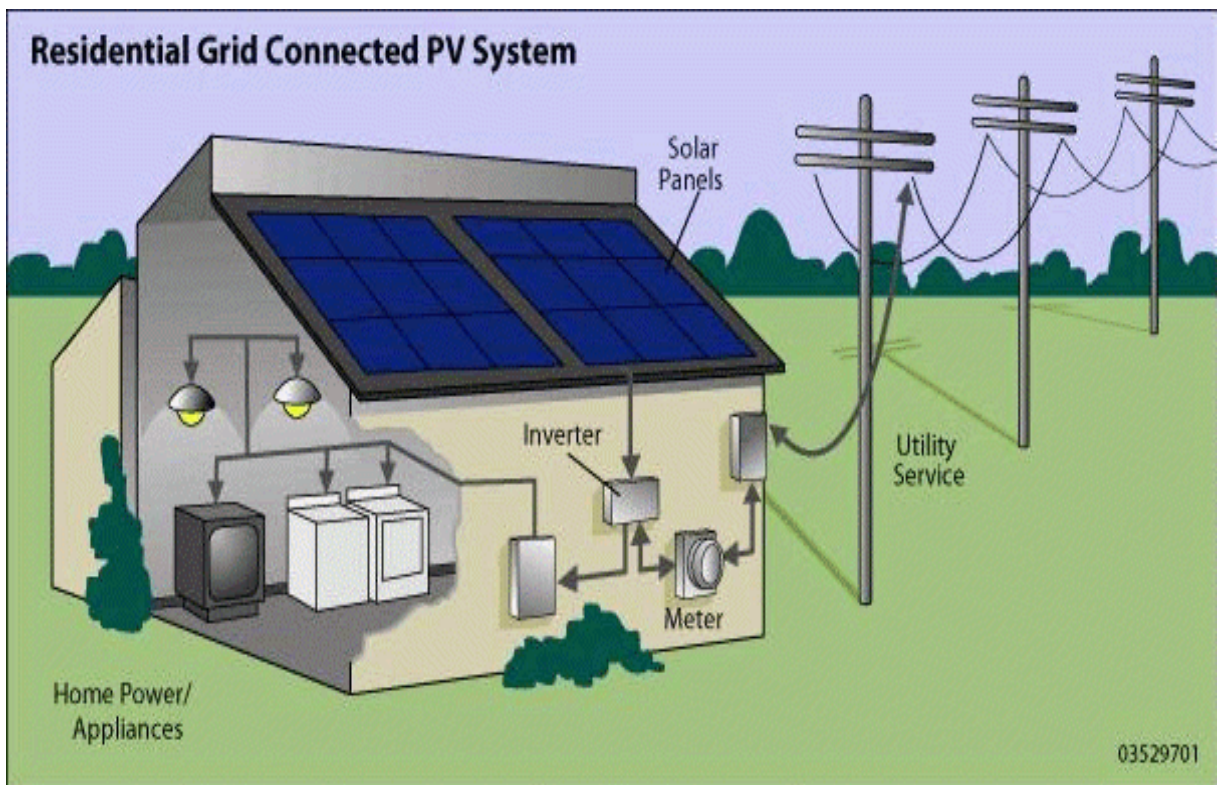


# TECHNICAL SPECIFICATION OF GRID INTERACTIVE ROOFTOP SOLAR PV SYSTEM FOR SEWA BHAWAN



**Central Electricity Authority  
New Delhi  
December, 2009**

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OF  
GRID INTERACTIVE ROOFTOP SOLAR  
PV SYSTEM  
FOR  
SEWA BHAWAN**

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**TECHNICAL SPECIFICATION  
FOR  
GRID INTERACTIVE ROOF TOP SOLAR PHOTO VOLTAIC SYSTEM**

**1 INTRODUCTION:**

Harnessing of non polluting renewable energy resources to control green house gases is receiving impetus from the government of India. The solar mission, which is part of the National Action Plan on Climate Change has been set up to promote the development and use of solar energy for power generation and other uses with the ultimate objective of making solar energy competitive with fossil-based energy options. The solar photovoltaic device systems for power generation had been deployed in the various parts in the country for electrification where the grid connectivity is either not feasible or not cost effective as also some times in conjunction with diesel based generating stations in isolated places, communication transmitters at remote locations. With the downward trend in the cost of solar energy and appreciation for the need for development of solar power, solar power projects have recently been implemented. A significant part of the large potential of solar energy in the country could be developed by promoting grid interactive solar photovoltaic power systems of varying sizes as per the need and affordability coupled with ensuring adequate return on investment. It has been proposed to set up a 25 kWp grid interactive solar photovoltaic power plant on the roof top terrace of the north wing of Sewa Bhawan as a pilot project.

- 1.1 The 25 kWp SPV system at roof-top of Sewa Bhawan, is estimated to provide annual energy generation of 42 MWh and operate at a capacity factor of 19%.
- 1.2 The Grid interactive Roof Top Solar Photo Voltaic (GTRTSPVS) consists of mainly three major components viz. the solar photovoltaic (SPV) modules, array, array mounting structure and the inverter or power conditioning unit(s). The SPV array converts the solar energy into DC electrical energy. The array mounting structure holds the PV modules in required position and the DC electrical energy is converted to AC power by the inverter or PCU, which is connected to the utility power grid. The AC power output of the inverter is fed to the AC distribution board through metering panel and isolation panel. The 415 V AC output-3Ø of the system can be synchronizing with the grid and the power can be exported to the grid depending upon solar power generation and local consumption.

**2 LOCATION:**

Sewa Bhawan is situated in the West Block area at R.K.Puram in New Delhi bounded by inner ring road (Mahatma Gandhi road) in the north and outer ring road in the south and the Bhikaji Cama place on the east. Sewa Bhawan houses the head offices of Central Electricity Authority, Central Water Commission, Bureau of Energy Efficiency (BEE), Registrar office of census and sub-offices of CPWD. The location of the site is shown in the **Exhibit – I**.

**3 SITE DESCRIPTION:**

The Sewa Bhawan has two wings known as north wing and south wing. The lay out of the rooftop terrace is shown in the **Exhibit – II**. The terrace on the north block

has communication antennas and an area of about 375 sq meters is vacant which could be used for SPV installation of 25 kWp. The terrace of the south wing having an area of about 1000 sq. meters is vacant and could also be used for larger size SPV installation. It is proposed to utilize the vacant area available on the north wing for installation of 25 kWp which could serve as a grid connected demonstration system and could be used for collection of data for analysis on the of availability of solar power. The development on the south wing terrace could be taken up later.

#### **4 EXISTING POWER SUPPLY ARRANGEMENTS:**

##### **4.1 BRPL Supply**

Electrical Power requirement for Sewa Bhawan is met from two sources of BRPL viz Main supply from sub-station Sector-1 and sub-station Sector-9, R. K. Puram. The power received at 11 kV level is stepped down to 0.4 kV by 4 Nos. dry type 11/0.4 kV, 4x1600 kVA distribution transformers located at the S/S in the ground floor of the Sewa Bhawan building. The load of north wing where the office of CEA is located is fed from transformers (TR-3 & TR-4). The maximum load for CEA is to be around 1-1.2 MW (1600 -1800 Amp). A 4x600 kVAr capacitor bank has also been provided to improve the power factor.

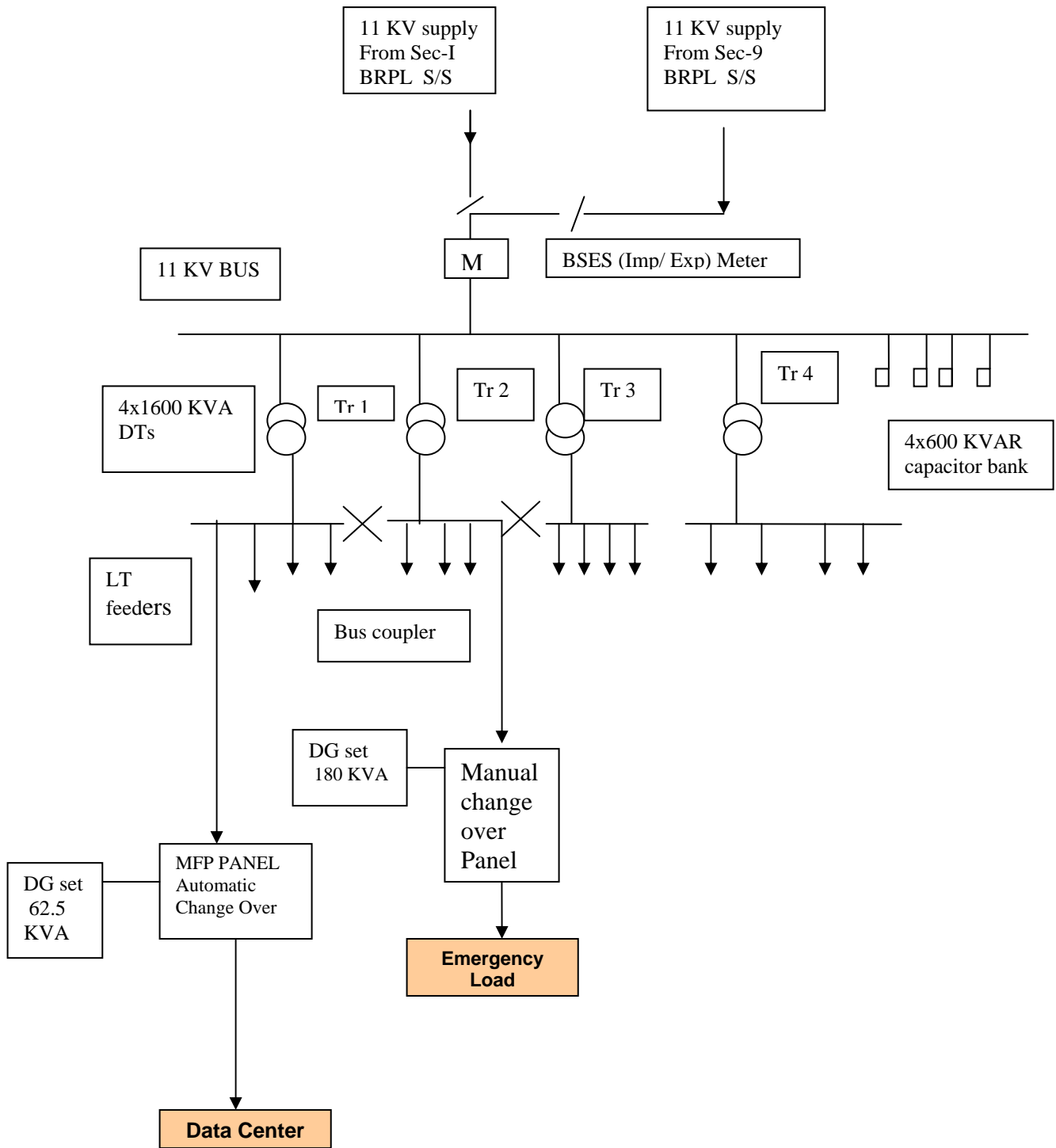
4.2 The Sub-station at Sewa Bhawan is operated and maintained by officers and operators of CPWD. The changeover of power supply from main to alternate is, however, under the control of BRPL.

