



CLAUSE NO.	TECHNICAL SPECIFICATIONS			
	<p>It shall have facility for arithmetic processing (Time Integration, Simple Average, and Moving Average etc.) of incoming raw data. Data logger shall be interfaced with Solar SCADA on modbus preferably on TCP-IP. Vendor shall submit Factory Acceptance Test (FAT) report and procedure before dispatch of material to site.</p> <p>Data logger shall be provided with key-locked door access and all the cables (Power and Signal) to the data logger shall be protected with heavy duty HDPE pipes.</p> <p>Project file (software, settings and sample reports) shall be handed over to site on permanent storage media (CD/DVD) in two copies after data integrity is verified by site and weather monitoring is commissioned.</p>			
DEVELOPMENT OF 22 MW FLOATING SOLAR AT RGCCPP KAYAMKULAM IN KERALA		TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5742-004-9	PART-E	PAGE 5

	<p align="center"><b>PURCHASE SPECIFICATION</b></p> <p align="center"><b>UPS WITH Ni-Cd BATTERY BANK</b></p>	PS-439-UPS
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## 1.0 Introduction

This technical specification provides BHEL requirements for supply of UPS with Ni-Cd battery bank for the solar photovoltaic project.

## 2.0 Scope of supply

Sl. No	Item Description	Qty
1	UPS System - 3KVA, along with Ni-Cd Battery bank	5 set

**Note: NTPC approved vendors only are acceptable.**

## 3.0 Technical specifications

The UPS system shall meet the following minimum specifications.

1.0	<b>Type</b>	1. UPS System - 3KVA along with Ni-Cd Battery bank shall be required for other four PCUs (placed on inverter platforms). Total auxiliary requirement of PCUs, HT panels and others are included.
2.0	<b>Configuration</b>	UPS system shall have <b>2x100% configuration</b> , at a time one incomer shall be in service. On failure of any UPS, its load shall automatically get transferred to the other healthy UPS. Suitable auto changeover logic shall be provided. The minimum capacity of the UPS at load factor of 0.8 lagging inclusive of 10% design margin at 50 deg C. The UPS shall have an overload capacity of 125 % rated capacity for 10 minutes and 150 % rated capacity for 10 seconds. The overall efficiency of UPS shall be at least 80% on full load. The UPS system shall be capable of operating without D.C. battery in circuit under all conditions of load and the performance of various components of UPS like inverter, charger, static switch etc. shall be guaranteed without the battery in circuit.
3.0	<b>Charger</b>	<p>The chargers shall be self-regulating, solid state silicon controlled, full wave rectifier type designed for single and parallel operation with battery and shall have automatic voltage regulators for close voltage stability even when AC supply voltage fluctuates, effective current limiting features and filters to minimise harmonics. The charger should be capable to fully charge the required batteries as well as supply the full rated load. Furthermore, the charger should be able to re-charge the fully discharged battery within 8 hours. The charger shall be current limited for charger circuit protection and protection of battery from overcharge shall also be provided. The current limit shall be continuously adjustable. The chargers shall have a slow walk-in circuit. Charger design shall ensure that there is no component failure due to fluctuations of input supply or loss of supply and restoration. The charger shall be design for input supply voltage variation of <math>\pm 10\%</math> and frequency variation of <math>\pm 5\%</math>.</p> <p>Battery Chargers shall have a selector switch for selecting the battery charging mode i.e. whether Trickle or Boost charging.</p> <p>All Battery Chargers shall be provided with facility for both automatic and</p>



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manual control of output voltage and current. A selector switch shall be provided for selecting the mode of output voltage/current control, whether automatic or manual. Means shall be provided to avoid current/voltage surges of harmful magnitude/nature which may arise during changeover from Auto to Manual mode or vice-versa under normal operating condition.

Soft start feature shall be provided to build up the voltage to the set value slowly. The chargers shall have load limiters which shall cause, when the voltage control is in automatic mode, a gradual lowering of the output voltage when the DC load current exceeds the load limiter setting of the Charger. The load limiter characteristic shall be such that any sustained overload or short circuit in DC system shall neither damage the Charger nor shall it cause blowing of any of the charger fuses. The Charger shall not trip on overload or external short circuit. After clearance of fault, the Charger voltage shall build up automatically when working in automatic mode.

When on automatic control mode during Trickle charging, the Charger output voltage shall remain within  $\pm 1\%$  of the set value for AC input voltage variation of  $\pm 10\%$ , frequency variation of  $\pm 3-5\%$ , a combined voltage and frequency (absolute sum) variation of  $10\%$  and a continuous DC load variation from zero to full load. Uniform and step-less adjustments of voltage setting (in both manual and automatic modes) shall be provided on the front of the Charger panel covering the entire Trickle charging output range specified & shall be capable of matching the float voltage correction recommendations (w.r.t. temperature) as suggested by the respective battery manufacturer. Step-less adjustment of the load limiter setting shall also be possible from  $80\%$  to  $100\%$  of the rated output current for Trickle charging mode.

During Boost charging, the Battery Chargers shall operate on constant current mode (When automatic regulator is in service). It shall be possible to adjust the Boost charging current continuously over a range of  $50$  to  $100\%$  of the rated output current for Boost charging mode. The charger output voltage shall automatically go on rising, when it is operating on boost mode, as the battery charges up. For limiting the output voltage of the charger, a potentiometer shall be provided on the front of the panel, whereby it shall be possible to set the upper limit of this voltage anywhere in the output range specified for boost charging mode. All voltage and current setting potentiometers shall be Vernier type.

Energizing the Charger with fully charged battery connected plus  $10\%$  load shall not result in output voltage greater than  $110\%$  of the voltage setting. Time taken to stabilize, to within the specified limits as mentioned elsewhere, shall be less than fifteen seconds.

Momentary output voltage of the Charger, without the Battery connected shall be within  $94\%$  to  $106\%$  of the voltage setting during sudden load Change from  $100\%$  to  $20\%$  of full load or vice-versa. Output voltage shall return to, and remain, within the limits specified as mentioned elsewhere in less than 2 seconds after the above mentioned change.



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Suitable filter circuits shall be provided in all the Chargers to limit the ripple content (peak to peak) in the output voltage to 1% irrespective of the DC load, even when they are not connected to a battery.

The DC System shall be ungrounded and float with respect to the ground potential when healthy. An earth fault relay shall be provided by the bidder in the DC distribution board for remote annunciation.

Digital Outputs shall be configured for connection to the SCADA for realtime charger status updation. Outputs like charger output current, output voltage, float/boost mode, etc may be configured to provide the update to SCADA.

The Battery Chargers as well as their automatic regulators shall be of static type. The Chargers shall be designed to operate, as mentioned above, at an ambient air temperature of 50°C.

Battery chargers shall be capable of continuous operation at the respective rated load in Trickle mode i.e. Trickle charging the associated DC Nickel-Cadmium Batteries while supplying the D.C. loads. The Batteries shall be Trickle charged at 1.4 to 1.42 Volts per cell. All chargers shall be capable of Boost Charging the associated D.C. Battery at 1.54 to 1.7 Volts per cell at the desired rate.

All Battery Chargers shall have an AC contactor on the input side. It shall be of air break type and suitable for continuous duty. A thermal overload relay incorporating a distinct single phasing protection (using differential movement of bimetal strips) shall also be provided for the AC input. The relay shall trip the above contactor.

The rectifier assembly shall be full wave bridge type and designed to meet the duty as required by the respective Charger.

Digital or analog indicating instruments shall indicate DC current, DC voltage & AC voltage.

The Chargers shall be indoor, floor mounted, self-supporting sheet metal enclosed cubicle type. The Contractor shall supply all necessary base frames, anchor bolts and hardware. The Charger shall be fabricated using cold rolled sheet steel shall not be less than 1.6 mm and shall have folded type of construction. The panel frame shall be fabricated using cold rolled sheet steel of thickness not less than 2.0 mm. Removable undrilled gland plates of at least 3.0 mm sheet steel and lugs for all cables shall be supplied by the Contractor. The Charger shall be tropicalized and vermin proof. Ventilation louvers shall be backed with fine brass wire mesh. All doors and covers shall be fitted with synthetic rubber gaskets. The Chargers shall have hinged double leaf doors provided on front and/or backside for adequate access to the Charger internals. All the Charger cubicle doors shall be properly earthed.

