

**NATIONAL CENTRE FOR BIOLOGICAL SCIENCES  
TATA INSTITUTE OF FUNDAMENTAL RESEARCH  
GKVK Campus, Bellary Road, Bangalore – 560 065**



**Supply, installation, testing and commissioning of 14kw roof  
top solar photo voltaic (SPV) at NCBS Campus, GKVK  
Bangalore.**

**TENDER DOCUMENT**

**SCIENTIFIC ENGINEERING & MAINTENANCE DIVISION  
2017**

**Tender notice No: NCBS/ELECTRICAL/E-IN-C/TR - 136/2017.**

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Tata Institute of Fundamental Research  
GKVK Campus, Bellary Road, Bangalore - 560 065.  
Phone: 23666001/02 Fax: 23636662

**Tender notice No: NCBS/ELECTRICAL/E-IN-C/TR - 136/2017.**

1. NAME OF THE WORK : Supply, installation, testing and commissioning of 14kW Roof Top Solar Photo Voltaic (SPV)
2. ESTIMATE VALUE PUT TO TENDER : Rs.10.00 Lakhs
3. EARNEST MONEY DEPOSIT : Rs.20,000.00
4. COST OF TENDER DOCUMENT : Rs. 500.00
5. SALE PERIOD : 13/02/2017 to 23/02/2017
6. TIME & DUE DATE OF RECEIPT : Up to 14:00 Hrs On:02/03/2017
7. TIME & DATE OF OPENING : After 15:00 Hrs On:02/03/2017

SOLD TO : \_\_\_\_\_ RECEIPT NO: \_\_\_\_\_ DATE: \_\_\_\_\_  
\_\_\_\_\_ FOR A SUM OF Rs. \_\_\_\_\_ TOWARDS  
\_\_\_\_\_ THE COST OF TENDER DOCUMENT.

SIGNATURE OF ISSUING OFFICER:

DESIGNATION:

**NATIONAL CENTRE FOR BIOLOGICAL SCIENCES**  
**Tata institute of Fundamental Research**  
**GKVK Campus, Bellary Road, Bangalore-560 065**

Name of Work: Supply, installation, testing and commissioning of  
14kw roof top solar photo voltaic (SPV) System at  
NCBS Campus

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## NATIONAL CENTRE FOR BIOLOGICAL SCIENCES

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### SECTION I- NOTICE INVITING TENDER

#### **NIT NO. NCBS/ELECTRICAL/E-IN-C/Tr-136/2017**

1. Separate sealed item rate tenders are invited in Single Bid System on behalf of Centre Director, NCBS and will be received in the office of the Electrical Maintenance, NCBS from MNRE approved vendors who have done similar type of work with proven technical and financial capabilities in CPWD, State PWD, Railways, Military Engineering Services, DOS & DAE for the following work:

Sl. No.	Description	Approx. Cost (Rs.)	EMD (Rs.)	Period	Cost of tender Documents (Rs.)
1.	Supply, installation, testing and commissioning of 14kw roof top solar photo voltaic (SPV) System at NCBS Campus.	10.00 Lakhs	20,000.00	3 weeks	500.00

2. The period of contract shall commence immediately and work shall be completed within three week time from the date of Work Order.
3. The contractor should have experience is similar kind of works i.e Solar works.
4. Tender Documents consisting of drawings, complete specifications, schedule of quantities for various items of works to be done and set of conditions of contract to be complied with by the tenderers whose tender may be accepted can be obtained from the office of Electrical Maintenance, NCBS on any working day between 10.00 Hours to 16.00 Hours on payment of amount mentioned in para 1 (non refundable) from 13/02/2017 to 23/02/2017. However, who are willing to downloaded tender document from NCBS website and CPPP, are required to enclose tender fee as mentioned in para 1 (non refundable) in the form of DD drawn on or before 23/02/2017 (i.e. DD date) in favour of "National Centre for Biological Sciences", Bangalore. **The Tender document received without Tender fee, shall be liable for rejection.**
5. Contractors, whose tender is accepted shall has to deposit Performance Guarantee at 5% of tendered value.

6. As we do not follow enlistment, it is preferred to specify eligibility of entire of having executed one of following in last 7 years.

