



**PURCHASE SPECIFICATION FOR  
SUPPLY AND COMMISSIONING SUPPORT OF  
3-PHASE GRID-CONNECTED POWER CONDITIONING UNITS  
OF 1500V, 2500 KW RATING, PCU TYPE: CONTAINERISED OR  
OUTDOOR**

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**PURCHASE SPECIFICATION FOR  
SUPPLY AND COMMISSIONING SUPPORT OF  
3-PHASE GRID-CONNECTED POWER CONDITIONING UNITS  
OF 1500V, 2500 KW CONTAINER SOLUTION / OUTDOOR TYPE**

01	Changes are highlighted	31-01-2020	VIPINDAS CP	PRACHI RAO V
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**INTRODUCTION:**

This technical specification provides details of supply of Container / outdoor 3-phase Grid-connected Power Conditioning Units (PCU). The scope also includes commissioning support for the supplied units at the project site for synchronizing the generated AC power with LV side of a transformer that connects to 33kV grid on HV side.

**1.0 Scope of supply**

SL No	Item Description	Qty
1.1	Supply of 1500V, 2500kW Container based / outdoor type inverter (IP54 or better protection) with (a) Unit power factor at ambient temperature of 50 Deg Celsius (b) 0.95 power factor at ambient temperature of 45 Deg Celsius.	19 sets
1.2	<p><b>Supply of Spares</b> for power conditioning units. List of items with quantity is as follows: O&amp;M Spares:</p> <ol style="list-style-type: none"> <li>1) Control Cards for PCU ** Quantity = 1 set of each type</li> <li>2) Fuses Quantity = 1 set of each type and rating</li> <li>3) Surge Protection Device Quantity = 1 set of each type and rating</li> <li>4) MCCBs, MCBs Quantity = 1 set of each type and rating</li> <li>5) AC Contactor, DC Contactor, Air Circuit Breaker – 1 no each</li> <li>6) Dust filters -100 % *</li> </ol> <p>Mandatory spares:</p> <ol style="list-style-type: none"> <li>1) Control Cards for PCU ** Quantity = 1 set of each type</li> </ol> <p><b>Notes:</b></p> <ol style="list-style-type: none"> <li>(a) <b>1 SET = Total Quantity of items used in 1 PCU of rating 2500kW .</b></li> <li>(b) The above spare quantities are for contingency purposes over and above the warranty requirements.</li> <li>(c) Item-wise BOQ and break-up prices shall be provided in the offer.</li> <li>(d) **Control cards for 1 PCU refers to all the electronics cards used in the PCU including main microprocessor cards, protection cards, I/O cards, gate driver cards and any other PCB used in the PCU not specifically indicated above.</li> <li>(e) *100% - Total quantity against supply</li> </ol>	2 sets
1.3	<p><b>Commissioning support for PCUs</b> <b>BHEL scope</b> of activities at site for installation and commissioning:</p> <ol style="list-style-type: none"> <li>(1) Movement and positioning of container / outdoor PCU panels at the earmarked position on the outdoor RCC platform</li> <li>(2) Crimping the incoming (DC side) and outgoing (AC side) cables (BHEL supply) .</li> <li>(3) Connecting at the respective termination ends of the panels using the cable glands and fastening hardware (nuts, bolts, washers etc) .</li> </ol>	19 AU