Treatment as per IS: 6005. Two coats of lead oxide primer followed by powder painting with final shade of RAL9002 for complete panel except end



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		<p>covers &amp; RAL 5012 for end covers.</p> <p>All acceptance and routine tests as per the manufacture recommendations and relevant standards shall be carried out.</p> <p>The cabinets shall be IP-42 protection class for indoor application and IP65 for outdoor application.</p> <p>The Contractor shall also carry out the site tests on battery charger systems required to be conducted as a standard practice of the UPS manufacture or deemed necessary by the Employer and mutually agreed between the Contractor and the Employer.</p> <p>For UPS capacity 5 kVA or more, in addition to indications/display on UPS panel, important alarms along with important analog signal shall also be provided for use in SCADA. For UPS capacity less than 5 kVA bidder shall provide status, common alarm and trip DI (soft or hard) signal to SCADA</p>
4.0	<b>Battery</b>	<p><b>BATTERY: NICKEL-CADMIUM BATTERY</b></p> <p>Ni-Cd vented type, pocket plate high discharge battery of adequate capacity to meet the requirement of UPS, generally conforming to IS-10918.</p> <p><b>BATTERY PARAMETERS</b></p> <p>a) Battery Voltage : To be decide during Detail Engineering b) No. of Cells : To be decide during Detail Engineering c) Battery type : Nickel-Cadmium d) Nominal discharge voltage per Cell: 1.2 V e) Float voltage : 1.42V/Cell</p> <p>Batteries should be suitable for continuous operation for the maximum ambient temperature as defined in technical parameters.</p> <p><b>CODES AND STANDARDS</b></p> <p>All standards, specifications and codes of practice referred to herein, shall be the latest editions including all applicable official amendments and revisions as on date of opening of techno-commercial bid. In case of conflict between this specification and those (IS codes, Standards etc.) referred to herein, the former shall prevail. All works shall be carried out as per the following standards and codes:</p> <p>IEC 60623/ IS 10918 : Specification for vented type Nickel Cadmium Batteries. IS 106 : Quality tolerances for water for storage batteries IEC 60993 : Electrolyte for vented Nickel-Cadmium cells Indian electricity rules Indian electricity acts</p> <p>Equipment complying with other internationally accepted standards such as IEC., BS, VDE etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards along with copies of all official amendments and revisions in force as on date of opening of techno-commercial bid and shall clearly bring out the salient</p>



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features for comparison.

DC Batteries shall be stationary Nickel Cadmium Pocket plate type conforming to IS:10918. The batteries shall be high/medium discharge performance type suitable for the backup time as specified. For the purpose of design an ambient temperature of 50 deg.C and relative humidity of 85% shall be considered.

DC batteries shall be suitable for standby duty. The batteries shall normally be permanently connected to the load in parallel with a charge and shall supply the load during emergency conditions when AC supplies are lost. Batteries shall be suitable for a long life under continuous float operations and occasional discharges. The batteries shall be boost charged at about 1.54 to 1.7 volts per cell maximum and float charged at about 1.42 V/cell.

#### Sizing

- a) Environmental temperature 0 to 50 degC.
- b) Power factor of load - 0.8
- c) Adequate I<sup>2</sup> t capability to clear fault in the maximum rated branch circuit.
- d) UPS shall be capable to operate without DC battery in circuit and under all conditions of load.
- e) In case of failure of a charger / input power, other charger whose input supply is healthy shall be capable to charge the battery and as well supply input power to inverter. No discharge of battery is allowed.
- f) Inrush current

#### Construction Features:

##### a) Containers

Containers shall be made of polypropylene plastic material. Containers shall be robust, heat resistance, leak proof, non-absorbent, alkali resistant, non-bulging type and free from flaws, such as wrinkles, cracks, blisters, pin holes etc. Electrolyte level lines shall be marked on container in case of translucent containers.

##### b) Vent Plugs

Vent plugs shall be provided in each cells. They shall be anti-splash type, having more than one exit hole shall allow the gases to escape freely but shall prevent alkali from coming out. The design shall be such that the water loss due to evaporation is kept to minimum. In addition, the ventilator shall be easily removed for topping up the cells and of such dimensions that the syringe type hydrometer can be inserted into the vent to take electrolyte samples.

##### c) Plates

The plates shall be designed for maximum durability during all service conditions including high rate of discharge and rapid fluctuations of load. The construction of plates shall conform to latest revisions of IS:10918. The separators shall maintain the electrical insulation between the plates and shall allow the electrolyte to flow freely. Separators should be suitable for continuous immersion in the electrolyte without distortion. The positive and negative terminal posts shall be clearly marked.





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		<p><b>d) Sediment Space</b> Sufficient sediment space shall be provided so that cells will not have to be cleaned during normal life and prevent shorts within the cells.</p> <p><b>e) Electrolyte</b> The electrolyte shall be prepared from battery grade potassium hydroxide conforming to IEC 60993. The cells can be shipped either in charged condition or in dry condition. Necessary electrolyte for make-up shall be supplied separately.</p> <p><b>f) Connectors and Fasteners</b> Nickel plated copper connectors shall be used for connecting adjacent cells and PVC insulated flexible copper cables shall be used for inter-row / inter-tier / inter-bank connections. Bolts, nuts and washers shall be Stainless Steel / Nickel coated steel to prevent corrosion. The thickness of Nickel coating of connectors should be not less than 0.02 mm. All the terminals and cells inter-connectors shall be fully insulated or have insulation shrouds.</p> <p><b>g) Battery racks</b> Mild steel racks for all the batteries shall be provided. They shall be free standing type mounted on porcelain/hard rubber/PVC pads insulators/High impact plastic insulators. Batteries shall preferably be located in the single tier arrangement. However, batteries having a complete cell weight of lower than 50 Kg could be located in the double tier arrangement. The batteries racks and supports for cable termination shall be coated with three (3) coats of anti-alkali paint of approved shade. Name plates, resistant to alkali, for each cell shall be attached on to the necessary racks. The bottom tier of the stand shall not be less than 150 mm above the floor.</p> <p><b>h) Test</b> The Contractor shall submit for Owner's approval the reports of all the type tests carried out as per latest IS-1146(for all applicable tests for containers) / IS-10918 (for NI-CD batteries). The complete type test reports shall be for any rating of battery in a particular group, based on plate dimensions being manufactured by supplier. Routine and Acceptance tests shall be as per Quality Assurance &amp; Inspection table of battery.</p>
5.0	<b>Inverter</b>	The UPS inverter shall be of continuous duty, solid state type using proven Pulse Width Modulation (PWM)/Quasi square wave/step wave technique. Ferro-resonant types Inverters are not acceptable. The nominal voltage output shall be 230 Volts single phase ,50 Hz. The inverter equipment shall include all necessary circuitry and devices to conform to requirements like voltage regulation, current limiting, wave shaping, transient recovery, etc. The total harmonic content shall be 5% maximum and content of any single harmonic shall be 3% maximum. The bidder shall provide status, common alarm and trip DI (soft or hard) signal to SCADA.
6.0	<b>Efficiency</b>	a) 100% Full load- 80%
7.0	<b>Synchronization limit</b>	Between inverter & standby AC source shall be within 47 Hz to 53 Hz field adjustable. Inverter shall remain synchronized with the AC mains.
8.0	<b>Inverter protection</b>	Overload, short circuit and 100% loss of load.
9.0	<b>Load sharing</b>	At a time one incomer from UPS shall be in service. On failure of any UPS, its load shall automatically get transferred to the other healthy UPS

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		without any degradation of the UPS power quality. Suitable auto changeover logic shall be provided. Power shall be transferred to the standby AC power without a break in synchronization if within limit in case of failure of both inverters. Asynchronous transfer to standby AC source in case inverters are being out of synchronism limit with AC mains.
10.0	<b>Static switch</b>	To transfer UPS loads automatically without any break from faulty inverter to standby AC source. Manual bypass switch shall be employed for isolating the UPS during maintenance.
11.0	<b>Enclosure</b>	Individual enclosure shall be ventilated switchboard type fabricated from not less than 1.6-mm thick sheet steel. Enclosures shall be furnished with concealed hinges. Front and rear doors shall be designed to permit easy access to all components for maintenance or replacement. The enclosures shall be reinforced with formed steel members as required to form a rigid self-supporting structure. Doors shall have three point latches. Adequate ventilating louvers and enclosure top panels shall be included. All vent openings shall be covered with corrosion resistant fine screen coverings. The cabinets shall be IP-42 protection class for indoor application and IP65 for outdoor application. The temperature rise inside all the cabinets/enclosures shall not exceed 10 deg.C above ambient temperature.
12.0	<b>Spare feeders</b>	25%
13.0	<b>Accessories</b>	Power distribution board, Voltage & current meters, power factor meter, KVA, frequency, panel alarms, switches etc. One set of tool shall be provided for maintenance and testing purposes.

#### 4.0 APPROVAL


The Detailed Design Report submitted by the contractor to NTPC must contain but not limited to the following details of the data acquisition and monitoring system:


- Detailed scheme
- Details of panels, metering system
- Necessary drawings for the scheme etc.

Drawings and scheme shall be submitted by the bidder for approval of BHEL/NTPC.