(i) Three similar works each of value not less than 40% of estimated cost i.e. Rs.4,00,000/- (OR) Two similar works each of value not less than 60% of estimated cost i.e. Rs.6,00,000.00/- (OR) One similar work of value not less than 80% of estimated cost i.e. Rs. 8,00,000/-.

(ii) One Completed work of any nature (either part of (i) or a separate one) costing not less than the amount equal to 40% of the estimated cost put to tender i.e. Rs.4,00,000/- with some Central Government Department / State Government Department/ Central Autonomous Body/ State Autonomous Body / Central Public Sector Undertaking / State Public Sector Undertaking / City Development Authority / State Government and published in the Central / State Gazette.

Note: The value of executed works shall be brought to correct costing level by enhancing the actual value of work at simple rate of 7% per annum, calculated from the date of completion to the last date of receipt of application for tender.

7. **Tenders should be submitted in a sealed cloth lined cover superscribing the name of work, NIT number and name of Tenderer.** The tenders with any deviation with respect to departmental conditions/stipulations are liable for rejection. The tender shall contain the EMD in the approved format, in the tender document issued by Department. The tender shall be submitted in the printed format issued by NCBS with schedule of quantity. Bids with any other document / with deviation condition / over all rebate / Conditional rebate etc., shall be liable for rejection.

8. If any tenderer withdraws his Tender after the price bid is opened within the validity period or makes any modifications in the terms and conditions of the Tender which are not acceptable to the Department, then the NCBS shall without prejudice to any/or other right or remedy be at liberty to forfeit 50% (Fifty Percent) of the earnest money absolutely.

**Application for Tender document along with following is compulsory:**

- (i) In case of registered contractors currently valid registration certificate in appropriate class if available.
- (ii) Latest work done certificates with respect to work experience.
- (iii) Letter of authority, in case the application is through authorized person, Application without the above documents are liable for rejection.

The NCBS reserves the right to reject any application for issue of tender papers without assigning any reason.

9. As said above Tender which should always be placed in sealed covers superscribed with the name of work (as given in Para I) will be received by NCBS upto 14.00Hrs on 02/03/2017 and will be opened by Head SE&M or his authorized representatives at NCBS on the same day i.e on 02/03/2017 at 15.00 Hours in the presence of the tenderers or their representative who would like to be present.
10. Tenders are to be on the printed form of the NCBS, which can be obtained on payment of the cost of documents mentioned above in cash/DD of scheduled bank drawn in favour of National Centre for Biological Sciences, Bangalore. The Contractors shall quote rates in figure as well as in words and /or amounts quoted by them. The amount for each item shall be worked out and requisite total given. All corrections shall be attested by the dated initials of the Tenderer. **Tenders with correction of rate/amount with correction fluid are liable for rejection.** The contractors not tendering for this work after the purchase of the Tender documents must return the Tender documents and drawings within 15days of the due of receipt of the Tender. However, the cost of the Tender documents will not be refunded.
11. Tenders not accompanied by the following are liable to be summarily rejected.

- (i) **Earnest Money Deposit** through a Crossed Demand Draft and Bank Guarantee by approved Scheduled Bank in prescribed form in favour of **“National Centre for Biological Sciences, Bangalore”**.
  - (ii) In case of Contractors in the approved list of PWD, CPWD or MES, evidence showing the appropriate and eligible class to which they belong.
  - (iii) Proof of technical and organizational competence to execute the work of above nature and magnitude.
  - (iv) Latest work experience certificate with respect to execution of similar works issued by client (in case of Government, autonomous bodies and institutions the certificate shall be issued an officer not below the rank of Executive Engineer or equivalent).
12. The Contractors whose tender/s is/are accepted will be required to furnish Security Deposit (including the Earnest Money Deposit) and Performance Guarantee for the due fulfillment of the contract/s as per details in clause 1 of the conditions of Contract.
13. The acceptance of the Tender will rest with the Centre Director, NCBS who does not bind himself to accept the lowest or any other Tender. No reasons will be furnished for the acceptance or rejection of any tender.
14. Canvassing in connection with Tender will result in disqualification.
15. The tender accepting authority reserves the option to give price preference to the offers from public sector units over those from other tenderers in accordance with the policies of the Government from time to time.
16. Any tender which does not fulfill any of the prescribed conditions will be liable for rejection.
17. NCBS reserves the right to alter the scope/or reduce quantum of work before issue of work order and the **Tenderer** shall not have any claim what so ever on this account.