##### **4.3 Emergency Power Supply**

- i. DG set of 1x180 kVA capacity has been installed for providing back up supply to important services like lifts, corridor lights, chairman & Members office and essential lighting in the building during the period of load shedding.
- ii. A 62.5 kVA DG set has also been installed to provide standby supply to the Data Centre located on the 3rd floor and Servers of Network Operation Control (NOC) Centre of NIC located on the 5th floor in the event of failure of Mains power supply. This DG set has been arranged on hire-purchase basis and its O&M is carried out by the vendor itself.

##### **4.4 LV Distribution System**

The load of CEA is fed from transformer (Tr-3 & Tr-4) through LT feeders. LT system is maintained by CPWD. The single line diagram of the supply system is given below.



## 5 SCOPE OF SPECIFICATION:

5.1 The scope of this specification shall cover design, engineering, manufacture, quality surveillance, testing at manufacturer's works, packing, and supply, erection testing and commissioning and performance testing of 25 kWp grid interactive roof top solar photovoltaic grid interactive system (GTRTSPVS) with associated components for installation at the roof of Sewa Bhawan building, R.K.Puram New Delhi and operation and maintenance for three(3) years from date of commissioning.

- 5.2 These systems shall be complete with PV modules, inverter, metering, junction boxes, AC, DC distribution boards and cables, communication interface, and any other equipment necessary for safe and efficient operation of the GTRTSPVS.
- 5.3 The work shall also include interconnection of GTRTSPVS with the grid.
- 5.4 The scope of supply shall also include comprehensive insurance, storage & in-transit transportation.
- 5.5 The civil works for installation of complete system shall also be in scope of supplier.
- 5.6 The scope of work shall also include operation and maintenance of the GTRTSPVIS for five years from the date of commissioning. However the prices for the same shall also be separately indicated in the bid.
- 5.7 The scope of supply shall also include essential spares necessary for operation, routine maintenance and testing of equipment supplied for 3 years.
- 5.8 It is not the intent of this specification to specify completely herein all the details of design and construction of equipment. However, the equipment offered shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in commercial operation up to Bidder's guarantee in a manner acceptable to the purchaser, who will interpret the meaning of drawings, specification and shall have the power to reject any work or materials, which in his judgment are not in full accordance therewith.
- 5.9 It shall be responsibility of the Bidder to ensure that all the works as per scope of the specification are completed for safe and efficient working of the system.
- 5.10 All the necessary co-ordination with regard to sub-contracted items shall be carried out by the Bidder. The purchaser/Engineer will communicate only with the Bidder for all matter pertaining to this contract.
- 5.11 It shall be responsibility of the Bidder to obtain all necessary clearances from the competent authorities.
- 5.12 The total price quoted for this contract shall be one lumpsum all-inclusive basis and shall cover all items and service necessary for successful completion of the contract. Even if all components of a system included in this specification are not explicitly identified and /or listed herein, these shall be supplied under this contract to ensure completion of the system and facilitate proper operation and easy maintenance of the plant. Changes in the quoted lump sum price would be permissible only in case of addition/deletion of one or more system/ equipment /service.
- 5.13 The breakup of lump sum price shall also be given for clarity and any addition and deletion.

5.14 Considering the reliability of the grid, no electrical storage batteries shall be required as excess electricity generated by the solar panels which are not required by the equipments/devices in the building premises shall be exported to grid.

#### 5.15 **Completeness of Equipment**

All the fittings and accessories that might not have been mentioned specifically in the specification but are necessary for equipment's of the plant, shall be deemed to be included in the specification and shall be supplied and furnished by the Contractor without any extra charge.

### **6 INSTRUCTIONS TO BIDDERS:**

6.1 Bids shall be submitted in two parts. Bid shall comprise of technical, commercial terms and conditions, documents as requisitioned / applicable along with the bid guarantee bond specified in the enquiry and comprise of price schedule as per prescribed proforma to be filled up by the bidders

6.2 The bidder shall be deemed to have carefully examined the specification in its complete form and to have fully informed and satisfied himself as to the details, nature, character and quantities of the work to be carried out, site conditions and other pertinent matters and details.

6.3 Bidder shall carefully study all sections of this specification and deviations if any shall be brought out in the bid. A pre-bid meeting shall be arranged on the request of the bidder. If the deviations are minor in nature, the successful bidder will be asked to withdraw these deviations taken during the pre-award meeting to bring all the bidders on par. If the deviations are major then their offer is likely to be considered as non-responsive.

6.4 The specification documents shall be attached in the final contract or purchase order for supply of materials, equipment and services.

6.5 The prices quoted shall be for supply, including all packing, forwarding, freight, transit insurance, storage insurance charges, unloading at site, sales tax, excise duty, storage, erection testing and commissioning and operation and maintenance for three years.

6.6 Bidder has also to give split up price for FOR Destination prices as per the price schedule and specify the prevailing rates of taxes and duties.

6.7 Bidder shall clearly indicate in his bid that the quoted prices are firm. No price variation shall be applicable.

6.8 **Sealed Bids in duplicate** duly filled in shall be submitted in sealed cover as indicated below super scribing the Bid Notification No. , Date and Title of the work/System etc,

Cover I shall contain

- a. Covering letter

- b. EMD
- c. Form of Bid
- d. Complete commercial terms and conditions
- e. Technical Bid and **Price Bid Only**.

## 6.9 **Delivery and Completion Period**

The entire work comprising design, engineering, manufacture, inspection and testing of performance, at manufacturer's and/or sub-Bidder's works, delivery to site, erection, testing and commissioning shall be carried out within the period of 5 months from the Letter of Intent/Award.

## 6.10 **Guarantee**

The successful Bidder shall guarantee the material and workmanship of all components and operation of the equipment and shall meet the requirement of the specification. Should the performance test result at works deviate from the guaranteed values including the specified tolerance the bidder shall correct his equipment at no extra cost to the Purchaser and repeat the performance tests within a reasonable period as agreed to by the Purchaser? As regard to the component clauses if the Bidder fails to meet the guaranteed values subject to tolerances specified, the Purchaser will levy a penalty.

## 6.11 **Tender Evaluation**

The Bidder shall comply with parameters as specified in the bid specification. No credit will be given during tender evaluation if parameters better than those specified are offered by the Bidder.

6.12 Unit prices quoted in the price schedule shall hold good for any additions/deletions during detailed engineering stage. The Bidder shall comply with the SPV Plant particulars as specified in Data Sheet. Bidder shall submit the design and performance data of the equipment offered by filling up data sheet. Bidder shall follow the tender specification strictly and conditional tenders will be rejected.

## 6.13 **Prices for Erection Testing and Commissioning**

The lump sum prices quoted for erection, testing and commissioning will be considered in the evaluation of bids.

## 6.14 **Commercial deviations**

No commercial deviations are acceptable and all commercial conditions shall be as per our specification. Any commercial deviation taken will not be considered for tender evaluation.

## 6.15 **Mode of Payment**

- 10% payment of cost of equipment within 30 days of the award of the contract

- 80% payment of cost of equipment within 30 days of supplying of all the material at site
- Balance 10% payment of cost of equipment including 100% erection ,testing and commissioning charges within 30 days of successful commissioning of the project.
- The payment for O&M would be paid within 30 days after end of each quarter on pro rata basis.

## **7 QUALIFICATION REQUIREMENTS:**

- 7.1 PV system shall be offered from a manufacturer who must have designed, manufactured, tested, installed and commissioned PV system of 15 KWp and higher which must be in satisfactory operation in India or abroad for at least 1 (one) year as on the date of bid opening.

## **8 CODES AND STANDARDS**

- 8.1 All Equipment and accessories shall comply to requirement of standards published by Bureau of Indian Standards (BIS). In case no BIS codes exists the equipments shall meet the requirement of international standard including IEEE for design and installation of grid connected PV system. The list of standards adopted shall be indicated in the bid.

- 8.2 The SPV Module must be provided with acceptable Test & Certified documents.

