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**SUPPLY OF BOS, PCU, ACDB AND E&C OF 30 kWp GRID CONNECTED FLOATING SPV
POWER PLANT**



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1.0 INTRODUCTION:

BHEL R&D Hyderabad is setting up a 30 kWp grid connected floating SPV power plant on Hussainsagar Lake near the banks of Sanjeevaiah Park, Hyderabad. This specification defines the scope of the vendor in **Supply of PCU, Balance of System (BOS) items and Erection & Commissioning (E&C) of the 30 kW_p solar Power Plant with 2 years of Annual Maintenance Contract from the date of commissioning of the plant.**

The site address is Sanjeevaiah Park, Necklace road, Hyderabad as per the Site Layout drawing attached in **Annexure-1**.

Vendor is required to furnish clause-wise response for this specification furnished below.

2.0 TECHNICAL SPECIFICATION:

2.1 FLOATING PONTOONS:

Floating pontoons will be supplied by BHEL R&D, and assembly of floats will be in the scope of BHEL.

2.2 MOUNTING STRUCTURE SPECIFICATIONS:

Mounting structures and clamps will be supplied by BHEL and assembly of structures to floats and panels mounting on structures shall be in the vendor scope. A total of 100 panels are to be mounted and clamped with the structures.

2.3 SUPPLY OF BALANCE OF SYSTEM (BOS):

					Scope	
Sl. No.	Description	Make & Specification	Quantity	Unit	Vendor	BHEL
1	PV Module	BHEL L24270, 290Wp/24 V	96	Nos	NA	✓
2	Central Inverter	30 kVA, 3Ø, 415V / Refusol, SMA, Sungrow, Delta or equivalent	1	No	✓	NA
3	PVC Double Insulated Copper DC Cable	6 sq.mm, 1000 Volts Rated (RED & Black)- Top cables, KEI, Polycab or equivalent	1000* (500 mtr Red & 500 mtr Black)	Mtr	✓	NA



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4	DC Cable Snap on connectors with one crimping tool	MC4 Compatible, IP67. Bizlink or equivalent	50	Pair	✓	NA
5	Array Junction Box	8 IN and 2 OUT	1	Nos	✓	NA
6	PVC Double Insulated Copper DC Cable.(AJB to Inverter)	95 sq.mm, 1000 Volts Rated (RED & Black)- Top cables, KEI, Polycab or equivalent	300*	mts	✓	NA
7	AC Cable(for connecting inverter output to ACDB and ACDB to LT injection point)	16 Sq.mm Copper cable- 3.5 core – Armoured. Polycab, KEI or equivalent.	500*	Mtrs	✓	NA
8	AC Power Distribution Board	V _{max} , Khodaya, Power Plus, Deprocon, L&T or equivalent make	1	No	✓	NA
9	PV Module mounting Structures	As per BHEL drawing	-	-	NA	✓
10	Conduit Pipe with necessary L,T bends	Heavy Duty PVC Conduit pipe of Finolex, supreme or equivalent reputed make 1" pipe 2" pipe	200 200	Mtrs Mtrs	✓	NA



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11	Lightning Arrestor	Copper globe type as per enclosed drawing	1	Nos	✓	NA
12	Earthing kit with necessary Back Fill Compound (Structure-1, Lightning Arrestor-1, Equipment earthing-1)	Chemical Earthing type of Ashlok, Pragathi or equivalent reputed make as explained in this specification	3	Nos.	✓	NA
13	GI Strip	25x3 mm	200	Mtrs	✓	NA
14	Fire Extinguisher	Cease Fire Extinguisher (ABC (Mono ammonium Phosphate 90 Grade)- 5 kg Application for all Class of Fire	1	Nos	✓	NA
15	Tools	Digital Multimeter - 1 No., Digital clamp meter - 1 No., (1000 V, 500 A capable of both DC and AC measurement of reputed make like Meco/Waco or equivalent) Cutting pliers - 1 No., Screw drivers - 1 set Nut runners required for	1	Set	✓	NA



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		Structure fitting - 1 set Allen key set - 1 no.,				
16	Cable trays & fixing accessories	As per Standard Practice.	40	mtr	✓	NA
17	Miscellaneous items	Cable ties, hardwires, lugs, Ferrules, Paint, consumables for termination, danger boards, marking plates and plant name board etc.,	As required qty for 30 kWp	LS	✓	NA
18	Installation, testing and commissioning of SPV plant		1	Set	✓	NA
19	Ambient and module temperature sensors	Each one numbers	2	No	✓	NA

Notes:

1. Vendor has to procure materials as per listed make or equivalent.
2. * Cable lengths indicated are tentative only. All power cables per meter price to be quoted separately to facilitate any additional requirement during erection.

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3. 2.3.1 Central INVERTER:

1 No., of 30 kVA, 3Ø, 50 Hz Central inverter shall be procured by vendor as per attached specification **SAG-535-48-02**. These are to be erected and testing of inverters will be in the scope of the vendor. 16 No of 290Wp SPV modules have to be connected in series to form a string (may vary during erection). Similarly 6 strings have to be formed for the entire array. These strings are made to form an Array by using 8 Input /2 output junction box. This one Output from Array Junction Box will be connected to inverter input. The output of the inverter is fed to final LT distribution board using 3.5C X 16 mm² armoured copper cable through the ACDB.

2.3.2 AC DISTRIBUTION BOARD:

(a) 30 kVA AC distribution board shall consist of following:

- (1) MCB 63 A, 4 Pole, 20 KA-1 No., L&T, Merlin Gerin /Schneider/ ABB /equivalent make.
- (2) RYB indicating LEDs (10mm size) at the input side with selector switch - 1 No., of reputed make.
- (3) Surge voltage protection & Residual current discharger - 1 No., suitable rating has to be provided by the vendor on all the 3 phases for protection, Phoenix /ABB/OBO Bettermann /equivalent make.
- (4) 3 ph Digital Ammeter - 1 No., Digital Voltmeter - 1 No., and Digital Energy Meter - 1 No., meters should be of konzerv, Schneider, L&T or equivalent make of appropriate ranges with necessary CT and PTs of reputed make. All the metering equipment and CT should be of class 0.5.
- (5) Surge Protection Device/Transient Voltage Surge Suppressor of appropriate rating on all the three phases of OBO-Betterman/Phoenix/ABB or equivalent reputed make

(b) System details - 30 kVA, 415V, 4 wire, 3 phase, 50Hz.

(c) All fasteners shall be stainless steel SS-304 with suitable spring washers.

(e) Painting- RAL 7032

(f) Mounting - wall Mounted

(g) The clearance between terminals in air should be as per IS for voltage rating and current ratings indicated above. Similarly, all the clearances and size of cable used for internal wiring of the cubicle should be complying to IS.