18. Rates quoted by the Contractor in item rate Tender in figures and words shall be accurately filled in so that there is no discrepancy in the rates written in figures and words. However, if any discrepancy is found, the rates which correspond with the amount worked out by the Contractor shall be taken as correct.
19. If the amount of an item is not worked out by the Contractor or if it does not correspond with the rate written either in figures or words, then the rate quoted by the Contractor in words shall be taken as correct.
20. Where the rates quoted by the Contractor in figures and in words tally but the amount is not worked out correctly the rate quoted by the Contractor will be taken as correct and not the amount.
21. In case rates are quoted only in words or only in figures, then the rate quoted will be considered and amount will be worked out accordingly.
22. In the event no rate has been quoted for any item / items, leaving space both in figure(s), word(s) and amount blank, it will be presumed that the contractor has included the cost of this / these item(s) in other items and rate for such item(s) will be considered as zero and will be required to be executed accordingly.
23. Deployment of adequate number of work force and machineries to ensure completion of the work within the stipulated time schedule should be ensured.

Note: Refer our website [www.ncbs.res.in](http://www.ncbs.res.in) / Central Public Procurement Portal : <http://eprocure.gov.in/cppp> for more details of the said tender

**Sd/-**  
**Head SE&M**



## **SECTION III- SPECIFICATION**

### **Supply, Installation, Testing and Commissioning of 14kW Rooftop Solar photo voltaic (SPV) plant at NCBS.**

#### **1. OVERVIEW**

A Grid Tied Solar Rooftop Photo Voltaic (SPV) power plant consists of SPV array, Module Mounting Structure, Power Conditioning Unit (PCU) consisting of Maximum Power Point Tracker (MPPT), Inverter, and Controls & Protections, interconnect cables and switches. PV Array is mounted on a suitable structure. Grid tied SPV system is without battery and should be designed with necessary features to supplement the grid power during day time. Components and parts used in the SPV power plants including the PV modules, metallic structures, cables, junction box, switches, PCUs etc., should conform to the BIS or IEC or international specifications, wherever such specifications are available and applicable.

Solar PV system shall consist of following equipments/components.

- Solar PV modules consisting of required number of Crystalline PV modules.
- Grid interactive Power Conditioning Unit /on grid.
- Mounting structures.
- Junction Boxes.
- Earthing and lightening protections.
- IR/UV protected PVC Cables, pipes and accessories.

#### **2. SPECIFICATION**

ARRAY CAPACITY	14 KW
TYPE OF PV MODULE	250 WP POLY CRYSTALLINE
NO OF PV MODULE	56 Nos
RATED PCU/INVERTER AC POWER	15000 W
RATED AC GRID VOLTAGE	400 V
TOTAL CURRENT HARMONIC DISTORTION, THDi	< 3%
PCU/ INVERTER POWR and EEFFICIENCY MAXIMUM EFFICIENCY PCU	>=97.0%

MOUNTING	ROOF TOP( height will be 10-14feet from the roof, so vendor should arrange mounting structure with all supports as required)
AREA AVAILABILE	1200 SQ FEET (Thousand two hundred Square feet)
MATERIAL CONSTRUCTION	MILD STEEL (AS PER INDIAN STANDARD)
ENVIRONMENTAL PROTECTION	HOT DIP GALVANIZED
DESIGN WIND SPEED	AS PER BANGALORE CONDITION
HARDWARE	STAINLESS STEEL
CABLE GLAND	SUITABLE SIZE
TERMINALS	CONNECTOR TERMINAL FOR COPPER CABLES AND BUS BAR

### 3. SOLAR PHOTOVOLTAIC MODULES:

3.1 The PV modules used should be made in India and it should be approved by MNRE, necessary certificate shall be enclosed along with technical bid.

3.2 The PV modules used must qualify to the latest edition of IEC PV module qualification test or equivalent BIS standards Crystalline Silicon Solar Cell Modules IEC 61215/IS14286. In addition, the modules must conform to IEC 61730 Part-1- requirements for construction & Part 2 – requirements for testing, for safety qualification or equivalent IS.