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	<p><b>Vendor scope</b> of activities at site for commissioning:</p> <ol style="list-style-type: none"> <li>(1) All the electrical checks that are required to confirm that solar DC parameters (current, voltage) are available at the DC input side of PCUs.</li> <li>(2) Service engineers shall be present at site during installation of PCUs, commissioning of solar power plant, providing all necessary guidance and support to achieve successful synchronization of PCU output with grid and also to trouble-shoot / resolve the technical problems associated with PCU. Commissioning / Service Engineer shall be from OEM.</li> <li>(3) Guidance and support to BHEL team, at the time of installation and commissioning of SCADA, in respect of connection of communication cables to PCUs and technical problems related to receiving data signals at SCADA station from PCUs.</li> <li>(4) Training: Vendor shall provide training at site to BHEL and customer's engineers during commissioning. Training shall cover various technical aspects such as functional/ operational features, trouble-shooting procedures, maintenance schedules, requirements, safety, emergency precautions etc. Both the theory and practical (hands on) training shall be covered.</li> <li>(5) The Supplier shall ensure by carrying out all necessary studies that the PCU will not excite any resonant conditions in the system that may result in the islanded operation of PV plant and loss of generation.</li> <li>(6) The PCU shall include appropriate self-protective and self-diagnostic feature to protect itself and the PV array from damage in the event of PCU component failure or from parameters beyond the PCU's safe operating range due to internal or external causes.</li> </ol> <p>Note: Supply and installation of integrated SCADA system for the overall power plant is within BHEL scope.</p> <p>A single lump-sum price shall be offered per PCU. The lump-sum price shall include all the costs that will be incurred by the vendor towards commissioning including travel, boarding, lodging and any other contingency expenses.</p>	
1.4	<p><b>Comprehensive Annual Maintenance Contract for first 5 Years (During warranty period):</b> Replacement of inductors, capacitors, electronic cards etc. as per OEM recommendations.</p>	19 AU
1.4	<p><b>Comprehensive Annual Maintenance Contract for next 5 years (After warranty period):</b> Replacement of inductors, capacitors, electronic cards etc. as per OEM recommendations.</p>	19 AU

## 2.0 Warranty

Vendor shall provide comprehensive warranty for 60 months from date of commissioning or 63 months from date of supply, whichever is earlier. Vendor shall enclose, along with technical bid, the complete scope, terms and conditions of the warranty.

During the warranty period, whenever a technical problem is encountered with the PCU, BHEL will report the same to the vendor. Vendor shall ensure that the problem is attended to by their service engineer within two days from the date of reporting.



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### 3.0 Technical Documents to be submitted along with offer

1. Vendor has to enclose the deviation sheet clause wise separately in case any deviations are sought by the vendor. Absence of any deviation sheet shall be taken as compliance of BHEL specification in total without any deviation.
2. Product datasheet of the offered PCU model.
3. Overall General Arrangement of PCU including DC and AC Combiner Panels.
4. List of spares offered (with quantity) and without prices.
5. List of type tests /IEC certifications available along with test certificates. Supporting test reports shall be provided by vendor during detailed engineering.
6. [If the vendor is not an approved vendor for PCU by M/s. NTPC, Filled up sub-vendor questionnaire format \(Attachment-A\) with supporting documents shall be submitted.](#)

### 4.0 Technical specification of Power Conditioning Units

#### 4.1 Basic requirements (PCU type, Standards, Technology, Interconnections, Interfaces etc)

#	Parameter	BHEL specification
4.1.1	PCU type	<p>Grid-interactive.</p> <p>PCU shall remain connected to the grid as per Central Electricity Authority Technical (standards for connectivity to the grid) regulation 2019 with all latest amendments and its components shall be designed accordingly.</p> <p><b>Low power mode:</b></p> <p>The control system that continuously monitors the output of the solar PV plant until pre-set value is exceeded and begins to export power provided there is sufficient solar energy and the grid voltage and frequency are in the specified range.</p> <p>Further, the inverter shall be capable of operation under reduced power mode and shall not trip when the PV array output voltage is below MPPT range under high temperature conditions.</p> <p><b>Active MPPT mode (high power mode):</b></p> <p>When solar radiation increases further, PCU shall enter maximum power point tracking (MPPT) mode and adjust the voltage of the SPV array to maximize solar energy fed into the grid. When the solar radiation falls below threshold level, the PCU shall enter lower power mode.</p> <p><b>Sleep mode:</b></p> <p>Automatic 'sleep' mode shall be provided so that unnecessary losses are minimized at night. Vendor shall provide threshold DC voltage level / power level of the PCU as to when it shall enter into the sleep mode and back to low power mode and MPPT mode during detailed engineering for BHEL/customer approval.</p> <p><b>Low Voltage mode:</b></p> <p>The Inverter shall be capable of operating under reduced power mode and shall not trip when the PV array output is below MPPT range under high temperature conditions.</p> <p><b>Standby Mode:</b></p> <p>In standby mode the PCU DC &amp; AC contactor are, open, inverter is powered on condition and waiting for start command.</p>