2.3.3 Array Junction Box:

Vendor has to supply 8 in 2 out Array junction box (AJB) and should be in line with the referred drawing i.e. DRG NO: DYS 1353548/03 (i.e 10 in 1 out) enclosed,

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2.3.4 Power & Control Cables:

- Power Cables of adequate rating shall be required for interconnection of:
- Modules/panels within array
- PV array & Junction Box
- Junction Box & Inverter
- Inverter & ACDB
- ACDB & LT Panel.

ii. **The power cable** shall be 1.1kv 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 Part-I & other relevant standards.

iii. **Control Cables:** The cable shall be 1.1kv 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 Part-I & other relevant standards.

iv. 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.

v. 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.

2.3.5 Communication Interface and SCADA:

- a). 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

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- **Software and communication compatibility:** a) Optical port with RS 485/ ETHERNET compatible to transfer the data locally through CMRI & remote through Optical fiber link to the main computer.
 - b) The Supplier shall supply necessary Software required. The supplier shall also provide training for the use of software. The software should be compatible to Microsoft windows systems (Windows VISTA OR Higher Version system).
 - c) Copy of operation manual shall be supplied.
 - d) The Supplier shall provide meter reading protocols.
- ii. The following parameters shall also be measured and displayed continuously.**
- a. Solar system (module) temperature.
 - b. Ambient temperature.
 - c. Should have provision for 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.
 - j. kW reading DC/AC i.e. input output (instantaneous power)
- 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 analyses would be required to be provided through bar charts, curves, tables.
- 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.

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2.3.6 Fire Extinguishers:

An in indoor space of approximate area 16 sq mtr will be provided for the installation of PCU and associated items. This control room shall be provided with Portable fire extinguisher for fire caused by electrical short circuits. Apart from this Sand buckets shall be placed in relevant areas mandated by BIS. The installation of Fire Extinguishers should confirm to TAC regulations and BIS standards. The fire extinguishers shall be provided in the control room housing the PCUs as well as on the roof top where the PV arrays have been installed.

2.3.7 Tools, Shackles

After completion of installation & Commissioning of the plant, necessary tools & shackles are to be provided free of cost by the supplier for the maintenance purpose.

2.3.8 Earthing Kit:

GOVERNING STANDARD: IS 3043 - 1987

The earthing for array, plant equipment and LT power system shall be required as per provisions of IS: 3043. The requirement of earthing system for the Plant shall be as furnished in the above table.

Installation of Chemical earth stations:

The Zinc electrode used for this will be of 3 m length & 80 mm diameter. So nearly 3.5 m depth & 0.5 Mtr dia hole to be drilled, 2 bags of 25 kgs of back fill compound to be filled along with electrode & water into the pit. Hence vendor has to organize the required machines & tools for earthing. .

The structures shall be inter-connected through interconnects and finally connected through 25 mm x 3 mm thick GI flat to the respective earth pits from roof top. This GI strip is to be properly routed from terrace to corresponding earthing pit through PVC pipe with bends properly by clamping to wall at regular intervals. Vendor has to make necessary arrangements to ensure proper routing and maintain the aesthetic look of the platform. Please note that GI flat to be painted by Asian paint 3 Mango type before lying.

GI flat is to be used for earthing the body of the LTDB & PCU to the earth pits. The GI flat has to be run all along the length of the cable trench through PVC conduits with bends till earthing points. The GI flat from equipment body earth is connected to this flat and is connected to the dedicated earthing pit. Masonry enclosure (identified with labels) with cast iron cover plate shall be provided for each earth pit.

Earth resistance of the earth pits shall be tested in presence of the representative of BHEL as per applicable IS before commissioning and value to be less than 3Ω for structures and to be less than 1Ω for equipment body earthing for acceptance.

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2.3.9 Danger Boards, Marking & plant name board:

(1). Danger plates (200mmx150mm) shall be provided in solar array area. Suitable size of each Danger Notice plates shall be provided as per statutory requirement, made of mild steel of min 2 mm thick, and vitreous enameled RED on both sides and with inscription in signal WHITE color on front side as required. The inscriptions shall be in English and local language.

(2) Marking plates/Sticker are to be made and should be attached to LAs, earthing pits, along the cable routing up to LT panel room for easier identification. The detailed size and matter to be inscribed will be given after installation.

(3) The name board of approx., 3 m x 1 m will contain brief description of the Power plant. The board will be made of steel plate/Acrylic sheet. Letters on the board have to be with proper illumination arrangement. The design and size of the sign board shall have to be befitting with Control Room and should be submitted for prior approval of BHEL before ordering.

NOTE: The drawing WITH DIMENSIONS of the name boards & marking plates are to be submitted for prior approval to BHEL before procuring.

2.4 Erection & Commissioning of 30 kWp Floating system:

A) The shifting of all the materials to the assembly and erection point/control room from storage location (BHEL R&D, Vikas Nagar) for erection will be in the scope of the vendor and he has to make necessary arrangements for the same. The storage, watch & ward responsibility of all the materials including BHEL supplies at site will be in vendor’s scope until the commissioning of the plant. Any deficit occurring due to misplacement/mishandling will be borne by the vendor at no extra cost.

B) 96 Nos of 290 Wp SPV modules have to be assembled using structure materials as per drawing (will be provided in the due course). The PV modules are to be carefully mounted on this structure with the necessary clamps and fixtures. Earthing strip has to be run neatly through the PVC pipes and bends, should be connected to the earthing pits installed.

Any activities requiring holes drilling, cutting for completing the installation and mounting of PV modules on the structures and other works is in the vendor’s scope. Vendor has to make necessary arrangement for the drilling machine/gas cutting machine, if required.

C) Before mounting the PV modules on to the structures, each PV module has to be tested during peak sunshine period. Short circuit current (Isc) & Open circuit voltage (Voc) of the module has to be checked & recorded using multimeter and Clamp meter. Ensure the modules are electrically OK and then only mount them on structures.

D) 16 numbers of PV modules of each 290 Wp are to be connected in series using quick connects with cables supplied along with PV modules. +ve & -ve terminals of each string has to be routed to Array Junction Box. Vendor shall supply the MC4 type male / female connectors and the suitable crimping tool required for making interconnection. On either side and throughout the routing of the cables through pipes marking has to be done. The number of PV modules connected in series

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indicated above is tentative; this may vary depending on the make of PCU. This will be decided before commencement of work.

Special crimping tools required for crimping to be arranged by Vendor as per this specification, have to be used to crimp 4 sq mm cables to quick connects for connecting output of series strings to inverter inputs. These crimping tools has to be kept at site permanently even after completion of project for O&M purpose.

E) Each string Open circuit Voltage & Short Circuit Current to be checked and recorded at site.

F) The terminations at PCU, ACDB and customer LT panel will be in the scope of the vendor. The necessary Copper lugs of appropriate dimensions and hardware required for the termination have to be arranged by the vendor. Vendor has to ensure that terminations have been made without any over-tension and stress on the cable connected.