- a) For the PV modules to be used in a highly corrosive atmosphere throughout their lifetime, they must qualify to IEC 61701/IS 61701 (Salt Mist Corrosion Testing).
- b) The total solar PV array capacity should not be less than allocated capacity (kWp) and should comprise of solar crystalline modules of minimum **250** Wp and above wattage.
- c) Protective devices against surges at the PV module shall be provided. Low voltage drop bypass diodes shall be provided.
- d) PV modules must be tested and approved by one of the IEC authorized test centres.
- e) The module frame shall be made of corrosion resistant materials, preferably having Anodized aluminium.
- f) The bidder shall carefully design & accommodate requisite numbers

of the modules to achieve the rated power in his bid. NCBS shall allow only minor changes at the time of execution.

- g) Other general requirement for the PV modules and subsystems shall be the Following:
  - i. The rated output power of any supplied module shall have tolerance of +/-3%.
  - ii. The peak-power point voltage and the peak-power point current of any supplied module and/or any module string (series connected modules) shall not vary by more than 2 (two) percent from the respective arithmetic means for all modules and/or for all module strings, as the case may be.
  - iii. The module shall be provided with a junction box with either provision of external screw terminal connection or sealed type and with arrangement for provision of by-pass diode. The box shall have hinged, weather proof lid with captive screws and cable gland entry points or may be of sealed type and IP-65 rated.
  - iv. IV curves at STC should be provided by bidder.
    - v. Efficiency should be  $\geq 14\%$
    - vi. Fill factor

3.3 Modules deployed must use a RF identification tag. The following information must be mentioned in the RFID used on each module (This can be inside or outside the laminate, but must be able to withstand harsh environmental conditions).

- a) Name of the manufacturer of the PV module
- b) Name of the manufacturer of Solar Cells.
- c) Month & year of the manufacture (separate for solar cells and modules)
- d) Country of origin (separately for solar cells and module)
- e) I-V curve for the module Wattage,  $I_m$ ,  $V_m$  and FF for the module
- f) Unique Serial No and Model No of the module
- g) Date and year of obtaining IEC PV module qualification certificate.
- h) Name of the test lab issuing IEC certificate.
- i) Other relevant information on traceability of solar cells and module as per ISO 9001 and ISO 14001

#### **4. WARRANTIES:**

- a) Material Warranty:-
  - i. Material Warranty: The manufacturer should warrant the Solar Module(s) and Inverter (PCU) to be free from the defects and/or failures specified below for a period not less than five (05) years from the date of installation and commissioning at NCBS.
  - ii. Defects and/or failures due to manufacturing

- iii. Defects and/or failures due to quality of materials
  - iv. Non conformity to specifications due to faulty manufacturing and/or inspection processes. If the solar Module(s) fails to conform to this warranty, the manufacturer will repair or replace the solar module(s), at the Owners sole option.
- b) Performance Warranty:-
- i. The predicted electrical degradation of power generated by PV module should not exceeding 20% of the rated power over the 25 year period and not more than 10% after ten years period of the full rated original output.

## **5. ARRAY STRUCTURE:**

- a) Hot dip galvanized steel with a minimum galvanisation thickness of 120 microns mounting structures should be used for mounting the modules/ panels/arrays. Each structure should have angle of inclination as per the site conditions to take maximum insolation. However to accommodate more capacity the angle inclination may be reduced until the plant meets the specified performance ratio requirements.
- b) The Mounting structure shall be so designed to withstand the speed for the wind zone of the location where a PV system is proposed to be installed (Wind velocity withstanding capacity 33m/sec (Standard for Bangalore location).It may be ensured that the design has been certified by a recognized Lab/ Institution in this regard and submit wind loading calculation sheet to NCBS. Suitable fastening arrangement such as grouting and calming should be provided to secure the installation against the specific wind speed.
- c) The mounting structure steel shall be as per latest IS 2062: 1992 and galvanization of the mounting structure shall be in compliance of latest IS 4759.
- d) Structural material shall be corrosion resistant and electrolytically compatible with the materials used in the module frame, its fasteners, nuts and bolts.
- e) The fasteners / nuts and bolts used should be made up of stainless steel SS 304. The structures shall be designed to allow easy replacement of any module. The array structure shall be so designed that it will occupy minimum space without sacrificing the output from the SPV panels.
- f) The total load of the structure (when installed with PV modules) on the terrace should be less than 60 kg/m<sup>2</sup>.
- g) Necessary structure shall be arranged by tenderer for the height about 8 feet( lower side) to 14 feet(higher side) from the existing building terrace. This job includes supply of MS including priming and painting and

fixing from the existing substation roof as per direction from Engr-in-charge and clearance from the civil department.