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4.1.2	Compliance with standards	<b>Sl.</b>	<b>Standard</b>	<b>Description</b>
		1	IEC 61683	Energy efficiency requirements
		2	IEC 61000	Emission/ Immunity requirement
		3	IEEE 519	Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
		4	IEC 60068	Environmental Testing
		5	IEC 62116	Testing procedure—Islanding prevention measures for power conditioners used in grid-connected photovoltaic (PV) power generation systems
		6	IEC 62109-1 & 2	Safety of power converters for use in photovoltaic power systems
		7	EN 50530	Overall efficiency of grid connected photovoltaic inverters
		8	BDEW 2008	Technical Guidelines for Generating plant connected to Medium voltage network
		9	IEEE 1547	Standard for interconnecting distributed resources with electrical power systems.
		10	IEC 60529	Ingress protection test
11	Grid Connectivity - Relevant CEA Regulations ( <b>2019 or latest</b> ) (including LVRT/HVRT compliance) and Grid Code as amended and revised from time to time.			
<p><b>The PCU shall conform to all the above applicable IEC standard. (Where an applicable IEC standard is not available, IS/ any applicable international standard shall be referred to as best practice). All the type test certificates as per the standards mentioned above shall be submitted for approval.</b></p>				
4.1.3	Maximum Power Point Tracking (MPPT)	<p>MPPT shall be integrated in the power conditioning unit to maximize energy drawn from the solar PV array. The MPPT should be microprocessor based to minimize power losses. In order to maximized the energy collection from solar PV array, the PCU shall have inbuilt maximum power point tracker (MPPT) controller and MPPT shall be able operate the PV array at its maximum power point by adjusting output voltage of PV array system according to atmospheric condition. PCU MPPT controller shall ensure that it operate the PV array system at its global maximum power point and it shall not have rapped into PV array local maximum power point during cloudy atmospheric condition. The PCU shall operate within its MPPT operating input DC voltage range (window). The PCU MPPT operating DC voltage range shall be large enough so that it shall be able to satisfactorily operate the PV modules exposed to the maximum ambient temperature of 50°C. In case the solar PV array operating maximum power point voltage fall below (or above) the PCU MPPT operating voltage range, then the PCU controller shall automatically adjust the PCU input voltage so that PCU shall not enter into sleep mode.</p>		



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		If the PV array output power fall below the PCU minimum preset power value, then PCU shall automatically switched to sleep mode. The details of working mechanism of MPPT shall be submitted during the detailed engineering. The operating voltage range of PCU and the MPPT shall be large enough such that it satisfactorily operates for PV modules exposed to the maximum ambient temperature of 50 deg C.
4.1.4	AC-DC conversion	3-phase Inverter stack
4.1.5	Built-in support systems	PCU shall be provided with protection circuits, monitoring circuits, data logging & storage system, provisions to download data to PC/Laptop, MODBUS communication outputs for SCADA interface etc as per Cl. 4.7 of this specification. Two nos of PCU connecting cable to Laptop shall be provided by vendor. Laptop is BHEL scope.
4.1.6	External ducts or heat exchangers	Containers (if used) shall be provided with cooling ducts or heat exchangers for the extraction of heat from PCUs. Design shall suit the HVAC requirements of the container. Vendor shall submit HVAC calculations during detailed engineering
4.1.7	Environment protection	All PCB cards shall be provided with suitable coating (epoxy etc) for protection.

