/ Surge protection on the SPV Array side and load side section 3.10
8. Earthing of the total system section 3.9
9. Field preparations and civil work associated section 3.11
10. Tools and spares section 3.13
11. Danger Boards/ Markings section 3.12
12. Fire Extinguishers section 3.15
13. Drawings and Manuals section 3.16
14. Any other accessories which is essential as per your knowledge. Please specify
15. The supplier shall be responsible for each component of work listed above for installation 2 x 10 kW SPV power plant.

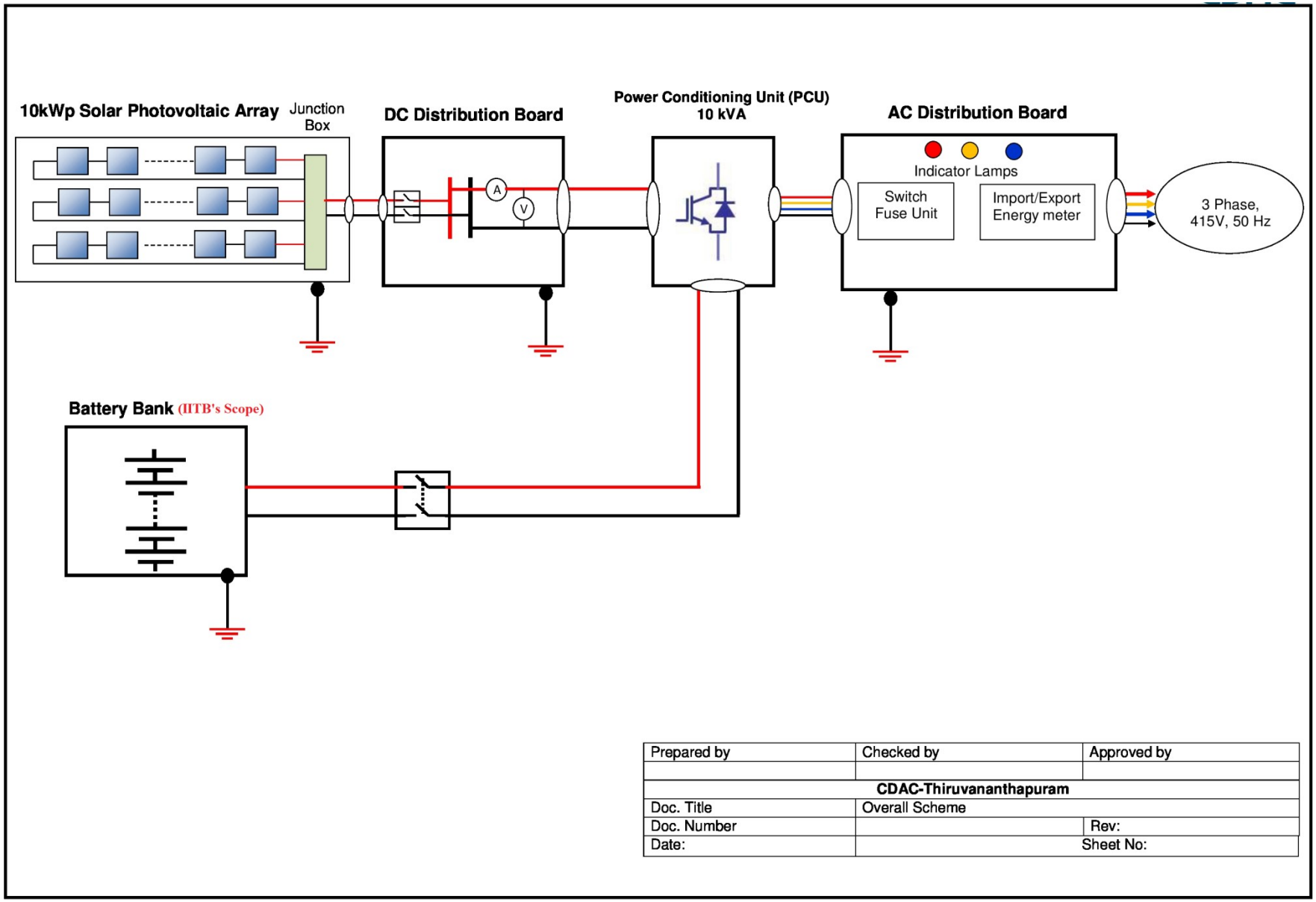


Fig.1. Detailed schematic of the system

3. Technical Description and Specifications

The objective of the work is design and commissioning of **2 x 10 kW_p** grid connected solar PV power plant. The major components will be solar photovoltaic modules, mounting structure, distribution boxes (DC and AC), PCU and Battery.