- 8.3 The quality of equipment supplied shall be generally controlled to meet the guidelines for engineering design included in the standards and codes listed in the relevant ISI and other standards, such as :

- i IEEE 928: Recommended Criteria for terrestrial PV power systems.
- ii IEEE 929 Recommended practice for utility interface of residential and intermediate PV systems.
- iii IEEE 519 Guide for harmonic control and reactive compensation of Static Power Controllers.
- iv National Electrical NFPA 70-1990 (USA) or equipment national standard.
- v National Electrical Safety Code ANSI C2 (USA) or equipment national standard.
- vi IEC : 61215 (2005)- Crystalline silicon terrestrial photovoltaic (PV) modules – Design qualification and type approval
- vii IEC: 61730 -1, -2 Photovoltaic (PV) module safety qualification Part 2: Requirements for testing
- viii IEC: 60904-1(2006) Photovoltaic Devices- Part-I: Measurement of Photovoltaic current-Voltage Characteristic
- ix IS 9000 Basic environmental testing procedure for Electronic and electrical items.

- 8.4 The PV power project developers will provide a copy of the type test certificate(s)/ report(s) with the bid and routine type reports before the dispatch of the equipment.

## 9 SPECIFIC TECHNICAL REQUIREMENTS:

9.1 Solar PV system shall consist of following equipments:

- i. Solar PV modules consisting of required number of PV cells .
- ii. Power Conditioning Unit/ Inverters with SCADA
- iii. Mounting structures
- iv. Cables and hardware
- v. Junction box and distribution boxes
- vi. Earthing kit
- vii. Lightning arrestors
- viii. PVC pipes and accessories
- ix. Tool kit
- x. Control room and civil pedestals
- xi. Spares for 3 years

### 9.2 Salient site and plant details

#### 1. Location

- |     |                  |                             |
|-----|------------------|-----------------------------|
| i   | State            | NCT Delhi                   |
| ii  | Locality         | West Block area, R.K. Puram |
| iii | Name of Building | Sewa Bhawan                 |
| iv  | Latitude         | 77° 12'                     |
| v   | Longitude        | 28° 32'                     |

#### 2. Area for SPV Plant

- |     |          |  |
|-----|----------|--|
| i   | Length   | 25.5m  |
| ii  | Width    | 13.0 m   |
| iii | Location | Terrace of North Wing of Sewa Bhawan (Eastern side of terrace) |

#### 3. SPV Power Plant

- |      |                                       |                     |
|------|---------------------------------------|---------------------|
| i    | Output                                | 25 kW <sub>p</sub>  |
| ii   | No. of modules                        | 150                 |
| iii  | No. of series modules in one array    | 5                   |
| iv   | No. of arrays in parallel combination | 30                  |
| v    | PV cell type                          | Poly crystalline    |
| vi   | Maximum Power Rating of one module    | 170 kW <sub>p</sub> |
| vii  | Rated Current of module               | 5 A                 |
| viii | Rated Voltage of module               | 34 V                |
| ix   | Short Circuit Current of module       | 6 A                 |
| v    | Open Circuit Voltage of module        | 42.8 V              |

#### 4. Mounting Arrangement

- |     |                                    |            |
|-----|------------------------------------|------------|
| i   | Mounting                           | Fixed Type |
| ii  | Surface azimuth angle of PV Module | 180°       |
| iii | Tilt angle(slope) of PV Module     | 28.32°     |

## 5. Inverter/ Power Conditioning Unit (PCU)

i	Number of units	1
ii	Rated Capacity	27 kWp
iii	Input DC Voltage range	170 V (Max.)
iv	Output Voltage	440 V AC
v	Frequency	50 Hz
vi	Minimum Efficiency	94%
vii	Inverter no load losses	1%(max)
viii	Accuracy of output voltage	±1%

## 6. Grid Connection Details

i	Electrical parameters for interconnection	440 V, 3Ph ,50 Hz
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7. Construction Time	5 months
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## 9.3 DUTY CYCLE

Average Hours of Operation/day: 8-10 hrs per day, as per insolation levels of the site.

## 9.4 PV ARRAYS

- i The PV modules convert the light reaching them into DC power. The amount of power they produce is roughly proportional to the intensity and the angle of the light reaching them. They are therefore required to be positioned to take maximum advantage of available sunlight within siting constraints. Supplier will position the PV modules in such a manner that the maximum power is obtained with the sun's movements during the day.
- ii Supplier shall follow the latest engineering practice; ensure long-term compatibility requirements and continuity of equipment supply and the safety of the operating staff.
- iii The PV power project developers are required to optimize generation of electricity in terms of kWh generated per kWp of PV capacity installed vis-à-vis available solar radiation at the site (may be obtained through use of efficient electronics, lower cable losses, maximization of power transfer from PV modules to electronics and the grid, maximization of power generation by enhancing incident radiation by optional methods like seasonally changing tilt angles etc).
- iv The PV system shall support remote monitoring of important parameters. The system shall be designed such that personnel without any background knowledge in Microprocessor-based technology are able to operate the system. The operator interface shall be intuitive such that operating personnel shall be able to operate the system easily after having received some basic training.
- v The manufacturer shall arrange certification on qualification of PV modules.
- vi The SPV cells shall be manufactured using unique highly efficient diffusion process or any other technology in vogue so as to ensure uniform diffusion profiler to achieve close spread and higher efficiency for each cell.

- vii Stabilized net output of the Solar PV Array for the Solar Power System should not be less than the Nominal design level for the System under Standard Test Condition.
- viii Each solar PV module shall be warranted by the manufacturer for at least 95% of its rated power for 10 years from the date of system acceptance.
- ix Photo electrical conversion efficiency of GTRTSPVS module shall not be less than 13%. The bidder shall indicate minimum module efficiency.
- x Fill factor of the module shall not be less than 0.70.
- xi The bidder shall provide the sample solar PV module electrical characteristics including current-voltage (I-V) performance curves and temperature coefficients of power, voltage and current. However, the tabulated document with all the relevant data like voltage, current, power output for all the modules also to be provided.
- xii The PV modules shall be suitable for continuous outdoor use.
- xiii The PV module shall be made of high quality laminated in ultra violet stabilized polymer material such as Ethyl Vinyl Accelerate (EVA), Tedler, toughend class. The size of single crystalline silicon PV cells shall be so chosen so as to maximize energy density and align with economies of scale.
- xiv PV module shall be provided with frame of anodized channels for size and simplicity in installation offered as a single module or series parallel combination of modules. The PV module shall be provided with screen-less frame with solar cable and connector.
- xv The PV modules shall be equipped with by pass diode to minimize power drop caused by shade.
- xvi The PV modules shall be made of light weight cells, resistant to abrasion, hail impact, rain, water and environmental pollution. The PV modules shall be provided with anti reflection coating and back surface field (BSF) structure to increase conversion efficiency.
- xvii The PV module shall use lead wire with weatherproof connector for output terminal.
- xviii The power output of the PV system under Standard Test Conditions (STC) should be 25 kWp made of 170 Wp or any other module size depending upon manufacturer prudent practice. With nominal output voltage of 24 V. The number of modules to be supplied shall be worked out accordingly.
- xix The operating voltage corresponding to the power output mentioned above should be 35.2 V for 24V system.
- xx The terminal box on the module should have a provision for opening for replacing the cable, if required.

xxi 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 Bidder or distinctive Logo
- b) Model or Type No.
- c) Serial No.
- d) Year of make.

xxii The GTRTSPVS shall perform satisfactorily in relative humidity up to 85% and temperature between -10°C to + 86°C.

## 9.5 INVERTER

- i. The DC power produced is fed to inverter for conversion into AC. In a grid interactive system AC power shall be fed to the grid at three phase 415 AC bus. Power generated from the solar system during the daytime is utilized fully by powering the building loads and feeding excess power to the grid as long as grid is available. In cases, where solar power is not sufficient due to more demand or cloud cover etc. the building loads shall be served by drawing power from the grid. The inverter should always give preference to the Solar Power and will use Grid/DG power only when the Solar Power is insufficient to meet the load requirement.
- ii. The output of the inverter must synchronize automatically its AC output to the exact AC voltage and frequency of the grid.
- iii. Inverter shall continuously monitor the condition of the grid and in the event of grid failure; the inverter automatically switches to off-grid supply within 20-50 milliseconds. The solar system is resynchronized with the grid within two minutes after the restoration of grid or DG set.
- iv. Grid voltage shall also be continuously monitored and in the event of voltage going below a preset value and above a preset value, the solar system shall be disconnected from the grid within the set time. Both over voltage and under voltage relays shall have adjustable voltage (50% to 130%) and time settings (0 to 5 seconds).
- v. Metal Oxide Varistors ( MOVs ) shall also be provided on DC and AC side of the inverter.
- vi. The inverter control unit shall be so designed so as to operate the PV system near its maximum Power Point (MPP), the operating point where the combined values of the current and voltage of the solar modules result in a maximum power output.
- vii. The inverter shall be a true sine wave inverter for a grid interactive PV system.
- viii. The degree of protection of the outdoor inverter panel shall be at least IP-55.
- ix. Typical technical features of the inverter shall be as follows:

<b>Continuous output power rating</b>	27 kWp 1.1 times for 60seconds
<b>Nominal AC output voltage and frequency</b>	415 V, 3 Phase , 50 Hz
<b>Accuracy of AC voltage control</b>	±1%
<b>Output frequency</b>	50 Hz
<b>Accuracy of frequency control</b>	±0.5%
<b>Grid Frequency Control range</b>	+/- 3 Hz
<b>Maximum Input DC Voltage</b>	170 VDC
<b>MPPT Range</b>	120 to 220 V DC
<b>Ambient temperature</b>	-10 deg C to 55 deg C
<b>Humidity</b>	95 % non- condensing
<b>Protection of Enclosure</b>	IP-55 (minimum)
<b>Grid Voltage tolerance</b>	-20 % and + 15 %
<b>Power factor control</b>	0.95 inductive to 0.95 capacitive
<b>No-load losses</b>	< 1% of rated power
<b>Inverter efficiency(minimum)</b>	94%

- x. Liquid crystal display shall at least be provided on the inverters front panel or on separate data logging/display device to display following
  - a. DC Input Voltage
  - b. DC Input current
  - c. AC Power output(kW)
  - d. Current time and date
  - e. Time active
  - f. Time disabled
  - g. Time Idle
  - h. Temperatures (C)
  - i. Converter status

- xi. Following shall also be displayed

Protective function limits (VIZ-AC over voltage, AC under voltage, Over frequency, under frequency, ground fault, PV starting voltage, PV stopping voltage, over voltage delay, under voltage delay over frequency, ground fault delay, PV starting delay, PV stopping delay.)