#### 4.2 Technical parameters

#	Technical parameter	BHEL specification
4.2.1	Output power rating	1500V, 2500KW with (a) Unit power factor at ambient temperature of 50 Deg Celsius. No derating upto 50degC (b) 0.95 power factor at ambient temperature of 45 Deg Celsius.
4.2.2	AC grid connection	3-phase
4.2.3	Output frequency	50 Hz +/- 5% The PCU shall be capable of operating in the frequency range of 47.5 Hz to 52 Hz and shall be able to deliver rated output in the frequency range of 49.5 Hz to 50.5 Hz.
4.2.4	Nominal output voltage	Value to be indicated by vendor
4.2.5	Maximum DC input voltage (Max open circuit PV voltage)	1500 V DC
4.2.6	MPPT Range of control system	Range to be indicated by vendor.
4.2.7	DC side peak power	Vendor shall confirm that PCU is suitable for overloading of DC input power. Vendor to indicate the value in %. Minimum requirement is 45%
4.2.8	Max DC operating current	Value to be indicated by vendor.
4.2.9	Max AC output current	Value to be indicated by vendor corresponding to the rated output power of the PCU.
4.2.10	Power factor	Designed operation close to unity PF. Adjustable window 0.85 lead to 0.85 lag



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4.2.11	Ambient temperature	0 to 50 deg C.
4.2.12	Relative Humidity	Upto 95% non-condensing.
4.2.13	Protection class	IP 54 or higher (Outdoor duty).
4.2.14	Grid Frequency tolerance	+/- 3 Hz
4.2.15	Grid Voltage tolerance	- 10% and + 10%
4.2.16	AC output THD limits	Less than 3% at rated power earth leakage
4.2.17	Maximum noise level	Value to be indicated by vendor
4.2.18	DC injection (as % of nominal load current)	DC injection shall be limited to <0.5 % at rated current
4.2.19	Flicker	Shall be as per IEC 61000
4.2.20	Set point pre-selection for active power and VAR control	PCU shall be provided with all necessary features that will enable set point selection through SCADA. For this PCU vendor shall furnish the Modbus mapping for the set points or suggest the possible method for selecting VAR control. Operator shall be able to limit the total power (Active and Reactive) injected in the grid through manual intervention as and when required in view of grid security.
4.2.21	Re-synchronization time	In case of grid failure, the PCU shall be re-synchronized with grid after revival of power supply. Vendor shall indicate the time taken by PCU to be re-synchronized after restoration of grid supply.
4.2.22	European Efficiency	> 97%, measured as per IEC 61683 standard for measuring efficiency.
4.2.23	Conversion efficiency	The bidder shall specify the conversion efficiency at following load Conditions, during detail Engineering: 1) 25% - 2) 50% - 3) 75% - 4) 100% -
4.2.24	PCU availability	The up-time of Inverters should be of 99% in a year, in case of failing to achieve this due to failure of any component of inverter the vendor shall either replace the inverter or the component at their own cost
4.2.25	No load loss	No load loss shall be < 1% of rated power and maximum loss in sleep mode shall be less than 0.05%.
4.2.26	Voltage Ride Through	The PCU shall remain connected to the grid during temporary dip or rise in grid voltage as per the LVRT requirements of CEA Technical Standards for Connectivity to the Grid Regulations. The PCU shall also be able to inject reactive power during the period of voltage dip.
4.2.27	Active power regulation	The PCU shall be able to limit the active power exported to the grid based on the set point provided through PCU front control panel. The PCU shall also be able