The mechanical design and construction of SPV modules, panels and mounting structure, steel structure for mounting of SPV Modules shall be inherently robust and rigid under all conditions of operation, adjustment, storage and transport. Sharp Edges shall be avoided.

The details regarding the individual components of the system and specification of work associated is described below.

3.1. SPV Module

In this document, the naming convention associated with the SPV array is mentioned below. Crystalline silicon SPV cells constitute a SPV module. Many modules stacked together in a metallic frame is named as SPV Panel. SPV panel will have specifications like Open Circuit Voltage (V_{oc}), Short Circuit Current (I_{sc}), Maximum Power Point Voltage (V_{MPP}), Maximum Power Point Current (I_{MPP}) and the Peak Power (W_P). Many SPV panels will be connected in series to form a SPV string with the required voltage. Many such SPV strings will be connected in parallel to form the SPV array with the required peak power capacity.
It is proposed that the supplier shall design the SPV array with the general specification given in table below.

1	Stabilized SPV Array Capacity	10 kW_p
2	SPV Array Voltage (V_{oc})	240 V
3	SPV Array Voltage (V_{mpp})	120-200 V
4	SPV cell type	Mono crystalline/poly crystalline silicon
5	Module rating (indicative)	355 W_p (based on availability) Fill Factor ≥ 0.7
6	Module Efficiency	≥ 15%

I. **The PV string architecture may be designed by the supplier after inspection of the site.**

II. **The sample sizing of SPV array (with optimum selection) has been shown in Annexure -X.**

III. **The vendor may choose any combination to achieve desired SPV array capacity ensuring not to exceed Voc and Vmpp level as specified in the Table.**

IV. **The bidder shall submit the design and array arrangements in detail for approval.**

The SPV Module must be tested, approved & certified by any one of the IEC authorized test centres – NABL/ BIS Accredited Testing/Calibration Laboratories or by any International IEC authorized test centre. The PV modules must conform to the latest edition of any of the following IEC/equivalent BIS Standards for PV module design qualification and type approval (as per JNNSM):

Type of Module: - Crystalline Silicon Terrestrial PV Modules - IEC 61215/ IS14286. The manufacturer should certify that the submitted module is also manufactured using same design and process and modules being supplied are as per above.

In addition, the modules must conform to

1. IEC 61730 Part 1- requirements for construction & Part 2 - requirements for testing, for safety qualification

2. IEC 61215 and IEC 61730 for the module and environmental test conditions: Test certificates from ETDC/any other Govt Test Centres
3. IEC 61701/IS 61701 for Salt Mist Corrosion Testing of Photovoltaic Modules

The stabilized net output of the SPV array for the Power Plant should not be less than Nominal Array Capacity – 2 x 10 kWp under Standard Test Condition (STC) after one year of operation. SPV modules used must be warranted for output wattage, which should not be less than 90% at the end of 10 years and 80% at the end of 25 years.

Each SPV Module must use a RF identification tag. The following information must be mentioned in the RFID used on each module.

I. Name of the manufacturer of SPV panel
II. Name of the Manufacturer of Solar cells
III. Month and year of the manufacture
IV. Country of origin of SPV cell
V. I-V curve for the SPV panel
VI. Wattage, I_{mpp}, V_{mpp} and Fill Factor for the SPV panel
VII. Unique Serial No and Model No of the SPV panel
VIII. Date and year of obtaining IEC SPV module qualification certificate
IX. Name of the test lab issuing IEC certificate
X. Other relevant information on traceability of solar module as per ISO 9000

Other terms and conditions pertaining to the SPV array are listed below.

I. The SPV cells shall be manufactured using unique, highly efficient diffusion process so as to ensure uniform diffusion profiler to achieve close spread and higher efficiency for each cell.

II. The SPV modules shall be suitable for continuous outdoor use. All materials used shall have a proven history of reliable and stable operation in external applications. It shall perform satisfactorily in relative humidity up to 100% with temperatures between -10^0C and $+85^0$C and withstand gust up to 180 km/h from back side of the panel

III. The SPV module shall be made of high quality laminated in ultra violet stabilized polymer material such as Ethyl Vinyl Accelerate (EVA), Tedler/ polyester laminated back surface and silicon edge sealant around the laminate. The size of crystalline silicon SPV cells shall be chosen so as to maximize energy density. The front of the module surface shall consist of impact resistant, low iron and high transmission toughened glass

IV. The SPV modules shall be made of light weight cells, resistant to abrasion, hail impact, rain, water and environmental pollution. The SPV modules shall be provided with anti reflection coating and back surface field (BSF) structure to increase conversion efficiency

V. The module frame shall be made of corrosion resistant material electrically compatible with the structural material used for mounting the modules. The series parallel combination of the SPV modules to form the panel will be decided by the supplier optimizing the size of the panel and considering mechanical strength of the SPV panel to mount it on the mounting structure. The SPV panel shall be provided with screen-less frame with weather proof solar cable and connector.