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	<div>E-2 FIRE FIGHTING AND ALARM SYSTEM</div> <p>The SPV plant shall be equipped with suitable fire protection &amp; fire fighting systems for protection of entire equipment switchyard &amp; control room as per CEIG requirements.</p> <div><div>1.0</div><div>Bidder shall comply with recommendation of Tariff Advisory Committee to incurring minimal premium for insurance. The installation shall meet all applicable statutory requirements, safety regulations in terms of fire protection.</div></div> <div><div>2.0</div><div>The fire fighting system for the proposed power plant for fire protection shall be consisting of:<div>a) Sand buckets</div><div>b) Portable fire extinguishers</div><div>c) Microprocessor based fire alarm panel.</div></div></div> <div><div>2.1</div><div><div>Portable Fire Extinguishers and Sand Buckets</div><p>Bidder to provide following numbers of type tested portable fire extinguishers as per relevant code in the rooms mentioned below.</p><table><tr><th>Rooms</th><th>DCP Type (ABC type) (10 Kg. Capacity)</th><th>CO<sub>2</sub> Type 9 kg capacity</th><th>Foam Type Hand 9 kg</th><th>Hand Portable pressurized water CO<sub>2</sub> 9 Litre</th><th>Sand Buckets</th></tr><tr><td>Control Room</td><td>2</td><td>2</td><td>1</td><td>1</td><td>1</td></tr><tr><td>Each Inverter Room</td><td>1</td><td>1</td><td></td><td></td><td></td></tr><tr><td>ACDB Room(If applicable)</td><td>1</td><td>1</td><td></td><td></td><td></td></tr><tr><td>Each Transformer Yard</td><td>1</td><td>1</td><td>1</td><td></td><td>1</td></tr></table></div></div> <div><div>2.2</div><div><div>Microprocessor based fire alarm panel</div><p>Bidder to provide intelligent microprocessor based main fire alarm panel of modular construction complete with central processing unit, input and output modules, power supply module, supervision control and isolator modules with 10% spare provisions in each loop. Fire detection alarm system shall include) but not limited to the following items</p></div></div>					Rooms	DCP Type (ABC type) (10 Kg. Capacity)	CO <sub>2</sub> Type 9 kg capacity	Foam Type Hand 9 kg	Hand Portable pressurized water CO <sub>2</sub> 9 Litre	Sand Buckets	Control Room	2	2	1	1	1	Each Inverter Room	1	1				ACDB Room(If applicable)	1	1				Each Transformer Yard	1	1	1		1
Rooms	DCP Type (ABC type) (10 Kg. Capacity)	CO <sub>2</sub> Type 9 kg capacity	Foam Type Hand 9 kg	Hand Portable pressurized water CO <sub>2</sub> 9 Litre	Sand Buckets																														
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2.3	<ul style="list-style-type: none"><li>a. Fire Alarm control Panel</li><li>b. Multi Sensor smoke detector</li><li>c. Heat Detectors</li><li>d. Hooter cum strobe</li><li>e. Manual call Point</li><li>f. Hooter</li><li>g. Fault isolation modules</li><li>h. Control Modules</li><li>i. Cables from Sensors to Fire panels.</li><li>j. Digital output from the fire detection system shall be integrated with SCADA</li><li>k. Network Control Module</li><li>l. Interfacing of Fire Alarm System with SCADA for display and storage of status and alarm in SCADA</li></ul> <p>Multi sensor type smoke detectors and heat detectors shall be provided for below false ceiling areas of control room and ACDB and/or inverter rooms. One (01) sensor shall be provided for each 20 sq. Meter of area. All the cable trench inside the control room and inverter room shall be provided with Multi Sensor smoke detector.</p> <p>Fault Isolation module shall be provided in every room and for every 15 sensors at location proposed by Bidder to be approved by employer during detail engineering.</p>			
	<p><b>Fire Alarm Control Panel Indication</b></p> <ul style="list-style-type: none"><li>i. Alarm conditions shall be immediately displayed on the control panel and in SCADA. Alarm LED shall flash on the control panel until the alarm has been acknowledged. Once acknowledged the LED shall remain lit. A subsequent alarm received from another zone after acknowledgement shall illuminate the alarm LED and the panel display shall show the new alarm information.</li><li>ii. During an alarm condition, an alarm tone shall sound within the control panel until the alarm is acknowledged.</li><li>iii. If the audible alarm signals are silenced for any reason, they shall automatically resound if another zone is activated.</li><li>iv. All alarm signals shall be automatically “locked in” at the control panel until the operated device is returned to its normal condition and the control panel is manually reset</li></ul> <p>There shall be weather proof Hooter cum strobe outside and strobe inside each Inverter room and control room for indication fire alarm for respective zone/area at suitable location that is visible from all direction. All the</p>			
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	<p>hardware, relay and accessories required for completeness of fire alarm system is in Bidder scope. Fire alarm system shall have its own battery and charger and it shall be provided power from UPS DB. Each Inverter room and control room shall be also be provided with manual call point, Alarm acknowledge and reset facility for alarm for respective zone only.</p> <p>Bidder shall submit document to employer for approval that will include fire alarm system configuration, layout, BoM, Datasheet and necessary test report.</p> <p>Bidder shall consider 30 % design and aging margin for selection of nos. of sensors in each loop and length of each loop. Bidder shall submit the certificate from OEM indicating maximum nos. of sensors in single loop and maximum length of single loop allowed with offered panel and type of cable to be used. Each Fire Alarm Control panel shall have provision for minimum 10 (Ten) % rounded to next higher integer but not less than 2 (two) nos. spare loops for future use of employer.</p> <p>Bidder shall submit Site Acceptance Test (SAT) for approval by employer. Complete fire alarm system shall be checked at site for verification of faithful performance and completeness of the system. Bidder shall carry out necessary modification and supply hardware/accessories if required.</p>			
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## TECHNICAL SPECIFICATION FOR 33KV INDOOR METERING CUBICLE

There will be 15MW, 7MW indoor metering panel each one number.

The 15MW Indoor metering panel shall have

1. Measuring CT with CL-0.2S, 5VA , 360/1A as per SLD.
2. Measuring PT with CL-0.2, 5VA , 33/√3 kV / 110/ √3 kV as per SLD.
3. ABT meters as per SLD and as per state electricity board approved make.

The 7MW Indoor metering panel shall have

1. Measuring CT with CL-0.2S,5VA , 180/1A as per SLD.
2. Measuring PT with CL-0.2,5VA , 33/√3 kV / 110/ √3 kV as per SLD.
3. ABT meters as per SLD and as per state electricity board approved make.

**Note: Maximum foot print of both the panels shall not exceed 1100mm X 1100mm.**

All standards, specification and codes of practices referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of Techno commercial bid. In case of conflict between this specification and those (IS Codes, Standards etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards and codes.

Sl No	IS Code	Name Of Equipment
a)	IS: 722	AC electricity meters.
b)	IS: 996	Single phase small AC and universal electrical motors.
c)	IS: 1248	Direct Acting indicating analogue electrical measuring instruments and Accessories.
d)	IS/IEC: 60947	Degree of protection provided by enclosures for low voltage and control gear.
e)	IS: 2544	Porcelain post insulators for systems with nominal voltages greater than 1000 Volts.
f)	IS: 2705	Current transformers.
g)	IS: 3156	Voltage Transformers
h)	IS: 6005	Code of practice for phosphating of iron and steel.
i)	IS: 5082	Specification for wrought aluminium and aluminium alloy bars, rods, tubes and selections for electrical purposes.
j)	IEC: 61850	Communication Standard for Numerical relays
k)	IEC: 61131-3	Automation Standard for Numerical relays
l)	IS: 9046	AC contactors for voltages above 1000 volts and upto and including 11000 Volts.
m)	IS: 13703	Low voltage fuses
n)	IS: 9385	HV fuses
o)	IS: 9431	Specification for indoor post insulators of organic material for system with nominal voltages greater than 1000 volts upto and including 300 kV
p)	IS: 9921	A.C. disconnectors (isolators) and Earthing switches for voltages above 1000 V

q)	IS: 11353	Guide for uniform system of marking and identification of conductors and apparatus terminals.
r)	IS: 13118	Specification for high voltage AC circuit breakers.
s)	IEC: 60099-4	Metal oxide surge arrestor without gap for AC systems
t)	IS/IEC: 62271100	High voltage alternating current circuit breakers.
u)	IS/IEC: 62271200	High voltage metal enclosed and control gear.
v)	IEC: 60947-7-1	Terminal blocks for copper conductors
w)	IS :513 (2008)	Cold Rolled Low Carbon Steel Sheets and Strips