- xii. Nuts & bolts and the inverter enclosure shall have to be adequately protected taking into consideration the atmosphere and weather prevailing in the area.
- xiii. Dimension and weight of the inverter shall be indicated by the bidder in the offer.

- xiv. All doors, covers, panels and cable exists shall be gasketed or otherwise designed to limit the entry of dust and moisture. All doors shall be equipped with locks.
- xv. Operation Mode:
  - a. Night or sleep mode : where the Inverter is almost completely turned off, with just the timer and control system still in operation, losses shall be less than 2 W per 5 kW
  - b. Standby mode: where the control system continuously monitors the output of the solar generator until pre-set value is exceeded (typically 10 W).
  - c. Operational of MPP tracking mode: the control system continuously adjust the voltage of the generator to optimize the power available. The power conditioner shall automatically re-enter standby mode input power reduces below the standby mode threshold. Front panel shall provide display of status of the inverter.

xv. **SYNCHRONISING EQUIPMENT**

- a. Solar PV systems shall be provided with synchronizing equipment having three input for comparison i.e. grid supply vs. solar output, DG output vs solar output so as to connect the SPV systems in synchronism with grid or DG. In case of grid failure, solar PV system shall be disconnected from the grid and out of synchronization for a period DG supply is not restored. PV system shall be synchronized with the DG supply after DG is started.

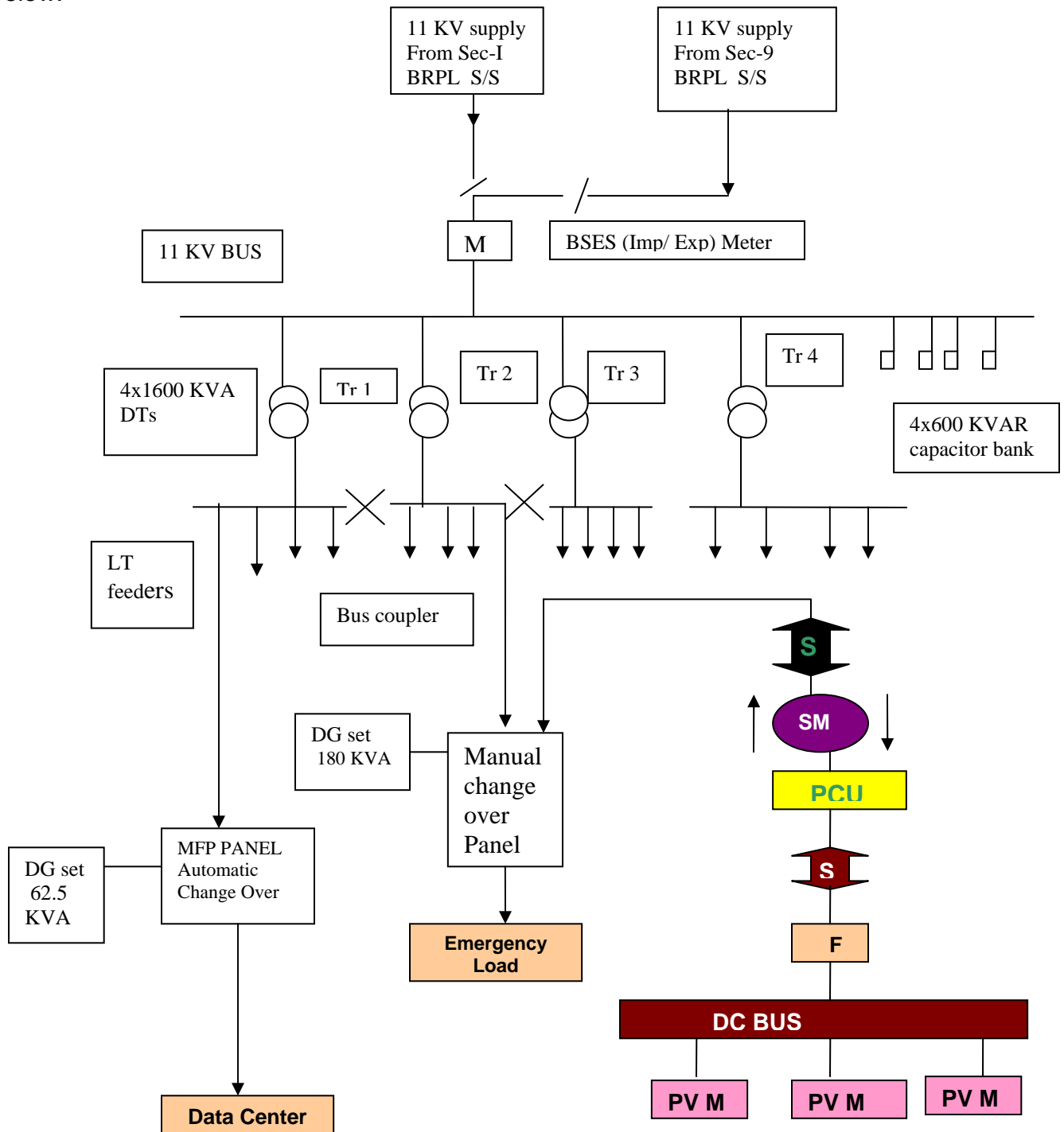
**9.6 PROTECTIONS AND CONTROL**

- i. PV system software and control system shall be equipped with islanding protection as described above. In addition to disconnection from the grid (islanding protection i.e. on no supply) , under and over voltage conditions , PV systems shall be provided with adequate rating fuses, fuses on inverter input side (DC) as well as output side (AC) side for overload and short circuit protection and disconnecting switches to isolate the DC and AC system for maintenances are needed. Fuses of adequate rating shall also be provided in each solar array module to protect them against short circuit.
- ii. A manual disconnect switch beside automatic disconnection to grid would have to be provided at utility end to isolate the grid connection by the utility personal to carry out any maintenance. This switch shall be locked by the utility personal.

**9.7 INTEGRATION OF PV POWER WITH GRID:**

The out put power from SPV would be fed to the inverter 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.

The out put power from inverter would be fed at the panel of 180 KVA DG set at CPWD S/S at Sewa Bhawan. The solar power would be used locally in Sewa Bhawan on working days to the extent of load in the building and the generation over and above the requirement of the building would be fed into the grid. On the week end and other holidays, almost the entire energy from the SPV module would be fed into the grid. The connection of the grid connected SPV power plant with the existing power supply system is shown in the diagram below.



## 9.8 9.8 METERING SCHEME

- i. Metering is required to measure the Solar Gross Generation on continuous basis and register cumulative energy based on 15 minute interval basis, daily, monthly and yearly energy generation.
- ii. The average voltage and power factor based on 15 minute interval must also be recorded.
- iii. Meter must also display on demand, instantaneous, AC system voltages and currents, frequency, reactive power with sign, Total harmonics current and voltage distortion etc.
- iv. Meters shall comply with the requirements of CEA Regulations on "Installation and Operation of Meters".
- v. Technical particulars of meters are indicated in **Annexure-I**
- vi. An integrating pyranometer (class II or better) to be provided, with the sensor mounted in the plane of the array. Readout shall be integrated with data logging
- vii. An Import/Export meter has already been installed by BSES at the entry point of 11kV incoming underground cable for metering for billing purpose which would also serve the purpose of registering the net export and import to the grid

## 9.9 POWER QUALITY REQUIREMENTS:

- i. **DC Injection into the grid:** The injection of DC power into the grid shall be avoided by using an isolation transformer at the output of the inverter. It is proposed to limit DC injection within 1% of the rated current of the inverter as per IEC 61727.
- ii. **Harmonics on AC side**
  - a. Harmonic distortion is caused principally by non-linear load such as rectifiers and arc furnaces and can affect the operation of a supply system and can cause overloading of equipments such as capacitors, or even resonance with the system leading to overstressing (excessive voltage & current). Other effects are interference with telephone circuits and broadcasting, metering errors, overheating of rotating machines due to increased iron losses (eddy current effects), overheating of delta connected winding of transformer due to excessive third harmonics or excessive exciting current.
  - b. The limits for harmonics shall be as stipulated in the CEA Regulations on grid connectivity which are as follows:
    - o Total Voltage harmonic Distortion= 5%
    - o Individual Voltage harmonics Distortion=3%

- Total Current harmonic Distortion=8%
- iii. **Voltage Unbalance**-The Voltage Unbalance in the grid shall not exceed 3.0%
  - iv. **Voltage Fluctuations**
    - a. The permissible limit of voltage fluctuation for step changes which may occur repetitively is 1.5%.
    - b. For occasional fluctuations other than step changes the maximum permissible limits is 3%.
    - c. The limits prescribed in (i) and (ii) above shall come into force not later than five years from the date of publication of these regulations in the Official Gazette.