#### **6. JUNCTION BOXES (JBs):**

- a) The junction boxes are to be provided in the PV array for termination of connecting cables. The J. Boxes (JBs) shall be made of GRP/FRP/Powder Coated Aluminium /cast aluminium alloy with full dust, water & vermin proof arrangement. All wires/cables must be terminated through cable lugs. The JB's shall be such that input & output termination can be made through suitable cable glands.
- b) Copper bus bars/terminal blocks housed in the junction box with suitable termination threads conforming to IP65 standard and IEC 62208 Hinged door with EPDM rubber gasket to prevent water entry. Single / double compression cable glands. Provision of earthings. It should be placed at 5 feet height or above for ease of accessibility.
- c) Each Junction Box shall have High quality Suitable capacity Metal Oxide Varistors (MOVs) / SPDs, suitable rating fuse and suitable Reverse Blocking Diodes.
- d) Suitable markings shall be provided on the bus bar for easy identification and the cable ferrules must be fitted at the cable termination points for identification.

#### **7. DC DISTRIBUTION BOARD:**

- a) DC Distribution panel to receive the DC output from the array field.
- b) DC DPBs shall have sheet from enclosure of dust & vermin proof conform to IP 65 protection. The bus bars are made of copper of desired size. Suitable capacity MCBs/MCCB and SPD (Surge protection) device shall be provided for controlling the DC power output to the PCU along with necessary surge arrestors.

#### **8. AC DISTRIBUTION PANEL BOARD:**

- a) AC Distribution Panel Board (DPB) shall control the AC power from PCU/ inverter, and should have necessary surge arrestors. Interconnection from ACDB to mains at LT Bus bar while in grid tied mode.
- b) All switches and the circuit breakers, connectors should conform to IEC 60947, part I, II and III/ IS60947 part I, II and III.
- c) The changeover switches, cabling work should be undertaken by the bidder as part of the project.
- d) All the Panel's shall be metal clad, totally enclosed, rigid, floor mounted, air - insulated, cubical type suitable for operation on three phase / single

phase, 415 or 230 volts, 50 Hz.

- e) The panels shall be designed for minimum expected ambient temperature of 45 degree Celsius, 80 percent humidity and dusty weather.
- f) All indoor panels will have protection of IP54 or better. All outdoor panels will have protection of IP65 or better.
- g) Should conform to Indian Electricity Act and rules (till last amendment).
- h) All the 415 AC or 230 volts devices / equipment like bus support insulators, circuit breakers, SPDs, VTs etc., mounted inside the switchgear shall be suitable for continuous operation and satisfactory performance under the following supply conditions

Variation in supply voltage	+/- 10%
Variation in supply frequency	+/-5Hz

### **9. PCU/ Inverter:**

As SPV array produce direct current electricity, it is necessary to convert this direct current into alternating current and adjust the voltage levels to match the grid voltage. Conversion shall be achieved using an electronic Inverter and the associated control and protection devices. All these components of the system are termed the “Power Conditioning Unit (PCU)”. In addition, the PCU shall also house MPPT (Maximum Power Point Tracker), an interface between Solar PV array & the Inverter. The power conditioning unit/inverter should also be DG set interactive and Inverter output should be compatible with the grid frequency.

Typical technical features of the inverter shall be as follows:

- PCU Rating & Control :15kVA & DSP
- Switching devices : IGBT
- Nominal AC output voltage and frequency : 415V, 3 Phase, 50 Hz
- Output frequency : 50 Hz
- Grid Frequency Synchronization range : + 3 Hz or more
- Ambient temperature considered : -20o C to 50 deg C
- Humidity : 95 % Non-condensing
- Protection of Enclosure : IP-20(Minimum )

- Grid Frequency Tolerance range : +/- 3 or more
- Grid Voltage tolerance : - 20% & + 15 %
- No-load losses : Less than 1% of rated power
- Inverter efficiency(minimum) : >97%
- THDi (Current harmonics) : < 3%
- Power Factor : > 0.9