TECHNICAL PARAMETERS		
A. SYSTEM PARAMETERS		
a)	Nominal System voltage	33kV
b)	Highest System voltage	36kV
c)	Rated Frequency	50Hz
d)	Number of phases/ poles	Three
e)	System neutral earthing	Solidly Earthed
f)	One minute power frequency withstand voltage	
	- for Type tests	70kV
	- for Routine tests	70kV
g)	1.2/50 microsecond Impulse withstand voltage	170kV (peak)
h)	Minimum system fault level	As per SLD
i)	Short time rating for bus bars, circuit breakers, current transformers and assembly.	As per SLD for one (1) sec.
c	Dynamic withstand rating	2.5 times of system fault current
k)	- Space heaters	240 V AC single phase with neutral solidly earthed
l)	Maximum ambient air temperature	50 deg. C
m)	Internal Arc testing	As Specified in chapter-A2
B. BUS BARS		
a)	Continuous current rating at 500C ambient:	As Per Requirement
b)	Temper Rise allowed above ambient	0 0 40 C for plain joints 55 C for Silver plated joints
c)	Rated Frequency	50Hz
d)	Number of phases/ poles	Three

<b>C. METERING. PANEL CONSTRUCTIONAL REQUIREMENTS</b>		
a)	Colour finish	
	Exterior	RAL9002 (Main body) RAL 5012 (Extreme end covers)
b)	Cable entry	
	Power Cables	Bottom
	Control Cables	Bottom
c)	Earthing conductor	Galvanized steel strip
d)	Service Continuity of metering (LSC2B-PM)	as per IS/IEC 62271200
<b>E. CURRENT TRANSFORMER</b>		
	Accuracy	Two, Tariff CTs shall be with 0.2s accuracy class./ as per tender SLD
<b>F. VOLTAGE TRANSFORMERS</b>		
a)	Accuracy	For tariff metering VT - 0.2

## **BUSBARS AND INSULATORS**

All Busbar and jumper connections shall be of high conductivity aluminium alloy. They shall be adequately supported on insulators to withstand electrical and mechanical stresses due to specified short circuit currents.

Busbar cross-section shall be uniform throughout the length. Busbars and other high voltage connection shall be sufficiently corona free at maximum working voltage.

Contact surfaces at all joints shall be silver plated or properly cleaned and non-oxide grease applied to ensure an efficient and trouble free connection. All bolted joints shall have necessary plain and spring washers. All connection hardware shall have high corrosion resistance.

Bimetallic connectors or any other technically proven method shall be used for aluminum to copper connections.

Busbar insulators shall be of arc and track resistant, high strength, nonhygroscopic, non-combustible type and shall be suitable to withstand stresses due to over-voltages, and short circuit current. Busbar shall be supported on the insulators such that the conductor expansion and contraction are allowed without straining the insulators. In case of organic insulator partial discharge shall be limited to 100pico coulomb at rated voltage x 1.1 / 3. Use of insulators and barriers of in-flammable material such as Hylam shall not be accepted.

Successful Bidder shall furnish calculation establishing adequacy of busbar sizes for the specified continuous and short time current ratings.

All busbars shall be color coded.

The temperature of the busbar and all other equipment, when carrying the rated current continuously shall be limited as per the stipulations of relevant Indian Standards, duly considering the specified ambient temperature (50 deg. C). The temperature rise of the horizontal and vertical busbars when carrying the rated current shall in no case exceed 55 deg. C for silver plated joints and 40 deg. C for all other type of joints. The temperature rise at the



terminals intended for external cable termination shall not exceed 40 deg. C. Further the parts handled by the operator shall not exceed a rise of 5 deg. C. The temperature rise of the accessible parts / external enclosure expected to be touched in normal operation shall not exceed 20 deg.C.

## **EARTHING AND EARTHING DEVICES**

A copper / galvanized steel earthing bus shall be provided at the bottom and shall extend throughout the length of each switch board. It shall be bolted/ welded to the framework of each panel and each breaker earthing contact bar.

Suitable arrangement shall be provided at each end of the earth bus for bolting to Employer's earthing conductors. All joint splices to the earth bus shall be made through at least two bolts and taps by proper lug and bolt connection.

All non-current carrying metal work of the panel shall be effectively bonded to the earth bus. Electrical continuity of the whole enclosure frame work and the truck shall be maintained even after painting.

The truck and breaker frame shall get earthed while the truck is being inserted in the panel and positive earthing of the truck and breaker frame shall be maintained in all positions i.e. SERVICE and ISOLATED as well as throughout the intermediate travel. The truck shall also get and remain earthed when the control plug is connected irrespective of its position.

All metallic cases of relays, instruments and other panel mounted equipment shall be connected to earth by independent stranded copper wires of size not less than 2.5 sq. mm. Insulation colour code of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connectors and soldering shall not be acceptable. Looping of earth connections which would result in loss of earth connection to other devices, when a device is removed is not acceptable. However, looping of earth connections between equipment to provide alternative paths of earth bus is acceptable.

VT and CT secondary neutral point earthing shall be at one place only on the terminal block. Such earthing shall be made through links so that earthing of one secondary circuit may be removed without disturbing the earthing of other circuits.

Separate earthing trucks shall be provided by the Contractor for maintenance work. These trucks shall be suitable for earthing the busbars as well as outgoing / incoming cables or busducts. The trucks shall have a interlock to prevent earthing of any live connection.

As an alternative to separate earthing trucks the Bidder may also offer built-in earthing facilities for the busbars and outgoing / incoming connections, in case such facilities are available in their standard proven design. The inbuilt earthing switches shall have provision for short circuiting and earthing a circuit intended to be earthed. These switches shall be quick make type, independent of the action of the operator and shall be operable from the front of the panel. These switches shall have facility for padlocking in the earthed condition.

## **PAINTING**

All sheet steel work shall be pretreated, in tanks, in accordance with IS: 6005. Degreasing shall be done by alkaline cleaning. Rust and scales shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be "Class-C" as specified in IS: 6005. The phosphated surfaces shall be rinsed and passivated. After passivation, Electrostatic Powder Coating shall be used. Powder should meet requirements of IS 13871 (Powder costing specification). Finishing paint shade for complete panels excluding end covers shall be RAL9002 & RAL5012 for extreme end covers of all boards, unless required otherwise by the Employer. The paint thickness shall not be less than 50 microns. Finished parts shall be suitably packed and wrapped with protective covering to protect the finished surfaces from scratches, grease, dirt and oil spots during testing, transportation, handling and erection.

## **SURGE ARRESTOR**

The surge arrestors shall be provided as per tender SLD/ as per system requirement and shall be of metal oxide, gapless type generally in accordance with IEC 60099-4 and suitable for indoor duty. These shall be mounted within the switchgear panel between line and earth, preferably in the cable compartment. Surge arrestor selected shall be suitable for un-earthed system and rating shall be in such a way that the value of steep fronted switching over voltage generated at the switchgear terminals shall be limited to the requirements of switchgear.

## **INSTRUMENT TRANSFORMERS**

All current and voltage transformers shall be completely encapsulated cast resin insulated type, suitable for continuous operation at the ambient temperature prevailing inside the switchgear enclosure, when the switchboard is operating at its rated load and the outside ambient temperature is 50 deg. C. The class of insulation shall be E or better.

All instrument transformers shall withstand the power frequency and impulse test voltage specified for the switchgear assembly. The current transformer shall further have the dynamic and short time ratings at least equal to those specified for the associated switchgear and shall safely withstand the thermal and mechanical stress produced by maximum fault currents specified when mounted inside the switchgear for circuit breaker modules.

The parameters of instrument transformers specified in this specification are tentative and shall be finalized by the Employer in due course duly

Current transformers may be multi or single core and shall be located in the cable termination compartment. All voltage transformers shall be single phase type. The bus VTs shall be housed in a separate panel on a truck so as to be fully withdrawable.

All voltage transformers shall have suitable current limiting fuses on both primary and secondary sides. Primary fuses shall be mounted on the withdrawable portion. Replacement of the primary fuses shall be possible with VT truck in isolated position. The secondary fuses shall be mounted on the fixed portion and the fuse replacement shall be possible without drawing out the VT truck from service position.

All voltage transformers shall be designed and manufactured for 0.8 Tesla operating point on B-H curve. VT shall be fully insulated type (i.e. double pole construction and neutral side fully insulated to rated BIL). VT shall be manufactured without any joint in secondary winding.

## **SPACE HEATER**

Each panel shall be equipped with thermostatically controlled space heater(s), suitably located in breaker and cable compartments to prevent condensation within the enclosure. The space heater shall be connected to 240V single phase AC auxiliary supply available in the switchgear, through switches and fuses provided separately for each panel.

A 240V single phase 50 Hz AC plug point shall be provided in the interior of each panel with ON-OFF switch for connection of hand lamp.

## **POWER CABLE TERMINATION**

Cable termination compartment shall receive the stranded Aluminium conductor, XLPE insulated, shielded, armored / unarmored, PVC jacketed, single core / three core, unearthed / earthed grade power cable(s).