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		to automatically the limit the active power after an increase in grid frequency above a pre-set value. The ramp rate shall be adjustable during operation and start-up after fault. The applicability of the requirement shall be as per CEA regulation and compliance.
4.2.28	Reactive power control	The PCU shall be able to inject /absorb reactive power to/ from the grid based on the set point provided through PCU front control panel. The same shall be performed automatically with adjustable ramp rate based on dynamic changes in grid voltage or reactive power reference
4.2.29	Auxiliary power requirement	<ol style="list-style-type: none"> <li>1. Auxiliary power for internal requirement of PCU shall be generated within the PCU. If UPS is required for the functioning of PCU, same shall be arranged by the vendor.</li> <li>2. Provision of tapping points for auxiliary transformer (Supply is in BHEL Scope) - Output AC busbars shall have additional holes to tap output for auxiliary transformer.</li> <li><del>3. For auxiliary power requirement for external BHEL equipment:               <ol style="list-style-type: none"> <li>a. For container solution, Auxiliary Transformer Dry type 3-Ph, 415V output – Rating 15KVA along with ACDB Panel – 1 set shall be provided within the container</li> <li>b. For Outdoor type PCU, Auxiliary Transformer Dry type 3-Ph, 415V output – Rating 15KVA along with ACDB Panel – 1 set shall be provided in a separate container.</li> </ol> </del> </li> <li><del>3. Cabling scope (including supply of cables, cable accessories, hardware etc) between PCU, Auxiliary Transformer, ACDB Panel shall be in vendor's scope.</del></li> <li><del>4. SCADA, HT breaker panel, lighting etc (in BHEL scope) shall be fed from ACDB panel. BHEL shall indicate the feeder details required during detailed engineering.</del></li> <li><del>5. For interconnection between ACDB and external equipment in BHEL's scope, cabling will be in BHEL scope.</del></li> </ol>

**4.3 Protection systems**

4.3.1	Protection systems for current, voltage, temperature, surges, ground faults, fan failure etc.	AC & DC over current
4.3.2		AC & DC short circuit
4.3.3		DC reverse polarity
4.3.4		Over temperature protection: Heat sink, Cabinet
4.3.5		Synchronization loss
4.3.6		Anti-islanding protection
4.3.7		EMI and RFI
4.3.8		Grid monitoring Protection against any sustained fault (lightning effect etc) in grid / feeder line.





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4.3.9		Ground fault protection
4.3.10		Power regulation in the event of thermal overloading
4.3.11		SPD-based overvoltage protection on both DC and AC sides. SPD shall consist of MOV type arrestors. It shall have thermal disconnectors to interrupt surge current arising from internal / external faults. Internal Surge Protection Device (SPD) shall be provided in the PCU on DC and AC side. It shall consist of Metal Oxide Varister (MOV) type arrestors. The discharge capability of the SPD shall be at least 12.5kA at 8/20 micro second wave as per IEC 61643-12.
4.3.13		Fan failure – Alarm contact shall be provided for air flow loss / rise of temperature of cooling fan

**4.4 DC, AC side load break disconnecting switch / breaker provisions**

4.4.1	DC side (Clause to be read in conjunction with clause 4.8.2)	<p>(a) DC isolator/contactors for isolation of PV array from inverter. Suitable rated fuse shall be provided (at inverter end) in incoming DC cable from each string combiner box (SCB). Fuse requirement (at inverter end) in the negative side of incoming DC cable shall be as per inverter manufacturer's recommendation. One set spare terminals with fuse/link (as applicable) and holder shall be provided for the future use.</p> <p>(b) DC MCCB are also acceptable in place of DC fuse based on standard design and configuration of PCU manufacturer. In case MCCB are provided, then one no spare MCCB (mounted in side PCU panel) shall be provided with each PCU.</p> <p>(c) <b>PCU shall be provided with current monitoring transducer (accuracy class-1 or better)</b> at incoming DC cables from each string combiner box (SCB) for PV array zone monitoring purpose.</p>
4.4.2	AC side	<p>(a) ACBs shall be provided on the AC output side.</p> <p>(b) Remote operating and controlling facility for PCU from the Main Control Room shall be provided.</p> <p>(c) Aux contacts (ON/OFF feedback) from both ACB and DC Switch Disconnecter shall be made available at TB terminals to enable external wiring for SCADA monitoring purpose.</p> <p>(d) Surge protection device (3P) with suitable rating shall be provided at the input of the ACB.</p> <p>(e) Indication for grid side supply ON / OFF status shall be available on the Door Interface.</p> <p>(f) Interconnection between the ACB Panel and PCU supply/provision of cables / busbars as applicable shall be in the scope of the vendor.</p>



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**4.5 Front panel display and control**