Note: Vendor have to carefully measure the exact length of 4 mm² required for the connections between strings and PCU before cutting the cable from cable drum. Any short fall in length of cable arising out of vendor works should be borne by the vendor.

For 4 mm² cable termination, appropriate marking with Ferrules and corresponding string numbers have to be done by the vendor. The necessary Ferrules have to be arranged by the vendor.

The DC cables from the array have to be terminated on the PCU with proper labeling.

G) The 3 phase output from the PCU is connected to ACDB by means of 3.5 C 16 sq.mm cable. All these cables have to be run through appropriate PVC pipes routed to ensure aesthetic look. Appropriate cable lugs and crimping tools for terminations have to be arranged by vendor.

H) The output cable from ACDB has to be routed to LT panel feeder terminals in the power house on the first platform by means of 1 run of 3.5C 16 mm² copper cables and routed through PVC conduits. Termination up to LT panel is under vendor's scope. Appropriate sized lugs should be supplied by the vendor and termination by proper crimping will be in the scope of vendor. Necessary crimping tools/tackles to be arranged by vendor at site.

I) Installation of the Lightning arrestor and 3 nos., of earthing pits will be in the scope of vendor. The necessary arrangements of digging and running the earthing strip from module array in water to the bank will be in the scope of vendor. Vendor has to neatly route the GI strip through PVC conduits, clamp the Pipe at regular intervals and should ensure aesthetic look of the platform. GI strip is to be painted with two coats of Aluminium paint of Asian 3 Mango type before installation.

J) Vendor shall associate with the other vendor's (Floats and mooring, mounting structures, and control room) technical team during erection & pre-commissioning checks and in commissioning of the power plant.

K) The vendor has to receive BHEL/BHEL vendor's material at the site. The vendor has to make necessary arrangement to store the material and arrange for watch & ward very near to the site. The safe custody of all the materials until the completion of project and handing over will be in the scope of vendor.

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L) The left out quantity of material procured for the execution of this project shall be handed over to BHEL after completing the commissioning.

M) The contractor shall take all the necessary measures to prevent accidents. It is the responsibility of the contractor not to allow any worker to work in an unsafe condition, nor with unsafe equipment.

N) The contractor shall provide adequate and suitable Personal Protective Equipments (PPEs), wherever they are required, to all concerned personnel. The quality of this equipment's shall conform to National (BIS) or International Standards.

2.5 Warranty:

- Vendor has to provide the on-site warranty (labour, parts) for a period of minimum 2 years from the date of successful commissioning (for vendor's scope of supply & work).
- Vendor shall attend the fault within 48 hours from the reporting time. Vendor shall furnish the fault report by giving details of fault, action taken and steps to prevent occurrence.
- Vendor has to supply necessary spares including consumables for continuous operation of plant for the warranty period for the successful commissioning.

2.6 Test Certificates:

- Warranty certificates shall be submitted for all bought-out items along with the shipment.

2.7 List of enclosures:

1. SLD of 30 kWp SPV plant. DRG No:3-535-48-00001
2. Floating pontoon drawing with structures drawing and PV array layout drawing (will be provided at the time of commencement of erection of the plant).
3. SPV Module Spec. No:CD-4-4001-106, R-01
4. Schematic of Lightning Arrestor. DRG No:3-679-05-00037
5. Reference Array junction box drawing: DYS 1353548/03 (i.e. 10 IN 1 Out)- for reference only
6. ACDB drawing No: DRG No: SAG-535-48-004
7. Compilation sheet: No: SAG-535-48-003
8. Site location drawing: SAG-535-48-005

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**TECHNICAL SPECIFICATIONS FOR SUPPLY, ERECTION & COMMISSIONING OF
GRID CONNECTED 30KW POWER CONDITIONING UNIT AT HUSSAIN SAGAR
HYDERABAD.**

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1. INTRODUCTION:

BHEL Corp. R&D is setting up a 30kWp Grid Connected SPV Power Plant at HUSSAIN SAGAR HYDERABAD near Sanjeevaiah Park. This technical specification provides details of supply of Power Conditioning Unit (PCU), installation, system integration, pre-commissioning checks, commissioning of the PCU along with data logger software, Comprehensive Annual Maintenance Contract of the PCU for a period of two years from the date of commissioning. The scope also includes providing PCU along with cabinet temperature and PV module surface temperature sensor with adequate length cables.

2.0 ELIGIBILITY CRITERIA:

(a). Supply of Grid connected 30 KW central PCU.

(b). Vendor should have successfully supplied, installed and commissioned within the past one year min. 30 kW and above rated Grid Connect PCUs for SPV Power Plant. Copy of Certificate of completion issued by the end customer shall be furnished.

(c). Vendor should confirm that he has an established service center along with required spares and manpower within India for maintenance of grid connected power conditioning units of rating 30 kVA and above. Details of such service centers shall be furnished.

(d). If vendor has business tie-up with a foreign manufacturer, a copy of the business agreement shall be attached with the offer. Such business agreement shall be;

(i). in force on date,

(ii). Authorization from principal manufacturer to the vendor that;

(1). He is authorized to quote for Indian Territory

(2). He is authorized to erect, commission and service.

(3). Confirmation from the principal vendor, that vendor representatives have been trained in for Erection & commissioning and repairs.

All the above conditions must be met in order to qualify.

(3). SCOPE OF SUPPLY, I & C, AND WARRANTY FOR 2 YEARS

This specification covers the design, manufacture, supply, installation, testing and commissioning of 30kVA PCU at Sanjeevaiah Park Hyderabad. The vendor has to attend to any complaint/break down within 48 hours from the date of complaint. Any component replaced and labour involved during the 2 years on-site warranty period shall be free of cost. Warranty period shall start from date of successful commissioning.

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3.1 SYSTEM FEATURES

The 30 KVA capacity solar PV plant shall consist of 1 no. 30kWp solar array. The solar array output is connected to DC input of 30 kVA Power Conditioning Unit (PCU). The corresponding MPP range for nominal power shall be minimum 350 to 800 Volts or higher.

3.2 DRAWINGS, SCHEMES AND MAKES OF EQUIPMENTS

Vendor shall furnish the following details along with the offer:

1. GA drawings of PCU with details of dimensions and cubicle paint finish
2. Schematics of inverter
3. Details of data logger with details of schemes and GA drawings with screenshot

3.3 Operational Strategy:

The solar PV PCU shall convert DC power into three phase AC power that is directly fed to the grid (unidirectional inverter). The output of the PCU shall be synchronized at the LT level. The power generated shall be exported to grid. All three phases shall be supervised with respect to rise/fall in programmable threshold value of frequency. The PCU shall automatically turn on and off automatically as the available solar irradiation varies over the day. The PCU shall have all the necessary synchronization equipment installed as necessary.