A minimum clearance of about 600 mm shall be kept between the cable lug bottom ends and gland plates for stress cone formation for XLPE cables. Interphase clearance in the cable termination compartment shall be adequate to meet electrical and mechanical requirement besides facilitating easy connections and disconnection of cables. Dimensional drawing of cable connection compartment showing the location of lug, glands, CTs, gland plates etc. and


the electrical clearances available shall be submitted for Employer's approval during detail engineering.


Cable termination compartment shall have provision for termination of power cables of sizes as indicated during detailed engineering with removable undrilled gland plates. For all single core cables gland plates shall be of nonmagnetic material. Cable entry shall be from bottom. Any change will be intimated later .

**Metering panel with padlock arrangement needs to be as per KSEB approval.**

**The panel GA and Technical GTP needs to be approved by BHEL/NTPC before manufacturing.**

CLAUSE NO.	TECHNICAL SPECIFICATIONS			
	<b>C-13 METERING SYSTEM</b>			
1.0	Energy meter (0.2s accuracy class suitable for ABT requirement with metering panel as required conforming to STU/PGCIL requirement shall be as per Cl. 2.0 of Chapter-A2.			
2.0	For measurement of Auxiliary power consumption, MFM in ACDB incomer shall be provided by the bidder.			
3.0	Meter shall be suitable for interfacing for synchronizing the built-in clock of the meter by GPS time synchronization equipment. Bidder shall synchronize the meter using GPS time synchronization equipment. All the hardware required for synchronization shall be in scope of bidder.			
4.0	The ABT meters supplied under this contract shall also meet the requirement of respective RLDC/State power Utilities.			
5.0	This metering system shall have following features: <ul style="list-style-type: none"><li>i. Meters shall be microprocessor-based MWH meters having an accuracy class of 0.2S or better. MVARH meters shall have accuracy class of 0.5 or better.</li><li>ii. These meters shall have provision for downloading of data through an optical port and /or through RS 232/485 port.</li><li>iii. Even under absence of VT input, energy meter display shall be available and it shall be possible to download data from the energy meters.</li></ul>			
6.0	<b>Technical Requirements of Energy Meters for ABT Requirement</b> <p>Contractor shall supply energy meters along with metering station, 4 Nos. machine Clients, 20 nos web client license. MRI or lap top (as applicable) as per the technical specification given below:</p> <ul style="list-style-type: none"><li>a) Shall be microprocessor-based conforming to IEC 62052-11, IEC 62053-22, IS 14697</li><li>b) Shall carry out measurement of active energy (both import and export) and reactive energy (both import and export) by 3-phase, 4 wire principle suitable for balanced/ unbalanced 3 phase load.</li><li>c) Shall have an accuracy of energy measurement of at least Class 0.2S for active energy and at least Class 0.5 for reactive energy.</li></ul>			
DEVELOPMENT OF 22 MW FLOATING SOLAR AT RGCCPP KAYAMKULAM IN KERALA		TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5742-004-9	PART-C	PAGE 166

CLAUSE NO.	TECHNICAL SPECIFICATIONS																														
d) e) f) g) h) i) j)	The active and reactive energy shall be directly computed in CT & VT primary ratings.																														
	The reactive energy shall be recorded for each metering interval in four different registers as MVARh (lag) when active export, MVARh (Lag) when active import, MVARh (lead) when active export, MVARh (Lead) when active import.																														
	Two separate registers shall be provided to record MVARH when system voltage is >103% and when system voltage is < 97%.																														
	Shall compute the net MWh and MVARh during each successive 15-minute block metering interval along with a plus/minus sign, instantaneous MWh, instantaneous MVARh, average frequency of each 15 minutes, net active energy at midnight, , net reactive energy for voltage low and high conditions at each midnight.																														
	Each energy meter shall have a display unit. It shall display the net MWh and MVARh with a plus/minus sign and average frequency during the previous metering interval; peak MWh demand since the last demand reset; accumulated total (instantaneous) MWh and MVARh with a plus/minus sign, date and time; and instantaneous current and voltage on each phases.																														
	All the registers shall be stored in a non-volatile memory. Meter registers for each metering interval, as well as accumulated totals, shall be downloadable. All the net active/reactive energy values displayed or stored shall be with a plus /minus sign for export/import.																														
	At least the following data shall be stored before being over-written for the following parameters.																														
	<table><tr><td></td><td>Parameters</td><td>Details</td><td>Min No of days</td></tr><tr><td>1.</td><td>Net MWH</td><td>15 min block</td><td>40days in meter</td></tr><tr><td>2.</td><td>Aver Freq</td><td>15 min block</td><td>40days in meter</td></tr><tr><td>3.</td><td>Net MVARH for V &gt; 103%</td><td>15min block</td><td>40days in meter</td></tr><tr><td>4.</td><td>Net MVARH for V &lt; 97%</td><td>15min block</td><td>40days in meter</td></tr><tr><td>5.</td><td>Cumulative Net MWH at every midnight</td><td></td><td>10 days in meter/ 40 days in PC</td></tr><tr><td>6.</td><td>Cumulative Net MVARH for V&gt; 103% at every midnight</td><td></td><td>10 days in Meter/ 40 days in PC</td></tr></table>					Parameters	Details	Min No of days	1.	Net MWH	15 min block	40days in meter	2.	Aver Freq	15 min block	40days in meter	3.	Net MVARH for V > 103%	15min block	40days in meter	4.	Net MVARH for V < 97%	15min block	40days in meter	5.	Cumulative Net MWH at every midnight		10 days in meter/ 40 days in PC	6.	Cumulative Net MVARH for V> 103% at every midnight	
	Parameters	Details	Min No of days																												
1.	Net MWH	15 min block	40days in meter																												
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4.	Net MVARH for V < 97%	15min block	40days in meter																												
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CLAUSE NO.		TECHNICAL SPECIFICATIONS		
7.0		7. Cumulative Net MVARH for V < 97% At every midnight		10 days in Meter/ 40 days in PC
		8. Date and time blocks of VT failure on any phase.		
	k)	Shall have a built in clock and calendar with an accuracy of less than 15 seconds per month drift without assistance of external time synchronizing pulse.		
	l)	Date/time shall be displayed on demand. The clock shall be synchronized by GPS time synchronization equipment being supplied by the contractor.		
	m)	The voltage monitoring of shall be inbuilt feature provided to signal failures to the Substation Automation System, The meter shall be suitable to operate with power drawn from the VT supplies. The burden of the meters shall be less than 2 VA.		
	n)	The power supply to the meter shall be healthy even with a single-phase VT supply. An automatic backup, in the event of non-availability of voltage in all the phases, shall be provided by a built in long life battery and shall not need replacement for at least 10 years with a continuous VT interruption of at least 2 years. Even under absence of VT input, energy meter display shall be available and it shall be possible to download data from the energy meter. Incase data downloading is not possible in absence of VT supply, meter with provision of 220V DC auxiliary power shall be provided. Date and time of VT interruption and restoration shall be automatically stored in a non-volatile memory.		
	o)	Shall have an optical port on the front of the meter for data collection from either a hand held meter reading instrument (MRI) having a display for energy readings or from a notebook computer with suitable software . The contractor shall supply the MRI and/or notebook complete with all optical interface unit required.		
	p)	The meter shall have means to test MWh and MVARh accuracy and calibration at site in-situ and test terminal blocks shall be provided for the same.		
	q)	Each meter shall have a unique identification code provided by the Owner and shall be permanently marked on the front of the meter and stored in the non-volatile memory of the meter.		
	<b>Type Test requirement for Energy Meter</b> All Type Test Reports shall be provided as per IEC 62052-11, IEC 62053-22, IS 14697.			
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## ANNEXURE -A

KAYAL WATER TEST READINGS (North of South Bund- 22MW floating Solar plan)											
	pH	Conductivity	Turbidity	CaH	Total hardness	Total Alkali	Chlorides(Cl <sup>-</sup> )	Sulphates(So <sub>4</sub> <sup>-2</sup> )	Silica(Sio <sub>2</sub> )	Fe	Organic Matter
SAMPLE 1	7.66	7.94	2.94	130	790	22	2573.75	38.602	0.8723	0.2016	1.2
SAMPLE 2	7.67	7.85	3.79	140	770	26	2556	34.045	0.8659	0.1837	1
SAMPLE 3	7.64	7.49	4.48	120	750	28	2564.87	36.488	1.3119	0.1318	1.1

sample 1 - From east side

sample 2- From south side

Sample 3- From west side


	PURCHASE SPECIFICATION ESE LIGHTNING ARRESTOR SYSTEM	PS-439-ESE LA
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**PURCHASE SPECIFICATION FOR  
SUPPLY OF  
ESE LIGHTNING ARRESTOR SYSTEM**

01	21-05-2020	VIPINDAS CP	SREENATH M
<b>Revision</b>	<b>Date</b>	<b>Prepared</b>	<b>Checked &amp; Approved</b>

	<b>PURCHASE SPECIFICATION</b>  <b>ESE LIGHTNING ARRESTOR SYSTEM</b>	PS-439-ESE LA
		REV NO: 00
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## 1.0 Introduction

This technical specification provides BHEL requirements for supply of ESE Lightning protection system for the Floating type solar photovoltaic project.