- a) Three phase PCU/ inverter shall be used.
- b) PCU/inverter shall be capable of complete automatic operation including wake-up, synchronization & shutdown.
- c) The output of power factor of PCU inverter is suitable for all voltage ranges or sink of reactive power; inverter should have internal protection arrangement against any sustainable fault in feeder line and against the lightning on feeder.
- d) The power conditioning units / inverters should comply with applicable IEC/ equivalent BIS standard for efficiency measurements and environmental tests as per standard codes IEC 61683/IS 61683 and IEC 60068-2(1,2,14,30) /Equivalent BIS Std respectively.
- e) The charge controller (if any) / MPPT units environmental testing should qualify IEC 60068-2(1, 2, 14, 30)/Equivalent BIS std. The junction boxes/ enclosures should be IP 65(for outdoor)/ IP 54 (indoor) and as per IEC60529 specifications.
- f) The power conditioning units / inverters should comply with applicable IEC/ equivalent BIS standard for safety measurements and EMC tests as per standard codes IEC 62109-2 and EN 61000:IEC 61000 /Equivalent BIS Std respectively.
- g) The PCU/ inverters should be tested from the MNRE approved test centres / NABL /BIS /IEC accredited testing- calibration laboratories.

## **10. INTEGRATION OF SPV POWER WITH GRID:**

The output power from SPV would be fed to the inverters which converts DC produced by SPV array to AC and feeds it into the main electricity grid after synchronization. In case of grid failure, or low or high voltage, solar PV system shall be out of synchronization and shall be disconnected from the grid. Once the DG set comes into service PV system shall again be synchronized with DG supply and load requirement would be met to the extent of availability of power. 4 pole isolation of inverter output with respect

to the grid/ DG power connection need to be provided.

## **11. PLANT MONITORING:**

- i. The following parameters are accessible via digital front panel display
  - a. AC Input Voltage.
  - b. AC Output current.
  - c. Output Power
  - d. Power factor.
  - e. DC Input Voltage.
  - f. DC Input Current.
  - g. Time Active.
  - h. Time disabled.
  - i. Time Idle.
  - j. Power produced
  - k. Protective function limits (Viz-AC Over voltage, AC Under voltage, Over frequency, Under frequency, ground fault, PV starting voltage, PV stopping voltage.
- ii. All major parameters available on the digital bus and logging facility for energy auditing through the internal microprocessor and read on the digital front panel at any time and logging facility (the current values, previous values for up to a month and the average values) should be made available for energy auditing through the internal microprocessor and should be read on the digital front panel.
- iii. String and array DC Voltage, Current and Power, Inverter AC output voltage and current (All 3 phases and lines), AC power (Active, Reactive and Apparent), Power Factor and AC energy (All 3 phases and cumulative), Energy exported and frequency shall be monitored.

## **12. METERING:**

- a) The bidirectional digital electronic energy meter (0.5 S class) shall be installed for the measurement of import/export of energy
  - b) PV array energy production: Digital energy meter to log the actual value of AC/DC voltage, current and energy generated by the PV system provided. Energy meter along with CT/PT should be 0.5 accuracy class.
  - c) The bidder must take approval/NOC from the Concerned BESCOM for the connectivity, technical feasibility, and synchronization of SPV plant with distribution network and submit the same to NCBS before commissioning of SPV plant.

Reverse power relay shall be provided by bidder (if necessary), as per the local BESCOM requirement.



### **13. PROTECTIONS**

The system should be provided with all necessary protections like earthing, Lightning, and grid islanding as follows:

#### **14. LIGHTNING PROTECTION:**

The SPV power plants shall be provided with lightning & overvoltage protection. The main aim in this protection shall be to reduce the over voltage to a tolerable value before it reaches the PV or other sub system components. The source of over voltage can be lightning, atmosphere disturbances etc The entire space occupying the SPV array shall be suitably protected against Lightning by deploying required number of Lightning Arrestors. Lightning protection should be provided as per IEC 62305 standards. The protection against induced high-voltages shall be provided by the use of metal oxide varistors (MOVs) and suitable earthing such that induced transients find an alternate route to earth.

#### **15. SURGE PROTECTION:**

Internal surge protection shall consist of three MOV type surge-arrestors connected from +ve and -ve terminals to earth (via Y arrangement)

#### **16. EARTHING PROTECTION:**

- i. Each array structure of the PV yard should be grounded/ earthed properly as per IS: 3043-1987. In addition the lightning arrester/masts should also be earthed inside the array field. Earth Resistance shall be tested in presence of the representative of Department/NCBS as and when required after earthing by calibrated earth tester. PCU, ACDB and DCDB should also be earthed properly.
- ii. Earth resistance shall not be more than 3 ohms. It shall be ensured that all the earthing points are bonded together to make them at the same potential.