4.5.1	Front panel screen (LCD display, etc) with browsing / navigation provisions to 1) select display parameters 2) provide settings for various parameters	Instantaneous DC power input DC input voltage DC Current of each SCB Total DC Current
4.5.2		Instantaneous active AC power output Instantaneous reactive AC power output AC voltage ( all the 3 phases and line) AC current ( all the 3 phases and line) Frequency Power Factor Energy (kWh) produced during entire day Total Energy (kWh) produced during its life
4.5.3		Faults
4.5.4		Other event logs
4.5.5		Other features as may be necessary for supervisory control and operation of the PCUs shall be provided.

**4.6 Data logging, storage, retrieval, downloading, uploading**

4.6.1	Provision of built-in systems for data logging, storage, retrieval, downloading, uploading etc.	Date-cum-time stamped logging of DC and AC side parameters (current, voltage, frequency, phase, power factor, power, export energy etc), faults and other events.
4.6.2		Data storage with retrieval features.
4.6.3		Provision of all necessary built-in systems, ports etc for downloading the data into a PC / Laptop etc that will be required for reporting, data analysis and trouble-shooting purposes.
4.6.4		Provision of all necessary built-in systems, ports etc for uploading of software etc that will be required for replacing, revising, upgrading the system.

**4.7 Provisions for SCADA interface**

4.7.1	SCADA interface requirement	Solar PV power plant will have an integrated SCADA, which is within BHEL scope, whereby all the PCUs will be integrated with other data systems such as solar array string monitoring, weather monitoring, HT side transformers / breakers monitoring, etc. Accordingly, PCU shall have necessary communication protocol and output ports to facilitate SCADA interface as per Clause 4.7.2. SCADA shall be OPC server based.
4.7.2	Communication protocol	Dedicated MODBUS TCP/IP on Ethernet Interface for networking with SCADA.
4.7.4	Parameters for SCADA	All DC and AC parameters (current, voltage, frequency, phase, power factor, power, export energy etc), grid data, temperature, faults, other event logs, date/time logs etc from each PCU will be required at SCADA



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		control desk. PCU shall provide for this requirement. (ALL SCB CURRENT SHALL BE MEASURED & DISPLAYED INDEPENDENTLY )
4.7.5	Remote monitoring features	PCU shall have features to facilitate remote monitoring via telephone modem or mini web server.

**4.8 DC Inputs and termination details for 2500kW PCU.**

Vendor shall supply the PCU with the termination features on DC side as tabulated below. Detailed drawings of termination arrangements with bus bar particulars such as positions, dimensions, hole sizes, spacing between holes, support to bus bar, etc shall be submitted for BHEL approval.

4.8.1	DC input terminals	<b>9inputs + 1 spare</b> (Minimum of 10 DC +Ve and 10 DC -ve)
4.8.2	Fuses / DC Ckt Breaker on DC input side	Fuse current rating <b>400A (min)</b> shall be provided on each DC input terminal. Alternately, DC circuit breaker can also be provided as per design. If DC breaker is provided for each input ,then DC switch disconnect- or as per clause 4.4.1 is not mandatory
4.8.3	Max DC input current rating of PCU	Vendor shall indicate the rating. In addition, max rating of each individual DC input shall be indicated
4.8.4	DC cable entry into panel	<b>Bottom entry.</b> Cable supply is within BHEL scope. 1Cx400 sq-mm Aluminium, multi-strand, Al, <b>Un-armoured</b> , XLPE insulation, PVC sheath cable will be used for each DC input. Exact size shall be provided during detailed engg.
4.8.5	Gland plates	Drilled Gland plates shall be provided with holes to accommodate the cable glands.
4.8.6	Bus bar design	Tinned Copper or Aluminium Busbars shall be provided.
4.8.7	In case of separate DC termination panel	(a) In case the DC terminations are not within the main PCU panel with the vendor design featuring a separate panel, the add-on panel shall also be included in the offer. (b) General arrangement showing views and details of termination panel, with cable entry particulars, shall be submitted as part of technical bid. (c) Interconnecting the add-on DC termination panel with the main panel, including supply of cables for this purpose, shall be within the scope of vendor.
4.8.8	DC Side Negative Grounding	DC side negative grounding system shall be provided for the PCU. The same shall be indicated in the GA/SLD/Schematics and BOM.