## 2.0 Scope of supply

Sl. No	Item Description	Qty
<b>A</b>	<b>Supply of Lightning arrestor protection system</b> (comprising of following components) <ul style="list-style-type: none"> <li>Supply of ESE lightning arrestor terminal as per clause A 1.0</li> <li>Supply of 5m LA mounting pole &amp; accessories for array as per clause A 2.0</li> <li>Supply of Down Conductor as per clause A 3.0</li> <li>Supply of Lightning Event Counter as per clause A 4.0</li> <li>Supply of earthing set for LA as per clause A 5.0</li> <li>Installation of ESE lightning arrestor as per clause A 6.0</li> </ul>	18 sets

## 3.0 Documents to be submitted along with offer

- BHEL specification duly signed and sealed by vendor on each page
- Product catalogue of ESE-LA
- Type test certificates for ESE-LA terminal with test reports complying to NF C 17 102(2011)
- General arrangement and detailed drawings with bill of materials of the overall LA arrangement
- Lightning arrestor protection coverage area calculations
- Installation manual for ESE-LA

## A) Supply and Installation of Lightning arrestor protection system


The vendor shall supply lightning protection system to protect the **floating** solar array, floating inverter platform and control room using ESE-type Lightning arrestors complying to NF C 17 102 (2011) standard. Vendor shall provide the lightning radius coverage with supporting calculations.

The complete lightning protection system will comprise the following key components:

- ESE type Lightning Air Terminal
- Mounting support and mounting accessories
- Down conductor
- Lightning Event Counter
- Dedicated earthing system

## 1.0 ESE type Lightning Air Terminal

- The lightning air terminal shall be an Early Streamer Emission type terminal which will respond dynamically upon downward leader activity in the near area.
- The external shape of the advanced lightning rod shall be such that it will limit the development of sharp point corona discharge under static thunderstorm conditions and enhance leader initiation.
- The lightning air terminal shall have no moving parts and will have no dependence on an external power supply or batteries.
- All components of the advanced lightning terminal shall be non-corroding.

	<p style="text-align: center;"><b>PURCHASE SPECIFICATION</b></p> <p style="text-align: center;"><b>ESE LIGHTNING ARRESTOR SYSTEM</b></p>	PS-439-ESE LA
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5. The lightning air terminal should have been tested and certified in accordance with NF C 17-102:2011.
6. The radius of coverage of LA shall be as per protection Level 4 (minimum 107m protection radius).
7. Triggering gap shall be selected so that streamers are not launched until the electric field conditions are at an optimum magnitude for conversion to a stable, propagating upward leader.

## **2.0 LA mounting pole for Lightning Air Terminal**

1. The mounting pole shall be used to support the lightning air terminal. It shall be steel material.
2. Lightning protection system shall protect the solar array modules which are floating on the water body. The lightning pole height shall be minimum 5 m from floater surface level for PV array and inverter platform, and minimum 5 m for control room.
3. The mounting pole shall be supported with minimum 3 set of Guy wires with suitable guy ring, clamps and hardware. The guy wire kit shall be supplied by vendor.
4. Mounting pole shall have appropriate base plate for mounting on floating platform/RCC control room.
5. Suitable provision for running the down conductors through the centre of the pole shall be provided.

## **3.0 Down Conductor**


1. Each lightning air terminal shall be connected to earth (under water) using down conductor.
2. The down conductors shall have a minimum size of 50 mm<sup>2</sup> each and shall be insulated round stranded copper conductor cable of reputed make. The down conductors shall be fixed securely every one meter along the length of mast wherever exposed.
3. Below water down conductor can be bare conductor also.
4. The down conductors shall allow for direct connection to the lightning rod and to the earth electrode through the use of compression lug. The ESE lightning terminal shall have provision for the lug connection. Suitable lugs and hardware shall be supplied along with the down conductor.

## **4.0 Lightning Event Counter**

1. Each ESE type lightning arrester shall be provided with individual lightning event counter to record lightning events arrested by particular ESE LA.
2. Lightning counters shall have IP65 or better rating enclosure and shall have provision for fixing of lightning mast pole using clamp, bolts and nuts.
3. Lightning counter shall have suitable lightning current withstand capacity according to the ESE LA rating. Test links shall be supplied along with each Lightning event counter to enable testing of LA and counter.

## **5.0 Earthing set for ESE LA**

The earthing system shall incorporate minimum two dedicated chemical earth electrode for each ESE LA. The electrode shall be deep driven solid copper, copper bonded steel rod. Earth resistance enhancing compound shall be used in order to reduce the resistivity levels of the earthing system. All components of the earthing system shall be electrically connected to the central injection rod which is securely connected to the lower end of the high voltage shielded cable. The earthing system shall be installed so that the enhanced earth resistance reading does not exceed 5 Ohms.

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## 6.0 Installation of ESE LA


Vendor shall fabricate suitable base plate for fixing the LA on HDPE floating platform or construct the suitable RCC foundations for installing on ground on case to case basis and install the LA mast along with guy wires, down conductor, lightning event counters and test link. The earth pit installation and interconnection with associated LA is also in vendor scope.

### **B) Documents to be submitted within 7 days after receipt of purchase order**


1. General arrangement and detailed drawings with bill of materials of the overall lightning arrestor arrangement
2. Lightning arrestor protection coverage area calculations
3. Mounting details of base plate arrangement.
4. Installation manual for LA-ESE and earthing