VI. The SPV panels shall be provided with Module Junction Box (MJB) consisting of bypass diodes and blocking diode. The by-pass diodes will be used to eliminate excessive heat dissipation during partial shading conditions and are connected in parallel with group of PV cells. The blocking diode will prevent the reverse current flowing into the module and connected in series path with reverse connected polarity.

The MJB shall be of a reputed brand and shall be weather proof with captive screws and cable gland entry points. The level of protection of the MJB must be IP 55.

VII. A strip containing the following details should be laminated inside the module as to be clearly visible from the front side.

a. Name of the supplier or distinctive Logo
b. Model or Type No.
c. Serial No.
d. Year of make

3.1.1. Should qualify under the following tests as per IEC norms:

1. Thermal cycling test
2. Damp heat test
3. Wet leakage current test
4. Potential induced degradation test
5. Solar cells: Cell tester
6. EVA: Gel content test and pressure cooker test
7. Glass: Fragmentation test
8. Flame: Frame anodizing test
9. Ribbon: Elongation test and camber test
10. RTV Silicone sealant: Adhesiveness test
11. Electroluminescence test to detect micro cracks
12. Ammonia test for anti-corrosion

3.1.2. Features:

1. Superior module Efficiency as per International Benchmarks
2. Positive Power Tolerance (+5 watts)
3. PID resistant with long term reliability
4. Glass with anti Reflective coating improves light transmission
5. Salt mist, Ammonia and Hail resistant
6. Sustain heavy wind (180 km/hr)
7. IP 55 rated MC4 compatible connectors
8. Excellent performance in low light
9. Sand and dust storm resistant

3.2. Array Field and Array Structure

The latitude of the site is 24.5926° N and the longitude is 72.7156° E. The SPV array has to be deployed on the roof top of residential complex and the SPV panels must be facing towards south. The supplier is responsible for the prior civil work for making the support platform, the foundation pedestal using RCC (1:2:4). The array structure shall be made of hot dip galvanized MS angles of standard size. The minimum thickness of galvanization shall be at least 70 microns. All fasteners including nuts, bolts, and washers shall be made of Stainless steel with superior quality. The minimum clearance between lowest part of the module structure and the ground level shall not be less than 500mm.

a. Structural material shall be corrosion resistant and electrolytically compatible with the materials used in the module/panel frames, its fasteners, nuts and bolts. Galvanizing should meet *ASTM A-123 hot dipped galvanizing* of minimum thickness of 70 microns on MS as per *IS 5905*, if steel frame is used.
b. The structure should be designed to allow easy replacement of any module
c. The structure shall be designed for simple mechanical and electrical installation. It shall support SPV modules at a given orientation, absorb and transfer the mechanical loads to the ground properly.

d. The array structure shall be designed in such a way to occupy minimum space without compromising the output from SPV panels. Also, it has to withstand severe cyclonic storm with wind speed upto maximum 180 km per hour.

e. The supplier is responsible for the effective earthing of the mounting structure
f. The supplier shall provide water outlet points in the array field for cleaning and washing panel surface

The engineering document along with the detailed design & drawings shall be submitted to IITB for approval before commencement of work.

RCC Array Foundation Base:
The legs of the structures made with GI angles will be fixed and grouted in the RCC foundation columns made with 1:2:4 cement concrete. While making foundations designs, due consideration will be given to weight of module assembly, maximum wind speed of 180 km per hour etc.
Requirement: Galvanised Angle structure to fit solar field (2 x 10 kw) with around 30 poles up to a maximum height of 5 metres with around 30 No of small concrete pillar of 40 cm x 40 cm x 50 cm. Exact requirement will be based on foundation requirement of 2 x 10 kw solar array.

For Battery:
A small level platform of PCC 1:2:4 has to be concreted upon a solid slightly sloped concrete floor. Size: 6 x 3 x 0.15 m (approx.)

For Inverter:
For the inverter a small platform of PCC 1:2:4 upon existing solid concrete floor has to be concreted. Size: 3.5 x 3.5 x 0.15 m (approx.)