#### 9.10 COMMUNICATION INTERFACE:

- i. The project envisages a communication interface which shall be able to support
  - Real time data logging
  - Event logging
  - Supervisory control
  - Operational modes
  - Set point editing
- ii. The following parameters shall also be measured and displayed continuously.
  - a. Solar system temperature
  - b. Ambient temperature
  - c. Solar irradiation/isolation
  - d. DC current and Voltages
  - e. DC injection into the grid (one time measurement at the time of installation)
  - f. Efficiency of the inverter
  - g. Solar system efficiency
  - h. Display of I-V curve of the solar system
  - i. Any other parameter considered necessary by supplier of the solar PV system based on prudent practice.
- iii. Data logger/Pc based monitoring system must record these parameters for study of effect of various environmental & grid parameters on energy generated by the solar system and various analysis would be required to be provided through bar charts, curves, tables, which shall be finalized during approval of drawings.
- iv. The communication interface shall be an integral part of inverter and shall be suitable to be connected to local computer and also remotely via the Web using either a standard modem or a GSM / WIFI modem. These

## 9.11 MOUNTING STRUCTURES:

- i. Hot dip galvanized iron mounting structures may be used for mounting the modules/ panels/arrays. These mounting structures must be suitable to mount the SPV modules/panels/arrays on the roof top, on the ground or on the poles/masts, at an angle of tilt with the horizontal in accordance with the latitude of the place of installation.
- ii. 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 (Delhi-wind speed of 150 km/ hour). It may be ensured that the design has been certified by a recognized Lab/ Institution in this regard.
- iii. 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.

## 9.12 POWER AND CONTROL CABLES:

- i. Power Cables of adequate rating shall be required for interconnection of :
  - Modules/panels within array
  - Array & Charge Controller
  - Charge Controller & Battery
  - Charge controller & Loads Including Inverter (if used) & between load & inverter.
- ii. The cable shall be 1.1 grade, heavy duty, stranded copper/ aluminum conductor, PVC type A insulated, galvanized steel wire/strip armoured, flame retardant low smoke (FRLS) extruded PVC type ST-1 outer sheathed. The cables shall, in general conform to IS-1554 P+I & other relevant standards.
- iii. The minimum size of 11 kV power cables shall be chosen taking into account Fault level contribution to the system and full load current. However, power cables size for 415 V systems shall be chosen taking into account the full load current & voltage drop. The allowable voltage drop at terminal of the connected equipment shall be max. 2.5% at full load. The derating factors viz. group duration of temp. duration shall also be considered while choosing the conductor size.

### iv. **Control Cables**

The cable shall be 1.1 grades, heavy duty, stranded copper conductor, PVC type A insulated, galvanized steel wire/strip armoured, flame retardant low smoke (FRLS) extruded PVC type ST-1 outer sheathed. The cables shall, in general conform to IS-1554 P+I & other relevant standards.

- v. The permissible voltage drop from the SPV Generator to the Charge controller shall not be more than 2% of peak power voltage of the SPV power source (generating system). In the light of this fact the cross-sectional area of the cable chosen is such that the voltage drop introduced by it shall be within 2% of the system voltage at peak power.

- vi. All connections should be properly terminated, soldered and/or sealed from outdoor and indoor elements. Relevant codes and operating manuals must be followed. Extensive wiring and terminations (connection points) for all PV components is needed along with electrical connection to lighting loads.

### 9.13 EARTHING MATERIAL:

- i. Earthing is essential for the protection of the equipment & manpower. Two main grounds used in the power equipments are :
  - System earth
  - Equipment earth
- ii. System earth is earth which is used to ground one leg of the circuit. For example in AC circuits the Neutral is earthed while in DC supply +ve is earthed.
- iii. In case of equipment earth all the non-current carrying metal parts are bonded together and connected to earth to prevent shock to the man power & also the protection of the equipment in case of any accidental contact.
- iv. To prevent the damage due to lightning the one terminal of the lightning protection arrangement is also earthed. The provision for lightning & surge protection of the SPV power source is required to be made.
- v. In case the SPV Array can not be installed close to the equipment to be powered & a separate earth has been provided for SPV System, it shall be ensured that all the earths are bonded together to prevent the development of potential difference between ant two earths.
- vi. Earth resistance shall not be more than 5 ohms. It shall be ensured that all the earths are bonded together to make them at the same potential.
- vii. The earthing conductor shall be rated for the maximum short circuit current. & shall be 1.56 times the short circuit current. The area of cross-section shall not be less than 1.6 sq mm in any case.
- viii. The array structure of the PV modules shall be grounded properly using adequate numbers of earthing pits. All metal casing/ shielding of the plant shall be thoroughly grounded to ensure safety of the power plant.

### 9.14 JUNCTIONS BOXES OR COMBINERS

Dust, water and vermin proof junction boxes of adequate rating and adequate terminal facility made of fire resistant Plastic (FRP) shall be provided for wiring. Each solar shall be provided with fuses of adequate rating to protect the solar arrays from accidental short circuit.

### 9.15 CIVIL WORKS

The following civil works shall be carried out by the firm.

- i Cutting and clearing of trees/plantation to remove the shadow.
- ii Site grading, leveling, drilling exploratory bore holes and consolidation of the area pertaining to the installation of SPV modules.
- iii Embedment of structures suitable for mounting PV modules.
- iv Laying of earthing equipments/structures and connecting to the main ground mat as per the statutory requirements.
- v Construction of control room;
- vi Cutting of cable trenches etc wherever necessary,

## **10 ACCEPTANCE OF SYSTEMS AND PERFORMANCE EVALUATION**

10.1 The installer must verify that the system has been installed according to the manufacturer's procedures. A checkout procedure should be developed to ensure an efficient and complete installation.

## **11 SYSTEM DOCUMENTATION:**

It is essential that the owner have complete documentation on the system. System documentation should include an owner's manual and copies of relevant drawings for whatever system maintenance might be required in the future.

## **12 INSTALLATION**

Installation shall be done by the licensed engineer who has adequate experience with installation of the PV system.

## **13 MAINTENANCE REQUIREMENT**

- i Easy access shall be provided for all components in the SPV plant and grid connecting equipments. Maintenance platform shall be provided for easy inspection of all the equipments.
- ii If special tools are required for installation and maintenance, the bidder shall indicate the same and to be supplied free of cost.
- iii The Bidder shall furnish operating and maintenance instruction manual to enable the purchaser to carry out maintenance of equipment effectively and safely.
- iv Washing / cleaning of SPV panels would be carried out as per the prudent practice of the supplier.

## 14 ENVIRONMENTAL CONDITIONS:

Nominal operating cell temperature(NOCT) (°C)	45+2
Maximum permitted module temperature (°C)	-40 to + 85
Maximum permissible system voltage(V)	1000
Relative Humidity at 85 °C	99
Temp.Coefficient of the short –circuit current	+ 4x10 <sup>4</sup> /K
Temp. Coefficient of the open –circuit voltage	-3.4x10 <sup>-3</sup> /K
Under Standard Test Conditions(STC): Am: 1.5 Irradiance: 1000W/m <sup>2</sup> Cell Temp.:25 °C	
Nominal Operating Cell Temperature(NOCT) at Wind speed 1m/s Irradiance: 800 W/m <sup>2</sup> Ambient Temperature 20 °C	

## 15 TEST AND TEST REPORTS

- i Type test certificates for all the tests specified for the factory built Solar PV modules, and the component parts shall be submitted by the Bidder along with the bid.
- ii The Supplier shall carryout all routine tests as specified in relevant standards on all major components in presence of the purchasers representative at works before despatch and furnish copies of test reports for purchaser's approval, If required, stage inspection will be carried out by the purchaser.
- iii. Supplier shall carryout all routine and functional tests as specified in the relevant standards on the assembled SPV Plant with all accessories of the equipment in the presence of the Purchaser's representative before despatch and furnish copies of the test reports for approval before despatch.
- iv. Equipment shall not be despatched unless the test certificates are duly approved by the purchaser.
- v. Two sets of copies of the compiled and approved test certificates shall be submitted to the Purchaser.

## 16 DRAWINGS TO BE FURNISHED BY BIDDER AFTER AWARD OF CONTRACT

- i The Contractor shall furnish the following drawings Award/Intent and obtain approval.
  - a. General arrangement and dimensioned layout
  - b. Schematic Drawing showing the requirement of SV panel, Power conditioning Unit(s), Junction Boxes, AC and DC Distribution Boards, meters etc.
  - c. Structural drawing along with foundation details for the structure
  - d. Itemised bill of material for complete SV plant covering all the components and associated accessories

- e. Overall layout showing SV Plant
- f. Format for reports and charts for analysis of various parameters

## **17 PERFORMANCE GUARANTEE AND PATENT RIGHTS**

The Supplier shall provide to the Purchaser the following guarantees in respect of solar PV system delivered by him.

### **a. Against-Patent - Infringements**

Except when the Purchaser furnishes design specifications to the Bidder, the Bidder shall at his own expense, defend and save the Purchaser harmless from the expenses and consequences of any suit or procedure brought against the Purchaser, so far as said suit or procedure is based on a claim that the goods furnished constitute an infringement of any patent in existence on the date of the order. In addition, the Supplier shall secure at his own expense a fully paid up license or licenses that will permit the Purchaser to continue use of the goods furnished free of further claim for infringement.

### **b. Guarantee of-Performance**

The Supplier shall guarantee that the goods furnished by him shall meet the requirement of specifications in full.

### **c. Guarantee Of Quality**

- a. The Supplier shall warrant that the goods are new and of high quality and that the goods will be free of defects in design. If within the expiry of the stipulated guarantee period the subject goods or any parts thereof are found defective because of design, workmanship or materials, the Supplier at his own expense, repair or furnish and install/ replace parts of design, workmanship and material approved by the Purchaser. The guarantee period for replaced parts or repair work shall be the same as above.
- b. The guarantee period shall be extended by the length of time required to make any adjustments, changes or repairs necessary to fulfill guarantee.
- c. The supplier shall obtain similar guarantees from each one of his Sub-contractor. However the overall responsibility shall lie with the Supplier.
- d. The guarantee period shall be for 18 months form the date of placing the LOI/award

## **18 RATING and NAME PLATE**

- i Each main and auxiliary item of plant shall have permanently attached to it a rating and name plate in a conspicuous position. This shall be of a non-corrodible material preferably chromium plated steel to stand the prevalent atmospheric conditions as indicated. The inscription shall be engraved in black on the plate or as otherwise specified in Section C/D.