### **C) Documents to be submitted along with consignment**


1. ESE LA installation manual with GA drawings
2. Manufacturer test report for each LA


CLAUSE NO.	TECHNICAL SPECIFICATIONS			
1.0	<b>C-10 PLANT ILLUMINATION SYSTEM</b>			
	This chapter covers supply and installation of suitable illumination system along the peripheral roads and along the approach roads to inverter room and main control room, control room, inverter room(s), switchyard and other facilities inside the plant.			
	<b>DESIGN PHILOSOPHY</b>			
2.0	A comprehensive illumination system shall be provided in the entire project. Each building shall be provided with adequate light fittings, 6A/16A socket, fans, etc. Exhaust fans shall also be provided in toilets, battery room, etc			
	All outdoor lighting system shall be automatically controlled by synchronous timer or photocell. Provision to bypass the timer or photocell shall be provided in the panel.			
3.0	<b>LIGHTING SYSTEM DESCRIPTION for CMCS and inverter room</b>			
	Normal AC Lighting System: AC lighting system 415V, 3Phase, 4wire, will be fed from lighting panels Control Board (LPs) which in turn will be fed from the lighting distribution boards (LDBs) of AC Switch board MCC. Emergency AC Lightning System: The emergency lighting system consisting of 20% of the lights shall be fed from UPS DB or DCDB as per scheme adopted by the EPC bidder. Load of the same has to be considered for UPS/ Battery and charger sizing. Bidder shall provide indoor and outdoor emergency lighting at each inverter room, CMCS, security room and main gate.			
3.0	<b>Lighting Fixture, Lamps &amp; Accessories</b>			
	<div>a. All lighting fixtures and accessories shall be designed for continuous operation for its life under atmospheric conditions existing at site.</div> <div>b. AC lighting fixtures and accessories shall be suitable for operation on 240 V, AC, 50 Hz supply with supply voltage variation of +/-10%, frequency variation of +/- 5% and combined voltage and frequency variation (absolute sum ) of 10% DC lighting fixtures and accessories shall be suitable for operation on 220 V, with variation between 190 V &amp; 240 V.</div> <div>c. All lighting fixtures shall be complete with lamp(s), lamp holder(s), LED chip assembly, terminal blocks, clamps, locking arrangements, fixing brackets etc. Driver circuit/Control gears shall be provided as applicable / specified. The fixtures shall be fully wired upto terminal block. The internal wiring of the fixtures shall be done with suitable low smoke halogen free thermo-plastic or silicon rubber insulated or fire</div>			
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	<p>retardant PTFE copper conductor wires of suitable size and type. Further fuse protection of suitable rating in input side shall also be provided specifically for LED luminaires. However, the normal cross section of conductor shall be not less than 0.5 Sq. mm and minimum thickness of insulation shall be 0.6 mm. The wiring shall be capable of withstanding the maximum temperature to which it will be subjected under specified service conditions without deterioration and affecting the safety of the luminaire when installed and connected to the supply. All fixing /locking screws, washers, nuts, brackets, studs etc, shall be zinc plated and passivated.</p> <p>d. All lighting fixtures shall be provided with an external, brass/GI earthing terminal suitable for connecting 14 SWG, GI earthing wire. All metal or metal enclosed parts of the housing and accessories shall be bonded and connected to the earthing terminal as so to ensure satisfactory earthing continuity through out the fixture</p> <p>e. The lighting fixtures shall be designed for minimum glare. The finish of the fixtures shall be such that no bright spots are produced either by direct light source or by reflection</p> <p>f. The reflectors shall be manufactured from CRCA sheet steel or aluminium as specified. The aluminium reflectors shall be made of high purity aluminium sheet, polished electrochemically brightened and anodized or proven alternate arrangement of anodizing</p> <p>g. Starters shall have bi-metal electrodes and high mechanical strength. Starters shall be replaceable without disturbing the reflector or lamps and without use of any tool. Starter shall have brass contacts and radio interference suppressing capacitor.</p> <p>h. LED luminaires body shall such designed that heat sink/heat dissipating housing shall be mounted outside the overall luminaires fixture housing, and shall be suitably clearing the driver circuit. Further for outdoor type LED luminaires, the exposed heat sink shall be suitably designed to avoid dust/foreign particles accumulation on the same.</p> <p>i. LED luminaires housing/body shall be pressure die cast aluminium or extruded Aluminium or CRCA as specified alongwith finished powder coating. Care shall be taken in the design that there is no water stagnation anywhere.</p>			
4.0	<p><b>LED LUMINAIRES:</b></p> <p><b>4.1 CODES AND STANDARDS</b></p> <p>All standards and codes of practice referred to herein shall be the latest edition including all applicable official amendments &amp; revisions as on date of techno-commercial bid opening. In case of conflict between this specification and those (IS codes, standards etc.) referred to herein, the</p>			
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	former shall prevail. All work shall be carried out as per the following standards & codes.		
16101:2012	General Lighting. LEDs and LED modules	Terms and definitions	
16102(Part 1):2012	Self Ballasted LED Lamps for General Lighting Services.	Part-1 Safety Requirements.	
16102(Part 2):2012	Self Ballasted LED Lamps for General lighting Services.	Part-2 Performance Requirements.	
16103(Part I):2012	LED modules for General lighting Safety	Requirements.	
15885(Part 2/Sec. 13) :2012	Lamp control gear Part 2 particular Requirements Section 13 d.c. or a.c.	Supplied Electronic control gear for LED modules	
16104:2012	d.c. or a.c. Supplied Electronic control gear for LED modules - Performance	Requirements.	
16105:2012	Method of Measurement of Lumen maintenance of Solid-state Light (LED)	Sources.	
16106:2012	Method of Electrical and photometric Measurements of Solid State Lighting (LED)	Products	
16107:2012	Luminarie Performance		
16108:2012	Photobiological safety of Lamps and Lamp	Systems	
IS 513	Cold rolled low carbon steel sheets and strips		
IS 12063	Classification of degree of protection provided by enclosures.		
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CLAUSE NO.	TECHNICAL SPECIFICATIONS		
	<p>IS 14700 (Part 3/Sec. 2)</p> <p>IS 9000 (Part 6)</p> <p>IS 15885 (Part 2/Sec. 13) IS 16004 – 1 and 2)</p> <p>IS 4905 IEC 60598</p> <p>IEC 61000-3-2</p> <p>IEC 61000-4-5</p> <p>IES-LM 80 along with TM 21/ IS 16105</p> <p>IES-LM 79 / IS 16106</p> <p><b>4.2 LED LIGHTING SYSTEM</b></p> <p>LED Luminaires shall be used for the lighting of all the indoor &amp; outdoor areas. However for DC lighting &amp; hazardous areas conventional type luminaires shall be used. In false ceiling area LED luminaires shall be recessed mounting type &amp; in non-false ceiling area the LED luminaires shall be surface mounting type.</p> <p>The individual lamp wattage for LED shall be upto 3 watt for outdoor type luminaires. However for indoor type luminaires fractional wattage LEDs are also acceptable. The LED chip efficacy shall be min 120 Lm/W. The luminaire efficacy shall not be less than 80 Lm/W. Heat sink/heat dissipation arrangement shall be provided in the luminaires. The LED used in the luminaires shall have colour rendering index (CRI) of Min 70 and 80 for outdoor and indoor luminaires respectively.</p> <p>Colour designation of LED shall be “cool day light” (min 5700K) type for indoor type LED luminaires. Further for outdoor type luminaires, the colour designation shall be 5000K, except for well glass type LED luminaires, where the colour designation shall be 4000K. The LED luminaires shall</p>	<p>Electro magnetic compatibility (EMC) – Limits for Harmonic emission – THD &lt; 15% (equipment, input current &lt; 16 Amps. per phase.</p> <p>Environment testing: Test Z – AD: composite temperature/humidity cyclic test.</p> <p>Lamp control gear: particular requirements for DC or AC supplied electronic control gear for LED modules.</p> <p>Method for random sampling Ingress protection, luminaire performance and safety</p> <p>Total Harmonic Distortion</p> <p>Surge Protection</p> <p>Lumen Depreciation and Rated life of LED chip</p> <p>Luminaire optics and color parameter and electrical parameter</p>	
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CLAUSE NO.	TECHNICAL SPECIFICATIONS			
	<p>have minimum life of 25,000 burning hours with 80% of lumen maintenance at the end of the life.</p> <p>The beam angle for LED chip for indoor type luminaires shall be 120 degrees. However for highbay &amp; flood light type outdoor luminaires the LED chip with suitable beam angle shall be used to deliver better lumen-output. The maximum junction temperature of bare LED without heat sink shall be limited to 85 deg C, further the lumen maintenance at this temperature shall be min 90%. The THD of tube light based LED Luminaires shall be less than 20%. For other type of luminaries, it shall be minimum 10%.</p> <p>Further the EMC shall be as per IS 14700. The power factor of the luminaire shall not be less than 0.9. The marking on luminaire &amp; safety requirements of luminaire shall be as per IS standards. Suitable heat sink/ heat dissipation arrangement, with proper thermal management shall be designed for the luminaires.</p> <p>Driver Circuit: LED modules and drivers shall be compatible to each other. The LED module driver's ratings and makes shall be as recommended by corresponding LED manufacturer.</p> <p>LED Drivers may have following control &amp; protections:-</p> <ul style="list-style-type: none"><li>• Suitable precision current control of LED.</li><li>• Open Circuit Protection</li><li>• Short Circuit Protection</li><li>• Over Temperature Protection</li><li>• Overload Protection</li><li>• Surge Protection</li></ul> <p>Lighting panels shall be powder coated with color shade RAL9002. Lighting panels shall have IP55 degree of protection.</p> <p>Wires of different phase shall normally run in separate conduit.</p> <p>Power supply shall be fed from 415 / 240 V normal AC supply through suitable number of conveniently located lighting distribution boards (LDB) and at least one 6/16A, 240V AC universal socket outlet with switch shall be provided in offices, cabins, etc.</p> <p>Suitable number of 63A, 3ph, 415V AC industrial receptacles shall be provided for welding purposes at one location.</p> <p>Incandescent lamps may be used only with DC Lighting.</p> <p>Electrification of all building shall be carried out as per IS 732-1989, IS 4648-1968 and other relevant standards.</p> <p>Indoor Lighting fixtures shall generally be controlled from switch boxes of each area not directly from lighting panel. Each switch shall control a maximum of three fixtures.</p> <p>All luminaries and their accessories and components shall be of type readily replaceable by available Indian makes.</p>			
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CLAUSE NO.	TECHNICAL SPECIFICATIONS			
	<p>Following test reports to be submitted for LED chip/LED luminaires:</p> <p>a) LED parameters like Lumen per watt, CRI, Beam angle from manufacturer.</p> <p>b) LM 80/IS: 16105 report.</p> <p>c) LM 79/IS: 16106 report</p>			
5.0	<p><b>JUNCTION BOXES, CONDUITS, FITTING &amp; ACCESSORIES</b></p> <p>Junction box for indoor lighting shall be made of fire retardant material. Material of JB shall be Thermoplastic or thermosetting or FRP type. Junction boxes for street lighting poles and lighting mast if applicable , shall be deep drawn or fabricated type made of min. 1.6 mm thick CRCA Sheet. The box shall be hot dip galvanized. The degree of protection shall be IP55.</p> <p>All switches and receptacles upto 16A shall be modular type. These shall be provided with pre-galvanized/galvanized modular switchbox &amp; plate.</p> <p>Conduits, Pipes and Accessories:</p> <p>Heavy duty PVC conduits conforming to IS: 9537 Part-III along with various accessories shall be used for indoor wiring in the buildings. These conduits shall be concealed in the wall/floor/roof. However, in PEB's, conduits can be fixed on surface.</p> <p>Pull out boxes shall be provided at suitable interval in a conduit run .Boxes shall be suitable for mounting on Walls, Columns, etc. Pull-out boxes shall have cover with screw. Pull out boxes used outdoor shall be weather proof type suitable for IP: 55 degree of protection and those used indoor shall be suitable for IP: 52 degree of protection.</p>			
6.0	<p><b>LIGHTING WIRES</b></p> <p>Lighting wires shall be 1100 V grade, light duty PVC insulated unsheathed, stranded copper/aluminium wire for fixed wiring installation. colour of the PVC insulation of wires shall be Red, Yellow, Blue and Black for R,Y,B phases &amp; neutral, respectively and white &amp; grey for DC positive &amp; DC negative circuits, respectively. Minimum size of wire shall not be less than 1.5.sq.mm. for copper</p>			
7.0	<p><b>LIGHTING POLES</b></p> <p>The Street Light system and peripheral lighting shall be designed generally in line with design guidelines. Height of the poles should be chosen so as not to affect working of Solar panels. The poles shall be hot-dip galvanized as per relevant IS2629/ IS2633/ IS4759. The average coating thickness of galvanizing shall be min. 70 micron. The System shall be capable of withstanding the appropriate wind load etc as per IS 875</p>			
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Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
1.	SPV module	I	Q-001	BHEL	Bangalore	A	
				Warree	Surat	A	
				Emmvee	Bangalore	A	
				Vikram Solar	Parganas	A	
				Lanco Solar	Chattisgarh	A	
				Tata Power Solar	Bangalore	A	
				Alpex	Solan	A	
				Synergy	Durgapur	A	
				Photonix	Satara	A	
				HHV Solar	Bangalore	A	
2.	Power Conditioning Unit (PCU)	I	Q-002	Schneider	Bangalore	A	Conditions apply
				ABB	Bangalore	A	Conditions apply
				Bongfiglioli	Germany	A	Conditions apply
				Fecon	Germany	A	Conditions apply
				AEG	Bangalore	A	Conditions apply
				Hitachi-Hirel	Gandhinagar	A	Conditions apply
				Hitachi-Hirel	Sananad	A	Conditions apply
				Vacon	Bangalore	A	Conditions apply
3.	String Monitoring Box (SMB)	II	Q-003	Trinity Touch	Palwal	A	Conditions apply
				Hensel	Sriperumbudur	A	Conditions apply
				AEG	Bangalore	A	Conditions apply