3.3. Junction Boxes
There will be a junction box in every panel which can be named as Module Junction Box (MJB) and Array Junction Box (AJB) to interconnect different strings to form a sub array. The typical structure of MJB is shown in Fig 2. The MJB shall be mounted on the bottom of the SPV panel. The basic function of module/array junction boxes is to facilitate the electrical interconnections for realizing the SPV array. The module junction box will house the by-pass diodes and blocking diode. The Junction Boxes shall be made of FRP/Powder Coated Aluminium with full dust, water & vermin proof arrangement and it should conform to IP 55 class protection. All wires/cables must enter into/out of the junction box through cable glands and cables must be terminated with copper cable lugs of premium quality. The Requirement specifications of these Junction Boxes are summarized below.

3.3.1 Certification:
1. IP55 rated junction box
   (IP code: International protection rating code, protected against quantity of dust that could interfere with the normal operation of the product but not fully dust tight. Complete protection against solid objects.)

3.3.2 Protections:
1. Reverse Polarity
2. Lightning
3. Transient / Surge
4. Suitably rated MCBs should be provided in the array junction box

3.3.3 Features:
1. Must be as compact as possible with safety and reliability

2. Must be Lighter in weight
3. Must have wide space for user termination
4. within view, window will be preferred

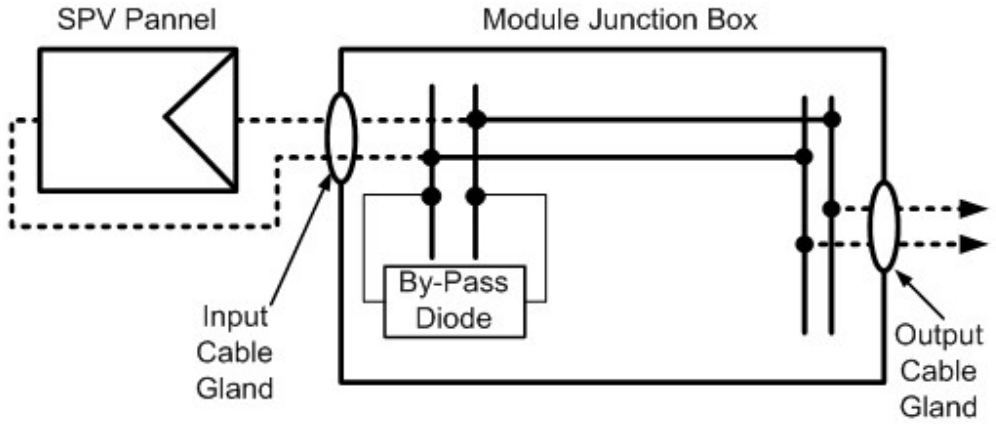


Fig.2. Connection details of module junction box

3.4. DC Distribution Board

A DC distribution box shall be mounted close to the PCU located at control room. The DC distribution box shall be of IP55/65 DIN rail mounted type and shall have dust and vermin proof enclosure with IP55/65 degree of protection.

The DCDB shall comprise the following components and cable terminations.

1. Incoming positive and negative DC cables from the junction box
2. DC circuit breaker / Isolator, 2 pole
3. DC surge protection device (SPD), class 2 as per IEC 60364-5-53
4. Outgoing positive and negative DC cables to the solar inverter
5. Metering (Voltage, Current and Power)
6. LED lamp indication

The DC Distribution Boards have metallic enclosure which is dust & vermin proof with IP 55 & IP 65 class protection. The bus bars are to be made of copper of suitable size. Surge Protective Devices (SPDs) shall be integrated with the Distribution Board. A separate earthing terminal (or) stud need be provided for earthing of the Distribution board.

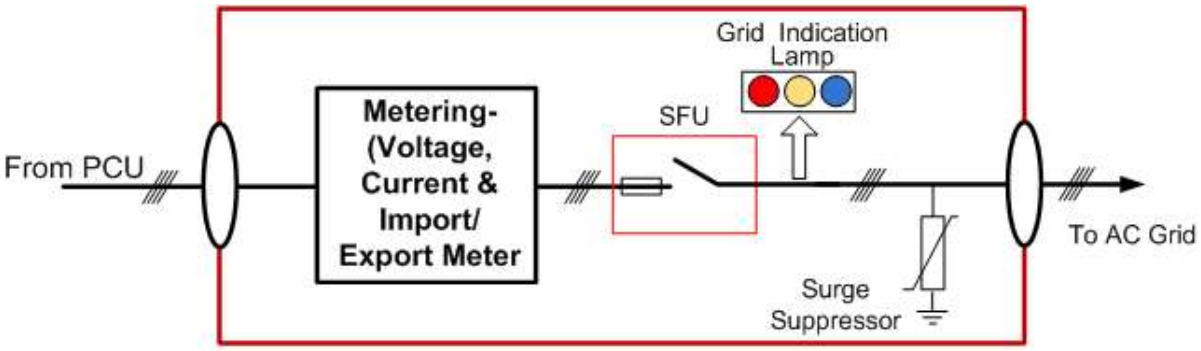
3.5. AC Distribution Board

An AC distribution board shall be mounted close to the PCU panel located at the control room. The Schematic of AC Distribution Board is shown in Fig 3. The AC distribution box shall be of IP65 DIN rail mounting type and shall have dust and vermin proof enclosure with IP65 degree of protection.