- ii The size of the rating and name plate shall depend upon space availability but and inscriptions shall be approved by the Engineer. The plates shall be should be reasonably sized for clarity and clear inscription.
- iii In case of indoor equipment, the plate shall be of transparent plastic material with black lettering engraved on the back.
- iv The name plates shall be screwed to the body of the equipment.

## **19 LAYOUT REQUIREMENTS**

The overall dimensions of the SPV Plant shall suit the space provided for the layout requirements. The arrangement to suit this space is to be intimated at the time of approving the general arrangement drawing of the equipments.

## **20 INSTRUCTION AND O&M MANUALS**

- i Two copies of Instruction and Operation and Maintenance Manual in English and the local language should be provided with the system.
- ii The manual shall be furnished at the time of dispatch of the equipment and shall include the following aspects:
  - a. Precautions during unpacking
  - b. Instructions for handling at site.
  - c. Erection drawings with written assembly instructions that would enable the Purchaser to carry out erection with his own personnel if opted by him.
  - d. Detailed instructions and procedures for the installation operation and maintenance.
  - e. Pre-commissioning tests.
  - f. About solar PV system – its components and expected performance.
  - g. Clear instructions about mounting of PV module (s)
  - h. About electronics
  - i. DO's and DONT's
  - j. Principle of Operation of various equipments
  - k. Safety and reliability aspects
  - l. Metering scheme
  - m. About power conditioning units software and controls
  - n. Clear instructions on regular maintenance and trouble shooting of solar power plant.
  - o. Name and address of the person or service center to be contacted in case of failure or complaint.
  - p. Outline dimension drawings showing relevant cross sectional views, earthing details and constructional features.

- q. Rated voltages, current and all other technical information which may be necessary for correct operation of the SV plant.
- r. Catalogue numbers of all the components which are liable to be replaced during life of the SV plant and all the component parts.
- s. Trouble shooting and diagnostic procedure

iii Customer training :

Bidder shall provide necessary training at factory/site for mutually agreed duration and number of persons to enable the purchaser to maintain the system.

## TECHNICAL PARTICULARS OF SINGLE PHASE 10-60 or 20-80 Amp ENERGY METERS

### 1.0 FUNCTIONAL SPECIFICATION:

1.1	Applicable IS	IS 13779 or IS 14679 depending upon accuracy of meters.
1.2	Regulations	CEA Regulations on “ Installation and Operation of Meters:” ,2006
1.3	Accuracy Class Index	1.0 or better up to 650 V
1.4	Voltage	415 Volt(P-P), +20% to -40% Vref, however the meter should withstand the maximum system voltage i.e. 440 volts continuously.
1.5	Display	a) LCD (Six digits),pin type
1.6	Power factor range	Zero lag –unity- zero lead
1.7	Display parameters	a) Display parameters : LCD test, KWH import, KWH export, MD in KW export, MD in KW import, Date & Time, AC current and voltages and power factor (Cumulative KWH will be indicated continuously by default & other parameters through push-button) b) Display order shall be as per <b>Annexure-A</b>
1.8	Power Consumption	Less than 1 Watt & 4VA in Voltage circuit and 2 VA for Current circuit
1.9	Starting current	0.2 % of Ib
1.10	Frequency	50 Hz with + / - 5% variation
1.11	Test Output Device	Flashing LED visible from the front
1.12	Billing data	a) Meter serial number, Date and time, KWH import, KWH export, MD in KW (both export and import), History of KWH import and export, & MD(both export & import) for last 6 billing cycles along with TOD readings. b) All these data shall be accessible for reading, recording and spot billing by downloading through optical port on MRI or Laptop computers at site.
1.13	MD Registration	a) Meter shall store MD in every 30 min. period along with date & time. At the end of every 30 min, new MD shall be compared with previous MD and store whichever is higher and the same shall be displayed. b) It should be possible to reset MD automatically at the defined date (or period) or through MRI. c) Manual MD resetting using sealable push button is an optional.
1.14	Auto Reset of MD	Auto reset date for MD shall be indicated at the time of finalizing GTP and provision shall be

		made to change MD reset date through MRI even after installation of meter on site.
1.15	TOD metering	Meter shall be capable of Time of use metering for KWH, and MD in KW with 8 time zones (programmable on site through CMRI)
1.16	Security feature	Programmable facility to restrict the access to the information recorded at different security level such as read communication, communication write etc
1.17	Memory	Non volatile memory independent of battery backup, memory should be retained up to 10 year in case of power failure
1.18	Software & communication compatibility	<p>a) Optical port with RS 232 compatible to transfer the data locally through CMRI &amp; remote through PSTN / Optical fiber / GSM / CDMA / RF / any other technology to the main computer.</p> <p>b) The Supplier shall supply Software required for CMRI &amp; for the connectivity to AMR modules. The supplier shall also provide training for the use of software. The software should be compatible to Microsoft Windows systems (Windows 98 system). The software should have polling feature with optional selection of parameters to be downloaded for AMR application.</p> <p>c) Copy of operation manual shall be supplied.</p> <p>d) The data transfer (from meter to CMRI / AMR equipment) rate should be minimum 1200 bps.</p> <p>e) The Supplier shall provide meter reading protocols.</p>
1.19	Climatic conditions	<p>a) Refer IS: 13779 or IS: 14697 for climatic conditions.</p> <p>b)The meter should function satisfactorily in India with high end temperature as 60°C and humidity up to 96%.</p>
1.20	Meter Sealing	As per CEA Regulations, Supplier shall affix one Utility /buyer seal on side of Meter body as advised and record should be forwarded to Buyer.
1.21	Guarantee / Warranty	10 Years.
1.22	Insulation	A meter shall withstand an insulation test of 4 KV and impulse test at 8 KV
1.23	Resistance of heat and fire	The terminal block and Meter case shall have safety against the spread of fire. They shall not be ignited by thermal overload of live parts in contact with them as per the relevant IS.
1.24	Battery	Lithium with guaranteed life of 15 Years
1.25	RTC & Micro controller	The accuracy of RTC shall be as per relevant IEC / IS standards
1.26	P.C.B.	Glass Epoxy, fire resistance grade

		FR4, with minimum thickness 1.6 mm
1.27	<b>Power ON/Off hrs:</b>	Along with billing history parameters, meter shall log monthly ON/ Off hrs as history.
1.28	<b>Tamper Logging</b>	Last 200 events of Magnetic tamper; single wire tamper and top cover tamper shall be logged in memory along with Occurrence and restoration event data. Logic of defining tamper and OBIS code shall be agreed before supply of meter.
1.29	<b>Protection against HV spark:</b>	Meter shall continue to record energy or log the event, incase it is disturbed externally using a 35KV spark gun/ ignition coil.

## 2. TAMPER & ANTI-FRAUD DETECTION/EVIDENCE FEATURES

The meter shall not get affected by any remote control device & shall continue recording energy at least under any one or combinations of the following conditions:

2.1	I/C & O/G Interchanged	Meter should record forward energy
2.2	Phase & Neutral Interchanged	Meter should record forward energy
2.3	I/C Neutral Disconnected, O/G Neutral & Load Connected to Earth.	Meter should record forward energy
2.4	I/C Neutral disconnected, O/G Neutral Connected To Earth Through Resistor & Load Connected To Earth.	Meter should record forward energy
2.5	I/C Neutral connected, O/G Neutral Connected To Earth Through Resistor & Load Connected To Earth.	Meter should record forward energy
2.6	I/C (Phase & Neutral) Interchanged, Load Connected To Earth.	Meter should record forward energy
2.7	I/C & O/G (Phase or Neutral) Disconnected, Load Connected To Earth.	Meter should record forward energy

## 3.0 INFLUENCE PARAMETERS

The meter shall work satisfactorily with guaranteed accuracy limit under the presence of the following influence quantities.

- a) External magnetic field – 0.5 Tesla.
- b) Electromagnetic field induction,
- c) Radio frequency interference,
- d) Vibration etc,
- e) Waveform 10% of 3rd harmonics,

- f) Voltage variation,
- g) Electro magnetic H.F. Field,
- h) D.C. immunity test,

## ANNEXURE A

### DISPLAY SEQUENCE FOR THE PARAMETERS

#### A Default Display:

Cumulative KWH to be displayed continuously without decimal

#### B On-demand Display:

After using pushbutton the following parameters should be displayed.