**4.9 AC Output and termination details for 2500kW PCU.**

Vendor shall supply the PCU with the termination requirements on AC side as tabulated below. General arrangement showing views of termination shall be submitted as part of technical bid. Detailed drawings of termination arrangements with bus bar particulars such as positions, dimensions, hole sizes, spacing between holes, support to bus bar, etc shall be submitted within seven days after receipt of purchase order for BHEL approval.



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4.9.1	Number of AC outputs	Three phases: R, Y, B terminals
4.9.2	AC cable entry into panel	<b>Bottom entry</b> Cable supply is within BHEL scope. For each phase, <u>min</u> 6 runs of 1Cx400 sq.mm aluminium, multi-strand, <u>un-armoured</u> , XLPE insulation, PVC sheath cable will be used. Final cable selected and cable O.D shall be informed to vendor during detailed engineering.
4.9.3	Gland plates	Drilled Gland plates shall be provided with holes to accommodate the cable glands.
4.9.4	Bus bar design	Tinned Copper or Aluminium busbars shall be provided.
4.9.5	In case of separate AC termination panel	In case the AC output terminations are not within the main PCU panel with the vendor design featuring a separate panel, the add-on panel shall also be included in the offer.  General arrangement showing views and details of termination panel, with cable entry particulars, shall be submitted as part of technical bid.  Interconnecting the add-on AC termination panel with the main panel, including supply of cables for this purpose, shall be within the scope of vendor.

#### 4.10 Panel related parameters

4.10.1	Structure sheets	Doors and frames - Type of enclosure and size/thickness details of the doors and frames shall be indicated by vendor Gland plate: Minimum 3mm thk min sheet steel or 4 mm thk non-magnetic material The enclosure must be suitable to withstand the harsh environmental conditions for complete life of plant.
4.10.2	Bus bars	Busbars shall be of appropriate size to match current rating, based on vertical / horizontal layouts and bus bar orientations. Insulation sleeves (PVC etc.) shall be used wherever necessary. Bus bars (both AC and DC) shall be suitably colour coded.
4.10.3	Internal power cables	Insulated (PVC etc.) copper cable with appropriate cross section to match current rating.
4.10.4	Control wiring	Insulated (PVC etc.) copper cable of appropriate cross-section.
4.10.5	Base channel	ISMC channel of appropriate size to withstand the weight of the panel; suitable anti-corrosive finish (powder coated finish etc). Single rectangular ISMC base frame shall be provided for the complete panel.
4.10.6	Fixing of PCU	PCU shall be suitable for fixing on the outdoor RCC platform
4.10.7	Earthing terminals as per relevant standards	Earthing terminals shall be provided using tinned copper / aluminium bars of suitable cross section. Terminals shall be brought out to facilitate external connections.
4.10.8	Insulation clearances	AC side: Phase to Phase / neutral: As per relevant standards



**PURCHASE SPECIFICATION FOR  
SUPPLY AND COMMISSIONING SUPPORT OF  
3-PHASE GRID-CONNECTED POWER CONDITIONING UNITS  
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		DC side: As per relevant standards.
4.10.9	Painting	<p>Paint shade shall be informed during detailed engineering.</p> <p>All PCUs shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel.</p> <p>All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. The parts which are likely to get rusted, due to exposure to weather, should also be properly treated and protected in a suitable manner. All primers/paints/coatings shall take into account the hot humid, corrosive &amp; alkaline, subsoil or overground environment as the case maybe.</p>
4.10.10	Overall dimensions	Width x Depth x Height in mm shall be indicated in the offer.
4.10.11	Weight	Panel weight shall be indicated in the offer.
4.10.12	Air Flow Requirement (m3/hr)	<p>To be indicated by vendor for each PCU.</p> <ul style="list-style-type: none"> <li>- HVAC calculations shall be provided by vendor during detailed engg including CFD analysis for ventilation.</li> <li>- Alternatively, if liquid cooling is recommended, vendor shall provide all the details along with thermal design calculations.</li> </ul>