The ACDB shall comprise the following components and cable terminations:

1. Incoming 3.5-core cable from the PCU
2. AC circuit breaker/Isolator, 4-Pole
3. AC surge protection device (SPD), Class 2 as per IEC 60364-5-53
4. Digital Voltmeter, Ammeter and Import/Export Energy meter
5. Outgoing cable to the grid interconnection
6. The cable entry/exit shall be through cable glands

All switches and the breakers, connectors should conform to IEC 60947, part I, II and III or EN 50521 standards.



3.6. General Specification about DC and AC Distribution Board

These specifications cover the requirement of design, supply, installation, testing and commissioning of the DC & AC distribution boxes.

1. The item specified herein, unless otherwise stated shall conform to the relevant and latest revisions of Indian standards and Indian Electricity Rules.
2. The DC & AC distribution boxes shall be designed for operation in high ambient temperature up to 50 degrees centigrade and high humidity of up to 95% and tropical atmospheric conditions. Means shall be provided to facilitate ease of inspection, maintenance and servicing.
3. The DC & AC distribution boxes shall be of metal clad, cubicle, outdoor, weather proof, free standing type suitable for mounting on MS frame / concrete platform, with adequate size for mounting the isolator switches/MCBs etc and ease of cable terminations. Dust and moisture ingress protected, the degree of protection shall be IP- 65 as specified in IS-2147.
4. The sheet steel cubicle shall have hinged front access door with easy operating fasteners. All the doors and covers shall be equipped with proper sealing using suitable gasket arrangements so as to make the compartment dust and moisture tight. Door hinges shall be of concealed type.
5. All insulating materials used in the construction of the equipment shall be non hygroscopic duly treated to withstand the effect of high humidity, high temperature and tropical ambient service conditions.
6. All doors / covers providing access to live parts shall be provided with tool operated fasteners to prevent unauthorized access.
7. Provisions shall be made for permanently earthing the frames and other metal parts by two independent connections.
8. **Metal treatment and finish:** All steel works used in the construction of the DC & AC distribution boxes shall have undergone a suitable rigorous metal treatment process so as to remove oxide scales and rust formation and to facilitate a durable coating of the paint on the metal surfaces and also to prevent the spreading of rust, in the event of the paint film being mechanically damaged.
9. Two coats of anti corrosive primer followed by a finishing coat of epoxy powder coating of the shade 631 of IS: 5 (i.e Siemens grey) shall be given. The total thickness of paint shall not be less than 25 micron.

3.7. Surge Protection

1. Surge protection shall be provided on the DC side and the AC side of the solar system. The DC surge protection device (SPDs) shall be installed in the DC distribution box adjacent to the PCU. The AC SPDs shall be installed in the AC distribution box adjacent to the PCU.

2. The SPDs earthing terminal shall be connected to earth through dedicated earthing system. The SPDs earthing terminal shall be of type 2 as per IEC 60364-5-53 & NFEN 50539-11

3.8. Cables

3.8.1. Cable Requirement

All the cables shall be of ISI standard of reputed brand shall be made of copper conductor. The size of the cable between array interconnection, array to junction box, junction box to PCU shall be so selected to keep the voltage drop and losses to the minimum. This shall be mentioned in the drawings along with Technical Bid.

Following are the cabling to be made by the contractor

3. Series connection of SPV panels to form the string
4. Cabling from Array to Junction boxes
5. Cabling from Array Junction Boxes to DC Distribution board
6. Cabling from DC Distribution board to PCU
7. Cabling from Battery energy storage to PCU
8. Cabling from PCU to the AC side Distribution Board
9. Cabling from AC side Distribution Board to the main incomer from the grid

Table below shows various cabling segments and the current rating required

Cabling Segment	**Current (Amps)**	**Approx. Distance(meters)#**
Series connection of SPV modules till the array Jn. Box	* As per the approved design of the contractor	Depends on the layout of the contractor
AJB to Input DC Distribution Board	-do-	20
DC Distribution box to PCU	50*	10
Battery storage to PCU	50*	15
Output PCU to AC Side Distribution Board	40*	10
AC distribution board to main incomer	40*	10