The PCU output shall always follow the grid in terms of voltage and frequency. This shall be achieved by sensing the grid voltage and phase and feeding this information to the feedback loop of the inverter. This control variable shall control the output voltage and frequency of the inverter, so that the PCU is always synchronized with the grid.

The voltage range shall be -15% to +10%. Capability to do voltage correction shall be a built-in feature. PCU output shall be capable to remain synchronized to grid supply within the variation of -15% to +10% of the grid supply w.r.t. nominal voltage of PCU output.

4.0 TECHNICAL SPECIFICATION OF 30KVA GRID CONNECTED PCU

Quantity: 1 Set.

Sl.No.	ITEM DESCRIPTION	Qty	SUPPLY	E&C	MAKE/ REMARKS
1	30 kVA grid connected PCU	1No.	✓	✓	As per this spec
2	Ambient and PV module temperature sensors with adequate length cables.	1 set	✓	✓	As per this spec

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3	Installation and commissioning of 30KVA PCU and data logger software	1 set	✓	✓	Personal computer for datalogging will be made available by BHEL at site. Vendor has to arrange necessary softwares for datalogging.
4	Spares for grid connected PCU*	1 set	✓		Shall be sufficient for 2 years warranty

***Note: Vendor to supply critical spares required for 2 years period, so that to attend the faults/repair during break down within 48 hours.**

3.0 30 KVA PCU shall consist of:

DC bus bar for termination of min 3 pair PV array cables (Positive and negative). This shall have appropriately rated fuse for each sub array cable at the incomer. Cable entry should be from rear side. If it is from bottom vendor has to arrange necessary arrangements for cable termination without any cable trenches. Gland plate with SS glands of single compression for the incomer and outgoing cables has to be supplied by vendor. 30kWp array shall be consisting of 4 runs of single core 95 sq. mm multi stranded copper cable (2 +ve and 2 -ve). The DC input of PCU shall be a through suitably rated DC isolator/DC MCCB. If MCCB is employed, the breaking capacity of the DC MCCB shall be 50 kA.

4.1.2: PCU FEATURES:

PCU shall confirm to IEC 60068-2 standards for environmental testing.

All sensors and hardware required for measurement and monitoring of solar radiation and PV module Tedlar temperature and ambient temperature are to be provided by the vendor.

The offered PCU shall essentially have the following requirements:

- a. PCU shall be complaint with IEEE Standard 929-200 or equivalent.
- b. Intelligent software based MPPT Controller as per IEC 62093 to maximize the solar energy generation from the array and it must have provision for constant voltage operation.
- c. MPPT should be microprocessor based to minimize losses and the details of working mechanism shall be mentioned by the vendor in his offer.
- d. DSP based, digitally modulated high efficiency grid connected inverter.
- e. Protection and monitoring circuit
- f. The PCU shall have internal protection against any sustained fault in the feeder line and against lightning in the feeder line.

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- g. The efficiency of PCU shall be equal to or more than 94% at 75% percent load as per IEC 61683. The vendor shall specify the conversion efficiency at different load say 25%, 50%, 75% and 100% in his offer.
- h. Data logging system via RS 232 & RS 485port
- i. Field sensors – PV module back surface temperature sensor, ambient temperature sensor and the associated electronic hardware for data logging shall be provided; the output of each sensor shall be SCADA compatible by conditioned signal.
- j. The PCU shall be provision for galvanic isolation. Each solid state electronic device shall have to be protected to ensure long life of the PCU as well as smooth functioning of the inverter.
- k. Nuts & bolts and the PCU enclosure shall have to be adequately protected taking in to consideration the atmosphere and weather prevailing in the area.
- l. Dimension and weight of the PCU shall be indicated by the vendor in the offer
- m. Power consumption during the operation and stand by condition should be mentioned by vendor in the offer.
- n. PCU should have local LCD and keypad for system control, monitoring instantaneous system data, event logs, data logs and changing set points. Control and read out should be provided on an indicating panel integral to the inverter.

Technical parameters:

Sl.No.	Description of technical parameter	Details
1.	Continuous output power rating	30 KW
2.	Nominal output voltage range	415 V, 3 Phase, 4 wire
3.	Input voltage Range	300-800 V DC range
4.	MPPT Range for Nominal Power.	350 V to 800 V DC or higher
5.	Ambient temperature	0 to 50°C
6.	Humidity	95 % non- condensing
7.	Enclosure	IP 20 (Indoor rated) or higher class.
8.	Nominal voltage & frequency of grid	415 V, 3 phase, 50 Hz
9.	Grid Frequency tolerance	+/- 3 Hz
10.	Grid Voltage tolerance	- 15% and + 10%
11.	Conversion efficiency of the PCU	shall be >94% at 75 % of full load as per IEC 61683
12.	Voltage THD	< 3 %
13.	No-load loss	< 1 % of rated power
14.	Maximum Sleep mode loss	< 0.05 % of rated power
15.	Self-commutated IGBT-based PCU with digital Pulse width modulation.	To be provided
16.	Sinusoidal current modulation with sharp dynamic response.	To be provided
17.	Integrated Data	Logging shall be provided

 Cor. R&D	PURCHASE SPECIFICATION	PS-535-48-02
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18.	Networking to be incorporated in the PCU	Dedicated Profibus / Ethernet
19.	Protection to the Unit shall be provided against the following	DC Over current, DC Over Voltage AC Over Current AC Over Voltage AC Short circuit (L-L, L-G) DC Shoot through fault Heat sink over temp, Sync loss, Anti islanding protection, Over temp, EMI & RFI, Surges, Cooling Fan failure (if provided), Ground fault detection of PV array,
20.	Front panel display	PV voltage, PV current, AC Power output, AC voltage (all three phases), AC current (all three phases), AC output frequency, Power factor, Solar radiation, PV module surface temperature, Ambient temp, PCU import & export KWH (Through separate multi-function meter),
21.	Circuit breakers	Grid input Solar input (Isolator can also be used)
22.	Optional VAR control	To be provided with set point pre-selection
23.	Protection against ground faults	Ground Fault Detector
24.	Communication Bus	Via isolated RS 232 / RS 485 / MODBUS/ WiFi/ Profibus /LAN for integration suitable for Datalogger
25.	Data logging	
	Computer access	Shall have local access port as well as a dial up facility with GSM/PSTN modem based and broad band connectivity for remote communications

 Cor. R&D	PURCHASE SPECIFICATION	PS-535-48-02
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	System features	<ul style="list-style-type: none"> • Adjustable logging with preset interval • Large storage capacity upto 3 to 4 years • Time and date stamped logs • Real time data depiction of <ul style="list-style-type: none"> * Solar radiation (W/m²) * PV module back surface temp * Ambient temp * PCU output power * Line and phase currents * Cumulative energy exported
27	Fuse	Provision of compatible fuses on DC side & AC side.