1. LCD test
2. Date
3. Real Time
4. Current MD in kW
5. Current kW generated by solar system
5. Last month billing Date
6. Last month billing KWH reading
7. Last month billing Maximum Demand in KW
8. Last month billing Maximum Demand in KW occurrence Date
9. Last month billing Maximum Demand in KW occurrence Time
10. Instantaneous AC Current and Voltages

**Note: The meter display should return to Default Display mode (mentioned above) if the 'push button' is not operated for more than 6 seconds.**

**GURANTEED TECHNICAL PARTICULARS  
(TO BE FILLED BY THE BIDDER)**

DC output of PV Array (KWp)  
Area required (square feet)  
No. of cells in one PV module  
DC rating of one module ( $W_p$ )  
Connection configuration  
Rated DC current of one module  
Rated DC voltage of one module ( $V_{mpp}$ )  
No. of PV module in one array (all in series)  
Max. DC output voltage of Array (Volt)  
No. of Arrays  
Rating of inverter(KVA)  
Nominal AC output voltage(volt)  
Variation In Output Voltage  
Nominal frequency(Hz)  
Grid Frequency variation  
No. of phases/ wire  
AC output voltage range(Grid)  
Power Factor Range  
Minimum Efficiency of Inverter (%)  
No load Losses of Inverter(max)  
DC Injection into Grid(max)  
Ripple content on DC side  
Total Voltage harmonic Distortion(AC side)  
Individual Voltage harmonic Distortion(AC side)  
Total Current harmonic Distortion(AC side)

## **MOUNTING STRUCTURE**

1. Type
2. Material
3. Overall dimensions
4. Coating
5. Wind rating
6. Tilt angle
7. Foundation
8. Number of Module structure
9. Fixing type

### SCHEDULE OF PRICES

Sl. No	Particulars	Qty.	Unit price Rs. L/S	Total price Rs. L/S
1.0	Lum sum and Firm Ex-works price for the design, engineering, manufacture, quality surveillance, testing at manufacturer's works, supply, storage, delivery at site including packing, forwarding, transportation to site, erection, testing and commissioning, insurance during all stages for the grid interactive solar PV plant as defined in scope of Technical specification	1Set.		
2.0	Excise duty			
3.0	Total of 1.0 and 2.0			
4.0	CST on item 3.0			
5.0	Any other taxes and levies			
6.0	Total of 3.0 to 5.0			
7.0	Transportation to site			
8.0	Transit / comprehensive insurance			
9.0	<b>Total of 6.0 to 8.0</b>			
10.0	<b>O&amp;M Charges for five Years</b>			

**Amount in Words**-----

## BREAK UP COST FOR SUPPLY, ERECTION, TESTING AND COMMISSIONING

Sl. No.	Description	Quantity in nos.	Rate L/S	COST L/S
1.	Supply and delivery of Solar PV system of , as per specification, each comprising of the following equipments	1Set		
	a) SPV arrays 0f -- KWp each b) Power conditioning unit with Inverters. c) Mounting structures. d) Cables and hard wares e) Junction box and distributes boxes. f) Lightening arrestor, earthing kit g) PVC pipes and accessories, tool kit h) Spares for 3 years i) SCADA System j) any other equipment required			
2	a) Lump sum price for storage erection, testing & commissioning of SPV System with accessories. including insurance coverage at all stages and associated civil works	1Set		
<b>TOTAL</b>				

## Schedule of General Particulars

Bidder shall furnish the following particulars with his bid

- 1.0 Name of the Company
- 2.0 Address
- 3.0 Year of Establishment under quoted Name
- 4.0 Telegraphical Address
- 5.0 Type of Organisation Property/Partnership/Pvt.Ltd./  
Public Ltd./Government
- 6.0 Name and designation of Officer of Bidder to whom all reference shall be made for expeditious technical co-ordination
- 7.0 Place of manufacture  
(give equipment-wise list)
- 8.0 Current registration No. with D.G.S & D
- 9.0 Details of service facilities available
- 10.0 Bidder's proposal No. & Date
- 11.0 Product manufactured based on indigenous know-how Yes/No
- 12.0 Any foreign collaborator Yes/No
- 12.01 Name & Address of Foreign collaborator
- 12.02 Extent of collaboration
  - a. Technical
  - b. Financial
- 13.0 Brand Name of product offered

Signature .....

Designation ,

Company .....

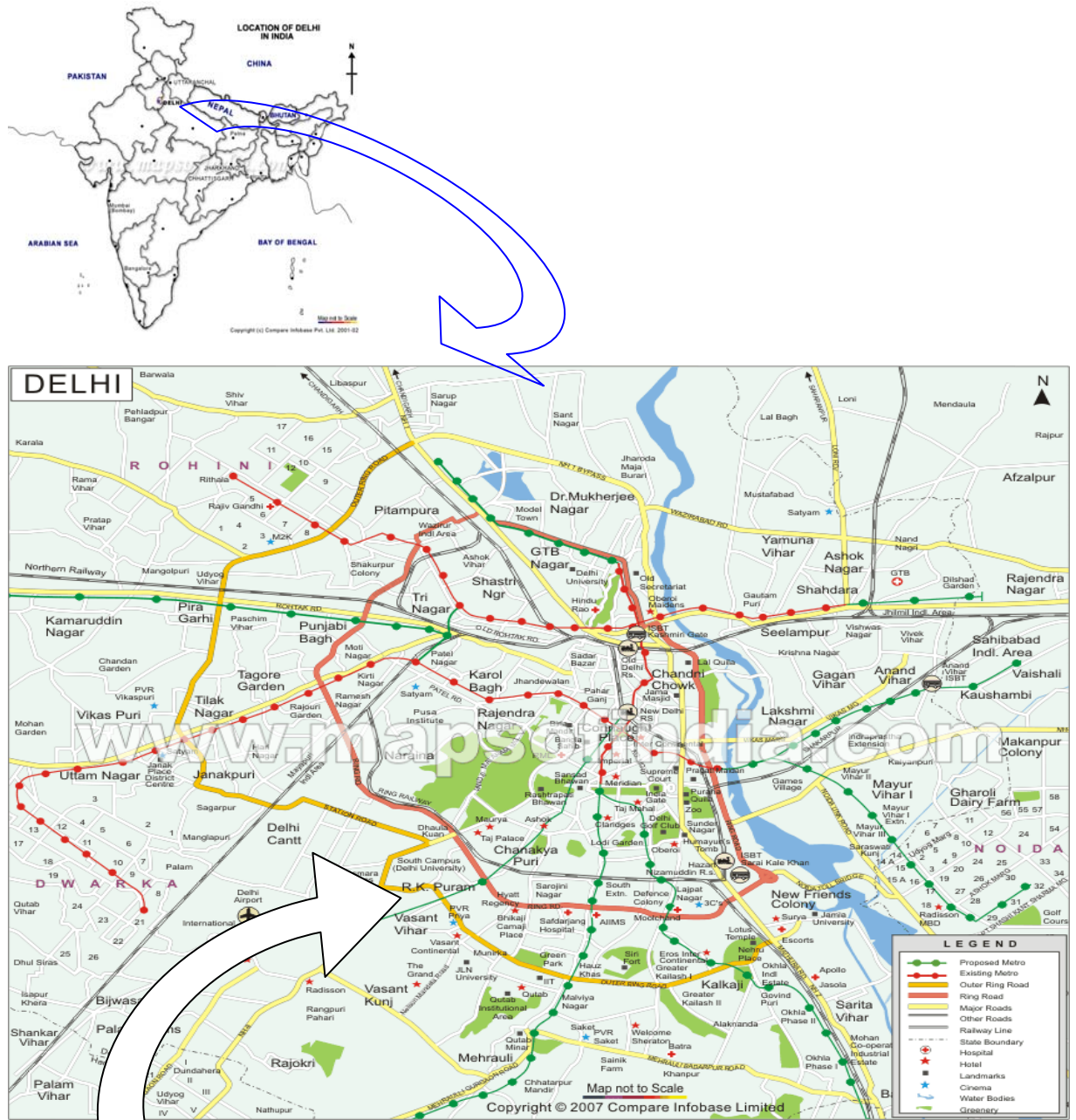
Company seal

Date

**Schedule of Declaration**

I, ..... certify that all data and information pertaining to this specification are correct and are true representation of the equipment by our formal proposal number ..... dated..... I hereby certify that I am duly authorized representative of the supplier whose name appears above my signature.