- for each 10 kW_p

 # - Actual length may be varied according to the criteria fixed by the vendor

The DC and AC distribution boards will be in the control room which is in close proximity to the SPV array field. The specification requirements to be met for cabling are listed below

1. The length of cable shown is indicative & actual length may vary depending on layout, design & site condition
2. The wiring for module interconnection shall be with hard PVC conduit of BIS approve make. All Tees, Bends etc shall also be BIS approve make hard PVC material
3. Cables in the array yard shall be laid direct in ground at a depth of 500 mm in the excavated trenches along the approved route and covered with sand cushion. A continuous single brick protective layer of first class brick shall be placed over the entire length of the underground cable before refilling the

trench with loose soil. Alternatively, 6" wide continuous layer of 1." Thick concrete cable markers may also be provided as protective cable cover. The cables shall be laid inside class-B, GI pipes of suitable size under road crossings, drains, sewerage lines, entry or exit points of the buildings or where there are chances of mechanical damage.

4. Cabling inside the control room and array area should in cable pipes with water/moisture sealing
5. Only FRLS copper wires of appropriate size and of reputed make shall be used
6. All connections are to be made through suitable cable/lug/terminals, crimped properly and with use of Cable Glands
7. All cable/wires are to be marked in proper manner by good quality ferrule or by other means so that the cable can be easily identified
8. All electrical cables / wires inside the building to be fixed in accordance with specifications for electrical works
9. Proper laying of cables have to be ensured in appropriate cable trays, pipes / trenches as per site requirement
10. A.C. supply cables to be terminated at the DB / LT bus bar
11. For laying / termination of cables, latest BIS / lEC codes / standards be followed

3.8.2. Cable Specifications:

1. Multi strand, annealed high conductivity copper conductor
2. DC Voltage rating for all cables shall be 1.1 kV
3. AC Voltage rating of the cable shall be 2.2 kV
4. PVC type 'A' pressure extruded insulation
5. Overall PVC insulation for UV protection and conform to IEC *69947*
6. Armoured cable for overhead laying
7. All cables shall conform to BIS standards IS 694 and IS 1554
8. The size of each type of cable selected shall be based on minimum voltage drop, however, the maximum drop shall be limited to 2% at full load
9. Selected cable should carry a current density of minimum 1.2Amp/Sq.mm
10. 1 set battery cable from battery to inverter - 15 m length (approx.) with conduit pipe.
    1 set solar cables to inverter - 20 m length (approx.) from field junction box to inverter with conduit pipe.

3.8.3. Cable Testing

Once cable is laid, following tests shall be conducted in the presence of IITB representative, before energizing the cable:

1. Insulation resistance test with 500V megger between the cores and all the cores to earth (Armor) and the results are to be recorded.
2. Sheathing continuity test.
3. Continuity and conductor resistance test.
4. Tests conducted shall be as per IS and National Electrical Code.

Note 1: Any change in cabling schedule/sizes if desired by the bidder/supplier to be approved after citing appropriate reasons, All cable schedules/layout drawings have to be got approved from IITB prior to installation. All cable tests and measurement methods should conform to IEC 60189.

Note 2: In case of any change in the array arrangement as suggested by the bidder, respective cable and connector required for the same also to be added in the bid.

Note 3: the bidder shall anticipate variations to +30% in the cabling distances. Cable sizes should be clearly mentioned in the offer.

3.9. Earthing

As in the case of any electrical earthing, the earthing system in SPV systems is essentially for safety of equipment and manpower. Two main earths used in the equipment are

a. System Earth
b. Equipment earth

System Earth is used to earth AC Neutral and DC supply negative. All the non current carrying metal parts of the total system are bonded together with the **Equipment Earth.** One terminal of the lightning protection arrangement also needs to be earthed.

1. The array structure of the PV modules shall be earthed properly using adequate numbers of earthing pits as per *IS: 3043-1987*.
2. Other than the PV array, array frame and structure, the PCU body, the Distribution board or any other non conducting metallic parts of the power plant must be earthed
3. Provision shall be provided for shorting and grounding of PV arrays during maintenance
4. The earth for the PV array shall be kept as a separate earth. it shall be ensured that all the earths are bonded together to prevent the development of potential difference between two earths.
5. A suitable earthing scheme (preferably plate earthing) which provides an earth resistance not more than 5 Ohms shall be adopted. The supplier should clearly mention the earthing scheme in the bid.
6. The earthing conductor shall be rated for 1.56 times the short circuit current. The area of cross-section shall not be less than 1.6 sq mm in any case.
7. After completion of the work the earth resistance should be measured with calibrated earth resistance meter in the presence of IITB representative.