4.1.3 SAFETY FEATURES

(a). When the grid fails, it leads to “Islanding” of the local grid and the load from the main grid. As a safety measure, the PCU shall be disconnected immediately and power not exported to the grid i.e., protection against Islanding shall be provided.

(b). The PCU shall have unique features like sleep mode, standby mode, invoke mode and export mode so that any disturbances on the grid such as overload short-circuit, over-voltage etc., disables the firing circuit of the PCU and causes it to quietly withdraw from the grid.

4.1.4 PROTECTION FEATURES

Over-voltage/surge protection shall be provided by using surge protection devices (SPDs) at the input and output of the inverter. The make of the SPDs shall be Phoenix/Obo Bettermann/equivalent.

Vendor shall furnish the details of cooling mechanism provided for PCU for the heat extraction that is generated during the operation temperature rise details with in the cabinet when the PCU is operating at 80% of full load shall be mentioned in the offer at an ambient of 50°C.

4.1.5 Instruments for Meteorological Measurements:

Vendor shall provide following measuring instruments with all necessary software and hardware required to make it compatible with Data logger. Conditioned signal output for following sensors shall be provided for using them in Datalogger. Clamps and cable for installation of following sensors are part of supply.

Vendor shall provide Instrument manual in hard and soft form.

(a). Module Temperature sensor:

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Vendor shall also provide one RTD type temperature sensor measuring instrument at suitable place in PV array. Instrument shall have a range of -5° C to 80° C. Necessary clamps and cabling are part of supply.

(b). AmbientTemperature sensor:

Vendor shall also provide one RTD type ambient temperature measuring instrument at suitable place in PV array. Instrument shall have a range of -5° C to 80° C. Necessary clamps and cabling are part of supply.

5.0 TESTING AND INSPECTION:

Vendor shall provide inspection and test certificate of the PCU along with shipment. Relevant IS or other equivalent standards shall be employed as the guideline for testing.

6.0 BREAKDOWN MAINTENANCE DURING WARRANTY PERIOD:

Vendor shall attend the fault within 48 hours from the reporting time. Vendor shall furnish the fault report by giving details of fault, action taken and steps to prevent occurrence.

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BOS compilation (SAG-535-48-003)

SL No	Desc	Spec	Qty	Make	YES	NO	Remarks
1.0	Power Control Unit(PCU)		1	Refusol, SMA, Sungrow, Delta or equivalent			
	Documents						
1.1	GA drawings of PCU with details of dimensions and cubicle paint finish						
1.2	Schematics of inverter						
1.3	Details of data logger with details of schemes and GA drawings with screenshot						
	Operational Strategy						
1.4	Automatically turn on and off as the available solar irradiation varies over the day						
1.5	DC bus bar for termination of min 3 pair PV array cables						
1.6	Rated fuse for each sub array cable at the inverter						
1.7	DC input of PCU shall be a through suitably rated DC isolator/DC MCCB(Breaking Capacity 50 KA)						
	FEATURES:						
1.8	PCU shall IEC 60068-2 standards for environmental testing sensors and hardware required for measurement and monitoring of solar radiation and PV module Tedlar temperature and ambient temperature						
1.10	PCU shall be compliant with IEEE Standard 929-200 or equivalent						
1.11	Intelligent software based MPPT Controller						
1.12	MPPT should be microprocessor based to minimize losses and the details of working mechanism shall be mentioned by the vendor in his offer.						
1.13	internal protection against any sustained fault in the feeder line and against lightning in the feeder line						
1.14	Efficiency of PCU shall be equal to or more than 94% at 75% percent load as per IEC 61683.						
1.15	Conversion efficiency at different load say 25%, 50%, 75% and 100%.						
1.16	Data logging system via RS 232 & RS 485port						
	Field sensors						
1.17	PV module back surface temperature sensor						
1.18	Ambient temperature sensor						
1.19	Associated electronic hardware for data logging						

SL No	Desc	Spec	Qty	Make	YES	NO	Remarks
1.44	Protection to the Unit shall be provided against the following	DC Over current, AC Over Current DC Over Voltage AC Over Voltage AC Short circuit (L-L, L-G), DC Shoot through fault Heat sink over temp, Sync loss, Anti islanding protection, Over temp, EMI & RFI, Surges, Cooling Fan failure (if provided), Ground fault detection of PV array,					
1.45	Front panel display	PV voltage, PV current, AC Power output, AC voltage (all three phases), AC current (all three phases), AC output frequency, Power factor, Solar radiation, PV module surface temperature, Ambient temp, PCU import & export KWH (Through separate multi-function meter),					
1.46	Circuit breakers	Grid input Solar input (Isolator can also be used)					
1.47	Optional VAR control	To be provided with set point pre-selection					
1.48	Protection against ground faults	Ground Fault Detector					
1.49	Communication Bus	Via isolated RS 232 / RS 485 / MODBUS/ WiFi/ Profibus /LAN for integration suitable for Datalogger					

SL No	Desc	Spec	Qty	Make	YES	NO	Remarks
	Data logging						
1.50	Computer access	Shall have local access port as well as a dial up facility with GSM/PSTN modem based and broad band connectivity for remote communications <ul style="list-style-type: none"> • Adjustable logging with preset interval • Large storage capacity upto 3 to 4 years • Time and date stamped logs • Real time data depiction of * Solar radiation (W/m2) * PV module back surface temp * Ambient temp * PCU output power * Line and phase currents * Cumulative energy exported 					
1.51	System features						
1.52	Fuse	Provision of compatible fuses on both DC and Ac side					
	SAFETY FEATURES						
1.53	Protection against Islanding shall be provided						
1.54	sleep mode						
1.55	standby mode						
1.56	invoke mode						
1.57	export mode						
	PROTECTION FEATURES						
1.58	Over-voltage/surge protection by Using surge protection devices (SPDs) at the input and output of the inverter.			SPD :Phoenix/Obo Bettermann/equivalent.			
1.59	Details of cooling mechanism provided						
1.60	PCU is operating at 80% of full load shall be mentioned an ambient of 50°C						
	Instruments for Meteorological Measurements:						
1.62	Necessary cables						
1.63	Calibration certificate						
1.64	Module Temperature sensor RTD type temperature sensor measuring instrument	Range of -5 C to 80 C	1				
1.65	Necessary clamps and cabling						
1.66	Ambient temperature sensor RTD type ambient temperature	Range of -5 C to 80 C	1				
1.67	Necessary clamps and cabling						