**LOCATION MAP OF SEWA BHAWAN, R K PURAM, NEW DELHI**



**Sewa Bhawan, R K Puram, New Delhi**  
 ( 28° 34' 2.02'' )  
 ( 77° 10' 44.93'' )

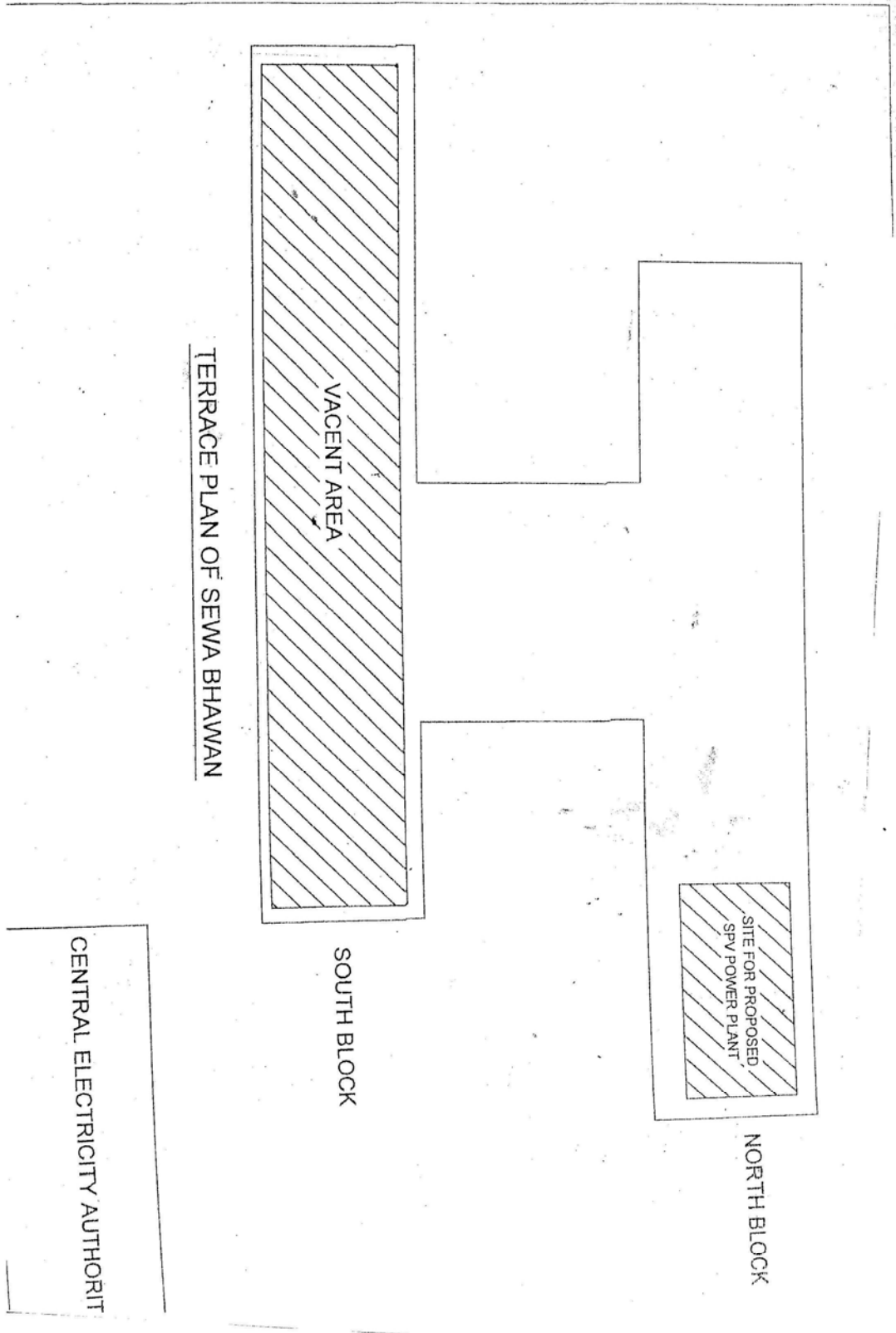
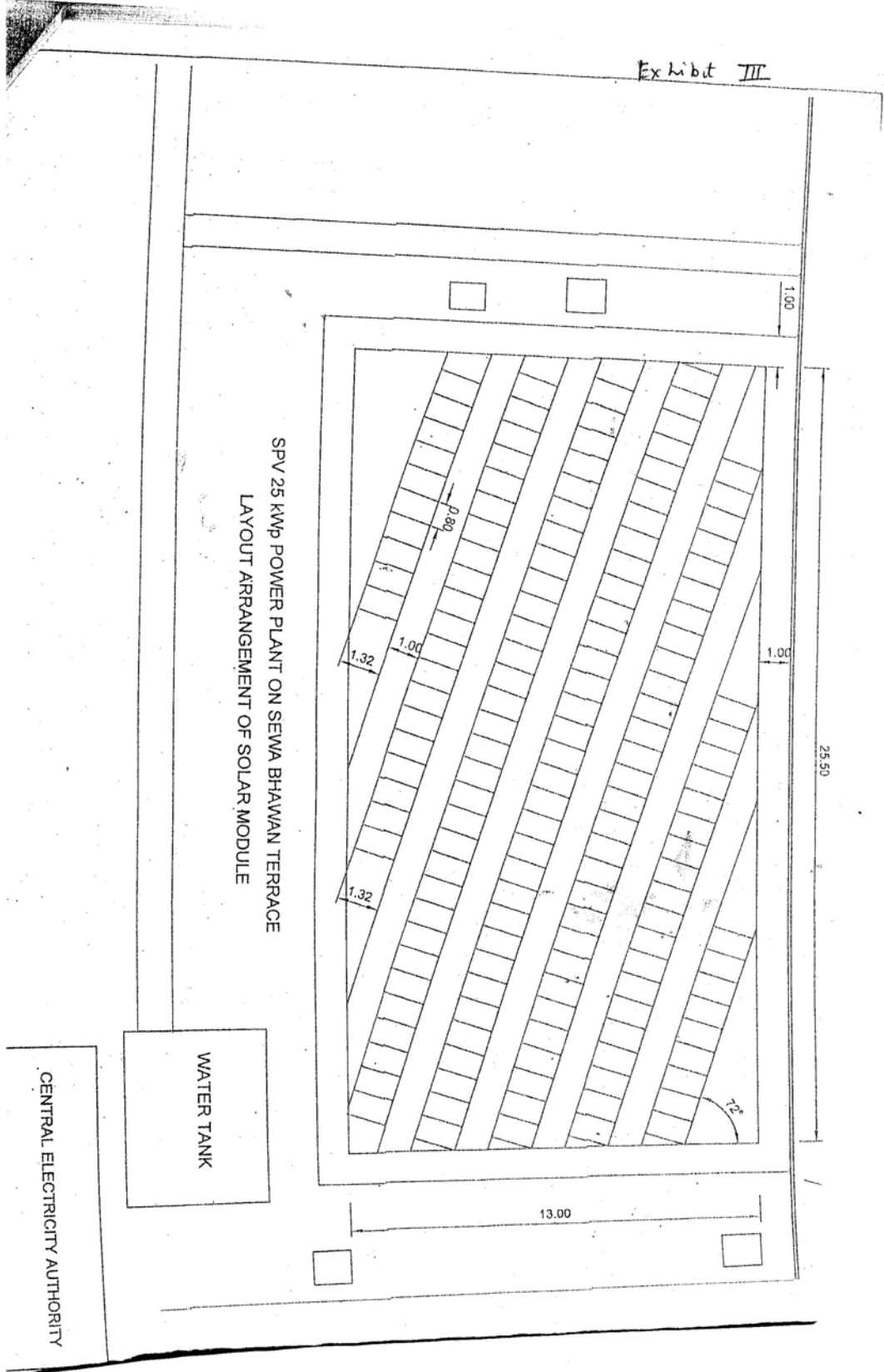
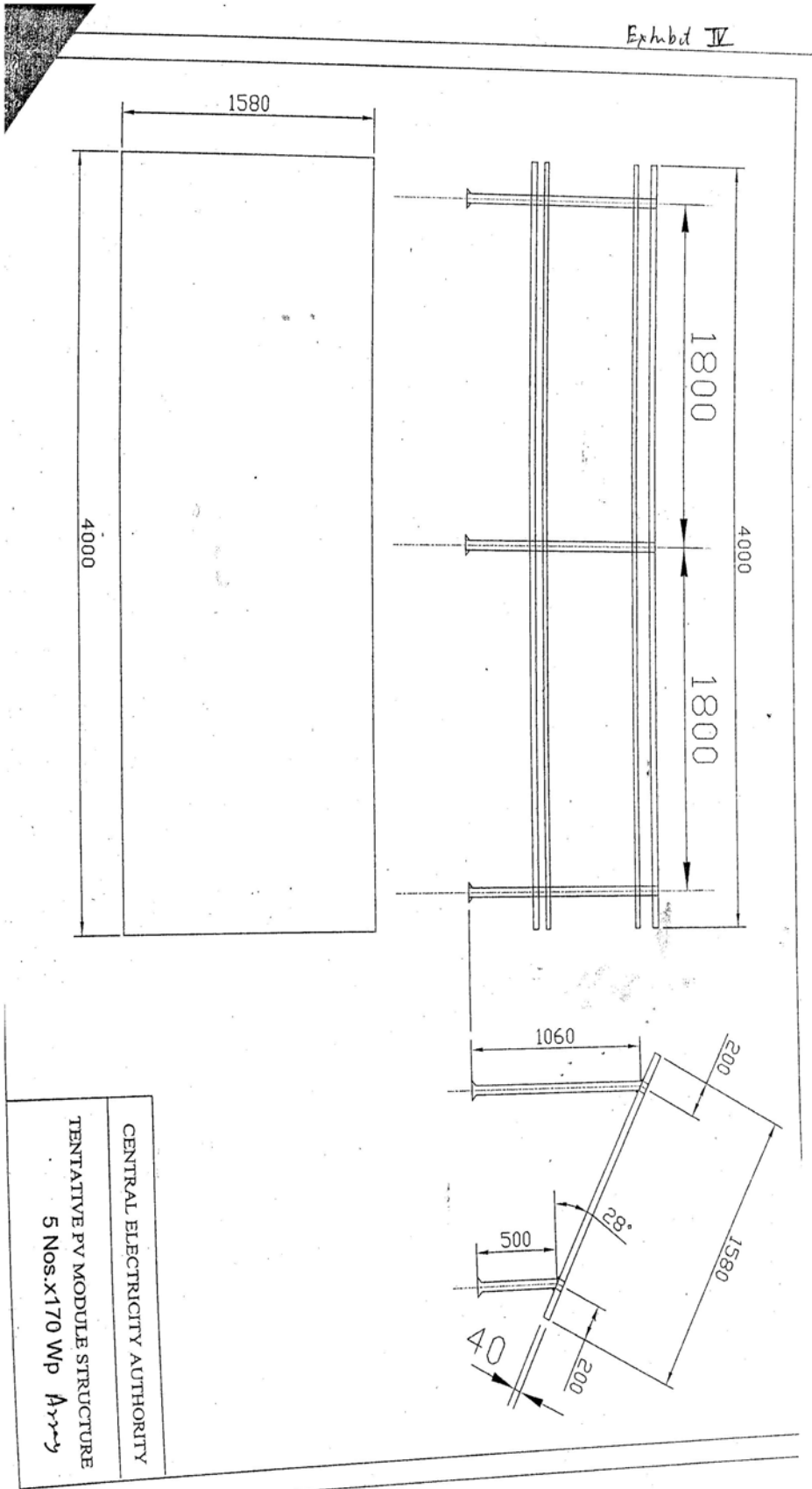


Exhibit III





CENTRAL ELECTRICITY AUTHORITY  
TENTATIVE PV MODULE STRUCTURE  
5 Nos. x 170 Wp A-2-2-y