3.10. Lightning Protection

There shall be suitable number of lightning arrestors in the array field and the control room. The lightning arrestors should be earthed properly. MOV type surge arresters on AC and DC terminations in the Distribution Boards/Junction boxes shall be provided for over voltage protection from lightning-induced surges. All the above shall be in accordance with *IS 2309/IEC 62305*.

3.11. Field Preparation

The supplier is responsible for various civil works associated with the deployment of the SPV array. The civil work include grading of drilling for fixing RCC pedestals for mounting the array support structure, laying of supporting structure required for lightning arresters, laying of earthing equipment, arranging cable ducts/cable tray for cabling and preparation of foundation for the PCU in the control room. The SPV panels should be distributed in the field on the mounting structure with standard spacing between each. Walk ways shall be provided around the array field to prevent encroachment. Two lamp pedestals at suitable points with CFL lighting should be provided in the array field. All the civil works shall be in accordance with the local PWD guidelines.

3.12. Markings/ Danger Boards

Danger boards shall be provided wherever necessary as per IE rules amended upto date. The DC cabling in the array filed as well as in the control room shall be marked distinctly in a spacing 10 feet. The cable used in

AC side should be color coded (Red, Yellow, Blue, &Black). The DC positive shall be with red color and negative shall be black color.

3.13. Tools and Spares

Two sets of tools essential for maintenance of the PV array installation shall be supplied. The minimum spares listed below should also be supplied

1. SPV Modules (5 Nos.)
2. Module junction box (10% of total no used)
3. Array junction boxes (2 Nos)
4. MCBs (5 Nos.)
5. Fuses (100% of total no used)
6. Cables and cable lugs (10 % of actual usage) (if snap-in cables and connectors are used along with module Jn. Boxes in the array field, 10% of the same should also be supplied as spares)

Details of the spares and tools should be mentioned in the bid.