SL No	Desc	Spec	Qty	Make	YES	NO	Remarks
	TESTING AND INSPECTION						
1.68	shall provide inspection and test certificate(as per Relevant IS or other equivalent standards) of the PCU along with shipment						
2.0	Array Junction Box	8 IN (8, + ive & 8, - ive.),2 Out (2, + ive & 2, - ive,)	1 No	CAPE Electric or Equivalent			
2.1	Enclosure	IP66	1 No				
2.2	PV Fuse	12A 1000V DC	16 No				
2.3	Diode	40A 1200V DC	8 No				
3.0	PVC Double Insulated Copper DC Cable	IS-1554 Part-I & other relevant standards					
3.1	6 sq.mm, 1000 Volts Rated (RED & Black)-		1000 Mts (R+B)	Top cables, KEI, Polycab or equivalent.			
3.2	95 sq.mm, 1000 Volts Rated (RED & Black)		600 Mts (R+B)	Top cables, KEI, Polycab or equivalent.			
4.0	AC Cable						
4.1	16 Sq.mm Copper cable- 3.5 core – Armoured		500 Mts	Polycab, KEI or equivalent.			
5.0	AC Power Distribution Board						
5.1	MCB 63 A, 4 Pole	20 KA	1 No	L&T, Merlin Gerin /Schneider/ ABB /equivalent make			
5.2	RYB indicating LEDs at the input side with selector switch	10 MM Size	1 No	Reputed make.			
5.3	Surge voltage protection & Residual current discharger		1 No	Phoenix /ABB/OBO Bettermann /equivalent make			
5.4	3-ph Digital Ammeter	Appropriate ranges with necessary CT and PTs of reputed make. All the metering equipment and CT should be of class 0.5.	1 No	conzerv, Schneider, L&T or equivalent make			

SL No	Desc	Spec	Qty	Make	YES	NO	Remarks
5.5	Digital Voltmeter		1 No				
5.6	Digital Energy Meter		1 No				
5.7	Surge Protection Device/Transient Voltage Surge Suppressor of appropriate rating on all the three phases of OBO			Betterman /Phoenix/ABB or equivalent reputed make			
5.8	All fasteners shall be stainless steel SS-304 with suitable spring washers						
6.0	DC Cable Snap on connectors with one crimping tool						
6.1	MC4 Compatible, IP67. Bizlink or equivalent		50 Pair				
7.0	Array Junction Box						
7.1	12 IN and 1 OUT			Khodaya, Power Plus, Deprocon, L&T or equivalent			
8.0	Conduit Pipe with necessary L,T bends						
8.1	Heavy Duty PVC Conduit pipe- 1" pipe & 2" Pipe		200 Mts Each	Finolex, supreme or equivalent reputed make			
9.0	Lightning Arrestor						
9.1	Copper globe type		1 No				
10.0	Earthing kit with necessary Back Fill Compound	As per IS:3043-1987					
10.1	The Zinc electrode used for this will be of 3 m length & 80 mm diameter		3 No	Ashlok, Pragathi or equivalent			
11.0	GI Strip						
11.1	25X3 MM		300 Mts				
12.0	Fire Extinguisher						
12.1	Cease Fire Extinguisher (ABC (Mono ammonium Phosphate 90 Grade)- 5 kg Application for all Class of Fire		1 No				

SL No	Desc	Spec	Qty	Make	YES	NO	Remarks
13.0	Tools, Shackles						
13.1	Digital Multimeter		1 No				
13.2	Digital clamp meter (1000 V, 500 A capable of both DC and AC measurement)		1 No	Meco/Waco or equivalent			
13.3	Cutting pliers		1 No				
13.4	Screw drivers set		1 Set				
13.5	Nut runners required for Structure fitting		1 Set				
13.6	Allen key set		1 No				
13.7	Necessary tools & shackles are to be provided free of cost						
14.0	Cable trays & fixing accessories		40 Mts				
15.0	Miscellaneous items						
15.1	Cable ties						
15.2	Hardwires						
15.3	Lugs						
15.4	Ferrules						
15.5	Paint						
15.6	Consumables for termination						
15.7	Danger boards	200mmx150 mm	As required				quantity to meet site condition
15.8	Marking plates	Should be attached to LAs, earthing pits, along the cable routing up to LT panel room for easier identification					
15.9	Plant name board	3 m x 1 m , Letters on the board have to be with proper illumination arrangement					
16.0	Breaker	As per SLD of 30KWp	1 No				
17.0	Communication Interface and SCADA						
17.1	Real time data logging						
17.2	Event logging						
17.3	Supervisory control						
17.4	Operational modes						
17.5	Set point editing						
17.6	Optical port with RS 485/ ETHERNET compatible						
17.7	Data locally through CMRI & remote through Optical fiber link to the main computer						
17.8	Shall provide meter reading protocols						
17.9	The communication interface shall be an integral part of inverter						

SL No	Desc	Spec	Qty	Make	YES	NO	Remarks
18.0	Following parameters shall also be measured and displayed continuously						
18.1	Solar system (module) temperature						
18.2	Ambient temperature.						
18.3	Solar irradiation/isolation						
18.4	DC current and Voltages						
18.5	DC injection into the grid (one time measurement at the time of installation).						
18.6	Efficiency of the inverter						
18.7	Solar system efficiency						
18.8	Display of I-V curve of the solar system						
18.9	kW reading DC/AC i.e. input output (instantaneous power)						
19.0	Installation, testing and commissioning of SPV plant	Erection, Commissioning					
19.1	Shall follow all the necessary measures to prevent accidents						
19.2	Not to allow any worker to work in an unsafe condition, nor with unsafe equipment						
19.3	Shall provide adequate and suitable Personal Protective Equipments (PPEs),						
20.0	Warranty for two years for the scope of supply	on-site warrant with parts and labour	2 Years				



**PRODUCT STANDARD
ELECTRONICS DIVISION**

CD-4-4001- 106

REV. 01

A4-10

PAGE 01 OF 01

TECHNICAL SPECIFICATION FOR PV MODULE L24270 (24 V, 290 WATTS)

- 1. PV MODULE TYPE NO. : L24270
- 2. CONFIGURATION :SINGLE GLASS LAMINATED TYPE WITH WITH 72 NOS. OF 156-mm MONO CRYSTALLINE SILICON SOLAR CELLS (12*6) IN SERIES CONFIGURATION.
- 3. OVERALL SIZE : 1976 (±3) * 996 (±2) * 50 (±1) mm
- 4. WEIGHT : 25 Kg. (Typ.)
- 5. PV MODULE FRAME MATERIAL : ANODISED ALUMINIUM
- 6. JUNCTION BOX : IP65 GRADE JUNCTION BOX WITH CABLES AND CONNECTORS
- 7. RFID Tag : As per JNNSM Guidelines
- 8. TYPICAL ELECTRICAL CHARACTERISTICS :
 - 8.1 OPEN CIRCUIT VOLTAGE (Voc) : 42.0 V
 - 8.2 SHORT CIRCUIT CURRENT (Isc) : 8.5 A
 - 8.3 VOLTAGE AT PEAK POWER POINT (Vmp) : 35 V
 - 8.4 CURRENT AT PEAK POWER POINT (Imp) : 8.29 A
 - 8.5 PEAK POWER OUTPUT (Pmax.) : 290 W ± 5 %
 - 8.6 MODULE EFFICIENCY : 14.7 %
 - 8.7 FILL FACTOR : 0.75