#### **17. GRID ISLANDING:**

- i. In the event of a power failure on the electric grid, it is required that any independent power-producing inverters attached to the grid should turn off in a short period of time. This prevents the DC-to-AC inverters from continuing to feed power into small sections of the grid, known as "islands." Powered islands present a risk to workers who may expect the area to be unpowered, and they may also damage grid-tied equipment. The Rooftop PV system shall be equipped with islanding protection. In addition to disconnection from the grid (due to islanding protection) disconnection due to under and over voltage conditions shall also be provided.
- ii. A manual disconnect 4pole isolation switch beside automatic

disconnection to grid would have to be provided at utility end to isolate the grid connection by the utility personnel to carry out any maintenance. This switch shall be locked by the utility personnel

## **18. CABLES**

Cables of appropriate size to be used in the system shall have the following characteristics:

- i. Shall meet IEC 60227/IS 694, IEC 60502/IS1554 standards
- ii. Temp. Range:  $-10^{\circ}\text{C}$  to  $+80^{\circ}\text{C}$ .
- iii. Voltage rating 1100V
- iv. Excellent resistance to heat, cold, water, oil, abrasion, UV radiation
- v. Double insulated Flexible/ Armoured
- vi. Sizes of cables between array interconnections, array to junction boxes, junction boxes to Inverter etc. shall be so selected to keep the voltage drop (power loss) of the entire solar system to the minimum. The cables (as per IS) should be insulated with a special grade PVC compound formulated for outdoor use.
- vii. Cable Routing/ Marking: All cable/wires are to be routed in a GI cable tray and suitably tagged and marked with proper manner by good quality ferule or by other means so that the cable easily identified.
- viii. The Cable should be so selected that it should be compatible up to the life of the solar PV panels i.e. 25years.
- ix. The ratings given are approximate. Bidder to indicate size and length as per system design requirement. All the cables required for the plant provided by the bidder. Any change in cabling sizes if desired by the bidder/approved after citing appropriate reasons. All cable schedules/layout drawings approved prior to installation.
- x. Multi Strand, Annealed high conductivity copper conductor PVC type 'A' pressure extruded insulation or XLPE insulation. Overall PVC/XLPE insulation for UV protection Armoured cable for underground laying. All cable trays including covers to be provided. All cables conform to latest edition of IEC/ equivalent BIS Standards as specified below:  
PVC/XLPE insulated cables for working Voltage up to and including 1100 V ,UV resistant for outdoor installation IS /IEC 69947.
- xi. The size of each type of DC cable selected shall be based on minimum voltage drop however; the maximum drop shall be limited to 1%.
- xii. The size of each type of AC cable selected shall be based on minimum voltage drop however; the maximum drop shall be limited to 1%.

## **19. CONNECTIVITY:**

The maximum capacity for interconnection with the grid at a specific voltage level shall be as specified in the Distribution Code/Supply Code of

the State and amended from time to time. Following criteria have been suggested for selection of voltage level in the distribution system for ready reference of the solar suppliers.

Plant Capacity: 14KW

Connecting voltage and frequency: 415V-Three phase + Neutral and 50Hz

Utilities may have voltage levels other than above, BESCO may be consulted

before finalization of the voltage level and specification be made accordingly.

## **20. DANGER BOARDS AND SIGNAGES:**

Danger boards should be provided as and where necessary as per IE Act. /IE rules as amended up to date.

## **21. DRAWINGS FOR APPROVAL & COMPLETION DRAWINGS**

The contractor shall prepare & submit two sets of following drawings and get them approved from the Engineer-in-charge before the start of the work.

- i) Lay out drawings of the GI structure, MS mounting structure (vertical column & interconnections), SPV cell placement including angle and inverter placement and cable interlinks with Junction boxes.
- ii) Drawings including section, showing the details of erection of entire equipments.
- iii) Approved ISI and reputed makes for equipment be used.
- iv) Any other drawings relevant to the work.

## **22. PLANNING AND DESIGNING:**

- i) NCBS reserves the right to modify the landscaping design, Layout and specification of sub-systems and components at any stage as per local site conditions/requirements.
- ii) The bidder shall submit preliminary drawing for approval & based on any modification or recommendation, if any. The bidder submits three sets and soft copy in CD of final drawing for formal approval to proceed with construction work.