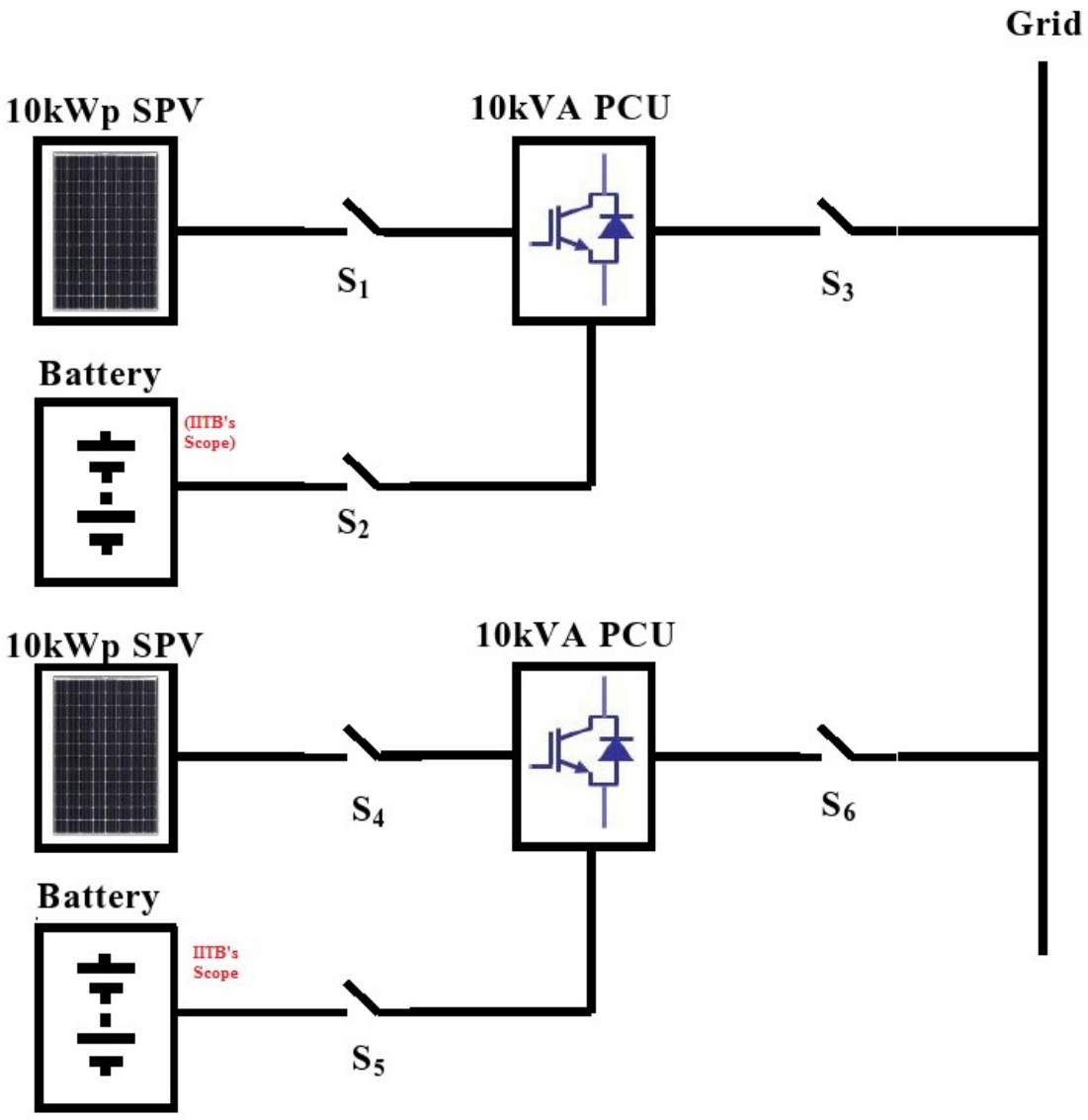


Fig4. Schematic of the proposed SPV power plant.

3.14 Storage Batteries/ Battery Bank

Battery Banks: There will be two sets of battery banks connected to each of the 10kWp PV modules arrays in the power plants. The battery will not be the scope of the tender and same is supplied by IITB.

3.15. Fire Extinguishers

The fire fighting system for the proposed power plant for fire protection shall be consisting of:

1. Portable fire extinguishers in the control room and SPV array field for fire caused by electrical short circuits
2. Sand buckets in the control room
3. The installation of Fire Extinguishers should conform to TAC regulations and BIS standards.

3.16. Drawings and Manuals

2 copies of Engineering, electrical drawings and Installation and O&M manuals are to be supplied. Bidders shall provide complete technical data sheets for each equipment giving details of the specifications along with make/makes in their bid.

It should be further noted that approved ISI or reputed makes should be used for all components. The bidders shall supply complete design regarding civil, electrical and mechanical work details and drawings for approval by IITB before proceeding to the work.

Table 1 : Summary Work Schedule:

Sl. No	Item	Section describing details	Relevant Standards	Preferred manufacturer	Quantity
1.	Solar Photovoltaic Array of capacity 10kWp	3.1	IEC 61215 IEC 61730 IEC 61701	Any standard certified make of PV module conforming to the technical specification as described in section 3.1 of Technical Specification	2 Sets
3.	Array Mounting Structure	3.2	IS 2062:1992 ASTM A-123	-	Suitable for deployment of 2X10kWp capacity SPV array.
2.	Junction Boxes (Module Junction Boxes and Array Junction Boxes) with cables and connectors	3.3	IEC 62208 IP 65	ABB/TYCO/ HENSEL/ SPELBERG	As per the design of the array by the supplier
4.	DC Distribution Boards	3.4	-	ABB/Siemens/ Schneider/L&T/ Havells	2 Sets

5.	AC Distribution Boards	3.5	IEC 60947	ABB/Siemens/ Schneider/L&T/ Havells	2 Sets
6.	Surge Protection	3.7	IEC 60364-5-53& NFEN 50539-11	ERICO/Harger	2sets
7.	Cables supply and laying	3.8	IEC 69947 IS694&IS1554 IEC 60189	Havells/Finolex/Polycab	Ref Section 3.9
8.	Earthing Pit & Earthing	3.9	IS: 3043-1987		2 Sets
9.	Lightning Protection	3.10	IS 2309 IEC 62305	ERICO/Harger	2 Sets
10.	Field preparation Levelling of ground/Civil work associated with foundation pedestals/Cable ducts/Cable trays/Foundation for PCU/Pathway/ Fencing etc.	3.11			
11.	Marking and Danger Boards	3.12			As required for the installation
12.	Tools and Spares	3.13			1 Set
13.	Fire Extinguishers	3.15			As required for the installation
14.	Drawings/Manuals	3.16		Supplier	1 Set
15.	Onsite warranty/Maintenance Contract for 5 Years			Supplier	

1. All the items which are not specified with particular manufacturer or supplier must conform to ISI standards and not below the Rural Electrification Corporation (REC) specifications.
2. All the items which are not specified with required quantity must be filled by the supplier according to their design.

3. **Time Period for Completion of Work**: 45 Days from Date of Purchase/ Work Order

Note: Vendor must be able to deliver all Items at World Renewal Spiritual Trust 'Gyan Sarovar Complex', Academy For a Better World, Salgaon, Dist: Sirohi, Mount Abu – 307501, State: Rajasthan. Also find Photos of Location of Solar PV Array and Batteries at Mount Abu below.