NOTE :

- 1. Electrical specifications mentioned above are at Standard Test Conditions of 100 mW/sq. cm solar insolation (AM 1.5) and at 25 deg C temperature.
- 2. Measurement repeatability of peak power output: ± 3 %

REFER MODULE DRAWING NO. : 3-679-02-00352

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REVISION : (01)
Electrical characteristics

APPROVED BY :

SR

PREPARED

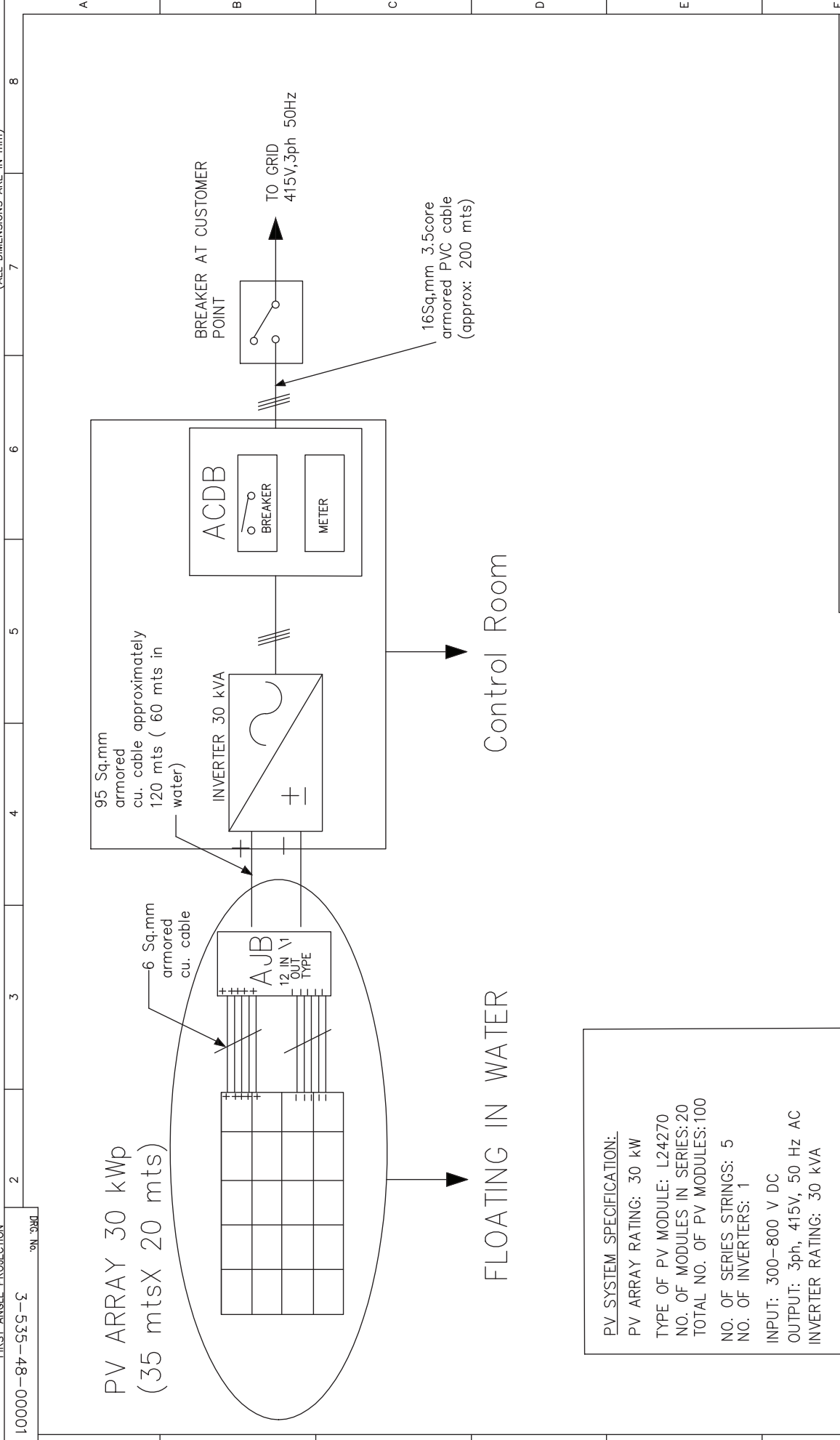
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ISSUED

Engg.

DATE

24.11.2012



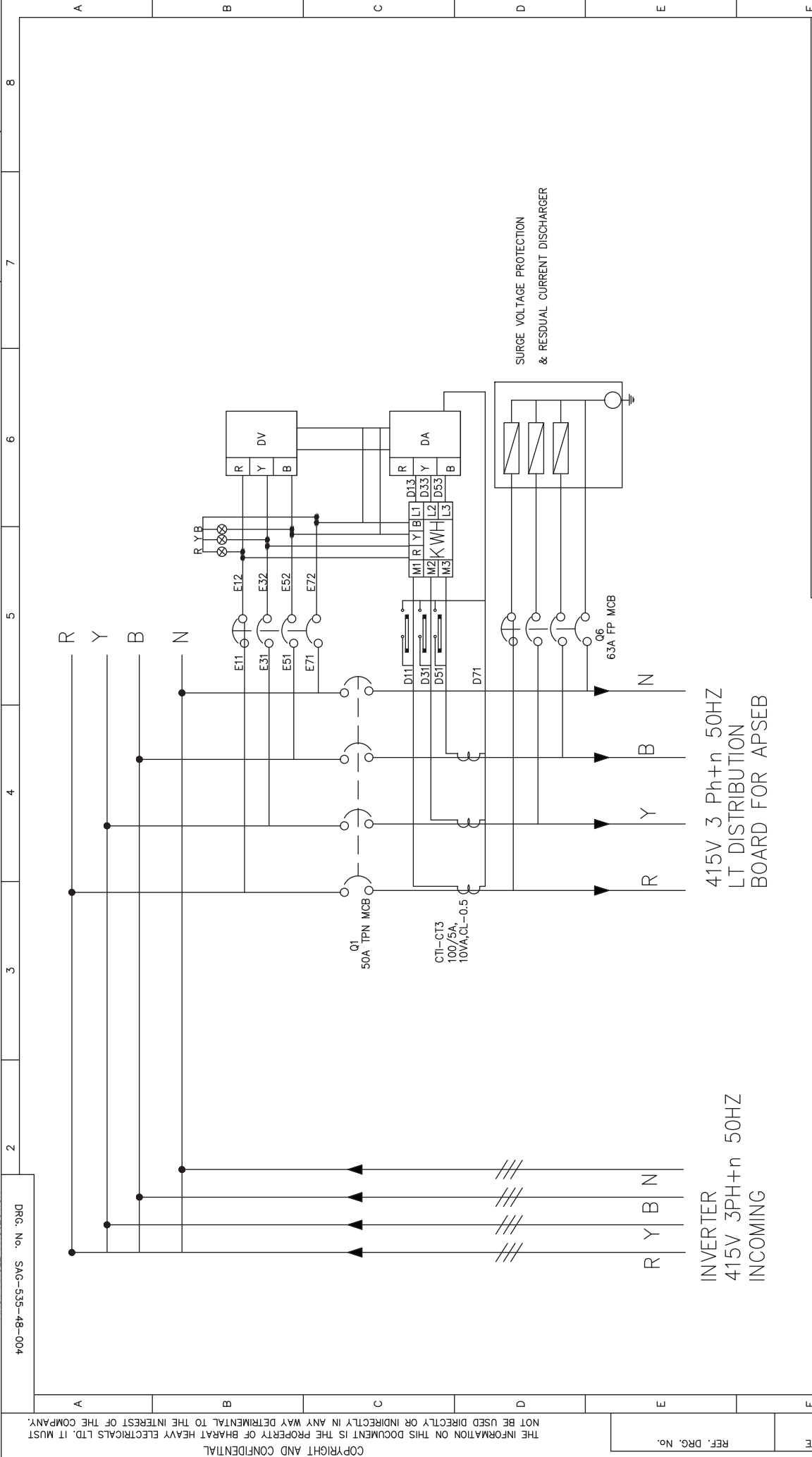
PV SYSTEM SPECIFICATION:
 PV ARRAY RATING: 30 kW
 TYPE OF PV MODULE: L24270
 NO. OF MODULES IN SERIES: 20
 TOTAL NO. OF PV MODULES: 100
 NO. OF SERIES STRINGS: 5
 NO. OF INVERTERS: 1
 INPUT: 300-800 V DC
 OUTPUT: 3ph, 415V, 50 Hz AC
 INVERTER RATING: 30 kVA