## 5.0 Testing and inspection

5.1	<p>Routine tests, as per relevant standards (IEC etc), shall be carried out on the PCUs and shall be witnessed by BHEL &amp; Customer/ Customer authorized third party inspection agency. Vendor shall submit Manufacturing Quality Plan (MQP) and detailed Test Procedure along with drawings for formal approval by customer prior to inspection.</p> <p>Routine tests shall be carried out by vendor on all the PCUs as per customer approved MQP. Following are the minimum tests to be conducted but not limited to:</p> <ol style="list-style-type: none"> <li>(a) HV and IR tests on 100% PCUs.</li> <li>(b) Functional tests</li> <li>(c) Load testing of inverter on 1No. PCU: <ul style="list-style-type: none"> <li>- Verification of inverter performance in its stand alone operational mode with a defined power (up to 100% rated full load power) and DC input voltage (up to max value). All parameters: DC voltage, current, power, grid voltage / current of R,Y,B lines, line frequency, ac output power, ac output energy, power factor, line current, efficiency, THD, etc. to be measured at 25%, 50%, 75% and 100% of the rated nominal power and checked against specified acceptance norms.</li> </ul> </li> <li>(d) Heat Run Test at rated full load on 1 no. panel</li> <li>(e) Protection tests (by direct method or simulation method) <ul style="list-style-type: none"> <li>- Verification of automatic disconnecting and reconnecting of Inverter to the grid, based on rise and fall of heat sink and cabinet temperature with reference to set points.</li> <li>- DC Reverse Polarity protection test</li> <li>- DC Ground Fault</li> <li>- AC and DC Overvoltage</li> </ul> </li> </ol>
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	<b>PURCHASE SPECIFICATION FOR SUPPLY AND COMMISSIONING SUPPORT OF 3-PHASE GRID-CONNECTED POWER CONDITIONING UNITS OF 1500V, 2500 KW RATING, PCU TYPE: CONTAINERISED OR OUTDOOR</b>	PS-439-1323
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	- Abnormal voltage and frequency Test reports shall be submitted prior to dispatch of the system to the site.
5.2	<del>Integrated Functional Testing on the PCU Container as per the approved MQP</del>

#### 6.0 Documents to be submitted after receipt of purchase order

6.1	<p>Following documents shall be submitted for approval within seven days from date of purchase order.</p> <ol style="list-style-type: none"> <li>1. GTP/Datasheet</li> <li>2. General Arrangement of PCU/Container along with PCUs and other auxiliary equipment, lighting, HVAC details, Fire alarm system etc</li> <li>3. BOM for complete PCU including all major components of PCU, AC and DC Combiner Panels</li> <li>4. Cable Schedule</li> <li>5. Type test reports (the type tests should have been conducted with ten years from the date of bid opening.)</li> <li>6. Spares List</li> <li>7. Civil Foundation drgs for PCU outdoor installation on RCC platform</li> <li>8. Manufacturing Quality Plan (MQP)</li> </ol> <p>Vendor shall proceed with Manufacturing only after final approval of all the listed documents.</p>
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#### 7.0 Documents to be submitted along with consignment

7.1	<p>Following documents shall be submitted at the time of dispatch:</p> <ol style="list-style-type: none"> <li>a. Test reports on individual PCUs</li> <li>b. Technical manual with system specifications, installation guidelines, commissioning guidelines, schematic drawings, circuit board overlays, system set points, calibration settings, hardware settings, cable schedule, general arrangement drawings, panel details.</li> <li>c. Operation and Maintenance manual including final As Built and tested drgs and datasheet, test reports, Catalogs of individual components, schematic drgs shall be provided (segregated section wise) in both hard copy and soft copy.</li> </ol>
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