## **23. DRAWINGS TO BE FURNISHED BY BIDDER AFTER AWARD OF CONTRACT**

The Contractor shall furnish the following drawings Award/Intent and obtain approval.

- i. General arrangement and dimensioned layout
- ii. Schematic drawing showing the requirement of SV panel, Power conditioning Unit(s)/ inverter, Junction Boxes, AC and DC Distribution Boards, meters etc.
- iii. Structural drawing along with foundation details for the structure.
- iv. Itemized bill of material for complete SV plant covering all the components and associated accessories.
- v. Layout of solar Power Array
- vi. Warranty certificate for the entire system.

## **24. SAFETY MEASURES:**

The bidder shall take entire responsibility for electrical safety of the installation(s) including connectivity with the grid and follow all the safety rules & regulations applicable as per Electricity Act, 2003 and CEA guidelines etc.

## **25. List of approved makes:**

<b>Sr.no</b>	<b>Description</b>	<b>Make</b>
1.	Solar module	Approved make from MNRE
2.	Inverter	Liebert/OEM
3.	Energy Meter	L&T
4.	Cables	Finolex/Havells
5.	Accessories	As per OEM

26. Certify that I/We have gone through the General Conditions of Contract, Special Conditions and detailed specifications for the works kept in the office of Electrical Engineer, NCBS. We agree to abide by the same and aware that these are part of the tender document.

We also understood that the items described in BOQ are to be read in conjunction with the above specifications and quoted our rates accordingly.

Signature of the Tenderer

**NATIONAL CENTRE FOR BIOLOGICAL SCIENCES  
TATA INSTITUTE OF FUNDAMENTAL RESEARCH**

**Name of the work: Supply, Installation, Testing and Commissioning of  
14kW Rooftop Solar photo voltaic (SPV) plant at NCBS.**

**SECTION IV: SECDULE OF QUANTITY**

<b>Sl. No.</b>	<b>Description of the work</b>	<b>Unit</b>	<b>Qty</b>	<b>Rate (in Figures &amp; words)</b>	<b>Amount</b>
1	The offer price shall be inclusive of all price that shall include all costs for delivery, supply & Installation, testing and commissioning of 250Wp Solar photovoltaic module as per specifications.	Nos	56		
2	Supply, installation, testing and commissioning of Module mounting structure -GI	set	1		
3	Supply, installation, testing and commissioning of elevated mounting MS (TATA/JINDAL make) Structure from existing terrace including primer and synthetic painting as per direction from Engr-in-charge.	Kg	1800		
4	Supply, installation, testing and commissioning of Array Junction Box as per specifications	Lot	1		
5	Supply, installation, testing and commissioning of Grid Tie Inverter – 15kVA Three phase as per specifications	No	1		
6	Supply, installation, testing and commissioning of AC Distribution Box as per specifications	Set	1		
7	Finolex make PVC FRLS Cu. Cables – 4Sqmm single core for interconnection of array	Mtr	100		
8	Finolex PVC insulated FRLS, 4C x 10sqmm Cu cable for 3phase+N connection on Input and Output side.	Mtr	20		

<b>Sl. No.</b>	<b>Description of the work</b>	<b>Unit</b>	<b>Qty</b>	<b>Rate (in Figures &amp; words)</b>	<b>Amount</b>
9	Providing standard GI pipe earth of 3.5 Mtr Long, 38mm dia GI pipe for earth stations with GI pipe, conforming to IS: 3043 with latest amendments including supply of all materials (charcoal and salt) and providing chamber and funnel complete as required Note: Pipe earth used for earthing shall be " medium " class with ISI marking.	Nos	2		
10	Supply, installation, testing and commissioning of Lightning Arrestor as per specifications	Nos	2		
11	Supply, installation, testing and commissioning of Bi – Directional Meter as per specifications	Nos	1		
12	Hardware/ Lugs/ Ferrules/ Miscellaneous	Set	1		
13	Licensing charges for getting subsidy from state/central govt. and follow up with BESCO.	Job	1		
<b>TOTAL</b>					

**Note: The Contractor shall quote their rates in this schedule of quantity. Submission of tender in any other format is liable for rejection.**

Total amount in words:

Signature of the Contractor

Date :