PRODUCT : R & D PROJECT, Hyderabad
 CUSTOMER:

BHARAT HEAVY ELECTRICALS LIMITED.
 ELECTRONICS DIVISION, BANGALORE

TITLE: SCHEMATIC OF 30 kWp FLOATING SPV POWER PLANT	No. OF SHEETS	01
	SHEET No.	01
DRG. No.	3-535-48-00001	
WBS. No.	00	

REV.	DATE	ALTERED	DATE	ALTERED	DATE	NAME	SIGN	DATE
		CHECKED		CHECKED				
		APPROVED		APPROVED				
DRAWN			DEPT. CODE SCPV 439			BHU		
CHECKED			APPROVED			4		
APPROVED			APPROVED			3		



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REF. DRG. No.

SIGN. & DATE

INVENTORY No.

REV.	DATE	ALTERED CHECKED APPROVED	DATE	ALTERED CHECKED APPROVED	NAME	SIGN	DATE



 DEPT: _____ CODE _____

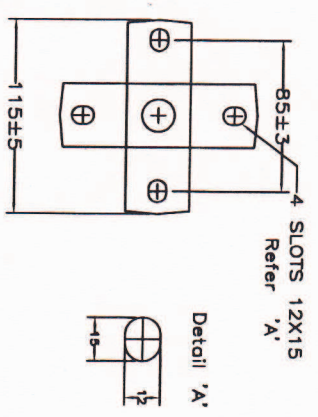
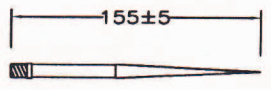
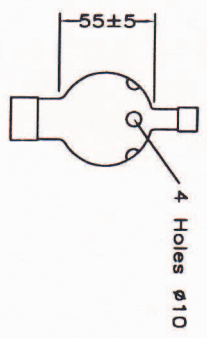
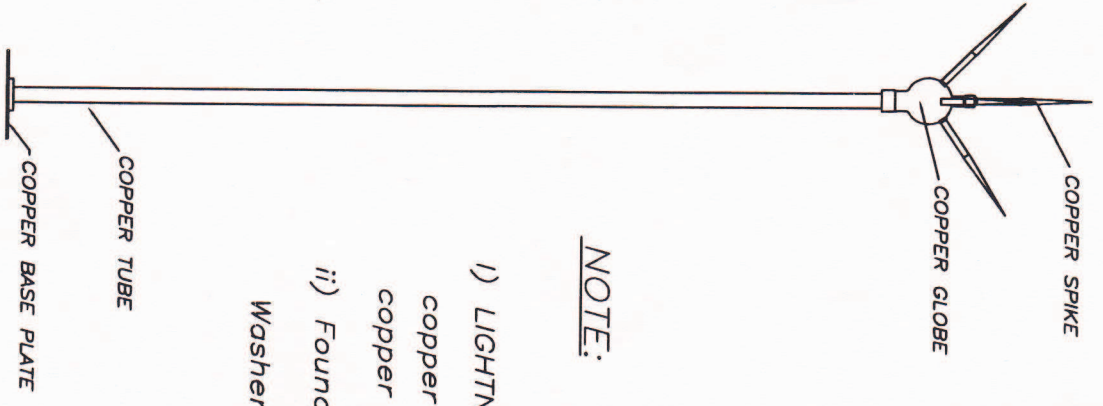
PRODUCT : R & D PROJECT, Hyderabad
CUSTOMER: IPE, HYDERABAD

BHARAT HEAVY ELECTRICALS LIMITED.
ELECTRONICS DIVISION, BANGALORE

TITLE:
SCHEMATIC OF ACDB FOR 30 kWp SPV POWER PLANT

WBS. No.	DRG. No. SAG-535-48-004	REV	00
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4C000-50-679-C



NOTE:

- i) LIGHTNING ARRESTOR: 25±3mm Dia 1.2 mtrs (Min) long Copper Tube with copper globe on the top. Screw on type Copper spikes- 5nos. mounted on the copper globe.
- ii) Foundation bolt AM10 x 125 AS PER IS:5624 with M10 hexnut, M10 Spring Washer & M10 Plain Washer - 4 sets - Finish; Zincplated to 12 microns.

INVENTORY NO.	SIGN & DATE	REF. DRG. NO.
REV. DATE	ALTERED CHECKED	REV. DATE
01		
DRAWN	NAME	SIGN.
CHECKED	ASN	DATE
APPROVED	BNR	9.10.01
	CVSN	9.10.01
All Dimensions in mm.		
SCALE :-	NTS	
DEPT. SC&PV	CODE 438	

PROJECT : SPV POWER PLANT.

BHARATH HEAVY ELECTRICALS LIMITED
 ELECTRONIC DIVISION - BANGALORE.

TITLE
 LIGHTNING ARRESTOR

MO.NO. DRG. NO. 3-679-05-00037

SHEET NO. 1
 NO. OF SHEETS 1

Location plan for proposed project (SAG-535-48-005)