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Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
				Statcon	Pilkhuwa	A	Conditions apply
				Weidmuller	Spain	A	Conditions apply
4.	Weather station panel (comprising of Pyranometer, anemometer & thermometer etc.)	III		Any make-model with VDE/ CE/UL/ CSA marking or BIS approved with CML no. (Refer Note-6)			
5.	DC Cable Connector	III		Any make-model which is Type Tested as per EN 50521 or having marking of VDE/ CE/UL/ CSA/ "BIS with CML no." (Refer Note-1)			
6.	Floor mounted Draw out type indoor LT Switchgear Panel (MCC etc.) Refer Note-5	I	Q-004	L&T	Mumbai / Coimbatore/Ahmednagar	A	BOIs preferably with VDE/CE/UL/CSA marked or BIS approved with valid CML no.
				GE	Bangalore	A	
				C&S Electric	Noida / Hardwar	A	
				Schneider	Nasik	A	ACB from Schneider, France
				Unilec	Gurgaon	A	
				Siemens	Kalwa	A	Conditions apply
				Tricolite	Sahibabad/Manesar	A	Conditions apply
				Nitya Electrocontrols	Noida	A	
7.	LV Air Circuit	*		C&S Electric	Noida	A	*(part of Swgr MQP)

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Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
	Breaker			L&T	Mumbai	A	
				GE	Bangalore	A	
				Siemens	Germany	A	
				Schneider	France	A	
8.	Floor mounted Fixed type indoor LT Switchgear Panel ( ACDB / DCDB / MLDB etc.) Refer Note-5	I	Q-005	Switching Circuits	Kolkata	A	BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no.
				Hindustan Control & equipment Ltd	kolkata	A	With fabrication & painting at unit II & MP Electrical Narendrapur
				Maktel	Vadodara	A	Prior Type Testing
				Jakson	Greater Noida	A	
				Vidyut Control	Gaziabad	A	
				Adlec Power	Rohad ( Jhajjar)	A	
				Pyrotech	Udaipur	A	
				Conquerent Control System	Manesar	A	Condition apply ,upto 1250A
				Control & Schematics	Hyderabad	A	
				Positronics	Vadodara	A	
				Anand Power Ltd.	Noida	A	
				Additionally all vendors identified for Floor mounted Draw out type indoor LT			

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				Switchgear Panel			
9.	Wall mounted fixed type indoor / outdoor LT Switchgear non compartmentalized Panel ( Lighting panels / AC / DC Fuse boards etc.) Refer Note-5	I	Q-006	Control Devices	Kolkata	A	BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no.
				Jasper	Noida	A	
				Havells	Faridabad	A	
				Novateur Electrical & distribution systems	Murthal	A	
				Avaid Technovator	Manesar	A	
				Additionally all vendors identified for Floor mounted Draw out type indoor LT Switchgear Panel			
				Additionally all vendors identified for Floor mounted fixed type indoor LT Switchgear Panel			
10.	Lighting & Welding Transformer	II	Q-007	Southern Electric	Chennai	A	


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Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
				Indcoil	Thane	A	
				Pragati	Thane	A	
				Prayog	Pune	A	
				Precise	Mumbai	A	
				Logicstat	Delhi	A	
				Gujarat Plug in	Vadodara	A	
				AE	Thane	A	
				Power Pack Enterprises	Mumbai	A	
				Amex Impex,	Ahmedabad	A	
11.	LT CT/PT/CBCT/ Control Transformer	III		Kappa	Bangalore	A	
				Southern Electric	Chennai	A	
				Precise	Mumbai	A	
				G&M	Baroda	A	CBCT Only
				Silkaans	Mumbai	A	
				Ind Coil	Mumbai	A	
				Pragati	Thane	A	
				Prayog	Pune	A	
				AE	Mumbai	A	
				Logicstat	Delhi	A	For control transformer only
				C&S Electric	Noida	A	For CT only
				Newtek	Aurangabad	A	For CT/PT/Control transformer
12.	1.1Kv LT Power Cable	Refer	Q-008	Universal Cable Ltd.	Satna	A	

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	(From SMB to PCU)	Note-2					
				NICCO	Shamnagar , Kolkata	A	
				Torrent Cable Ltd	Nadiad	A	
				Incab	Pune	A	
				Hindustan Vidyut Products Ltd	Faridabad	A	
				KEI Industries	Bhiwadi	A	
				Delton Cable Ltd	Faridabad	A	A) Unarmoured cable all sizes. B) Armoured cable up to 3.5 x 240 sq. Mm with GI strip armour and 1CX70 sq mm with Al strip armour
				Paramount Cable	Khushkhhera	A	
				Polycab Wires Pvt. Ltd	Daman	A	
				Gemscabs Industries	Bhiwadi	A	
				Cords Cables	Bhiwadi	A	
				Havells India Ltd.	Alwar	A	
				Sri ram Cables	Bhiwadi	A	
				Ravin Cables	Pune	A	
				Thermocables	Hyderabad	A	
				Sbee Cables	Bangalore	A	
				Suyog Cables	Vadodara	A	
				Gupta Power Cables	Khurda	A	
				Finolex	Pune	A	
				Scot Innovation wires and cables	Baddi	A	
				Anhui Hualing	China	A	

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SI. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
				LS Cable	Korea	A	
				Radiant Cables	Hyderabad	A	
				Tirupati Plastomatics	Jaipur	A	
				Apar Industries	Umbergao n	A	
				Special Cables	Rudrapur	A	
				ABB Kabel	Germany	A	
				Advance cable	Bengaluru	A	
				Step Industries	Shahjahanp ur	A	
				Taihan Electric Wire	Korea	A	
				Tbea Shandong	China	A	
				CMI	Baddi	A	
				Dynamic Cables	Jaipur	A	Conditional Approval
13.	1.1 KV Control Cable	Refer Note-2	Q-009	Universal Cable Ltd.	Satna	A	
				NICCO	Shamnagar , Kolkata	A	
				Torrent Cable Ltd	Nadiad	A	
				Incab	Pune	A	
				Polycab WiresPvt. Ltd	Daman	A	
				Hindustan Vidyut Products Ltd	Faridabad	A	
				KEI Industries	Bhiwadi	A	
				Delton Cable Ltd	Faridabad	A	
				Paramount Cable	Khushkher	A	



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Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
					a		
				Gemscabs Industries	Bhiwadi	A	
				Cords Cables	Bhiwadi	A	
				SPM Cables	Hyderabad	A	
				Elkay Telelink	Faridabad	A	
				Havells India Ltd.	Alwar	A	
				R.R. Kabel	Silvasa	A	
				Ravin Cables	Pune	A	
				Gupta Power cable	Khurda	A	
				Thermocables	Hyderabad	A	
				Finolex	Pune	A	
				Sbee Cables	Bangalore	A	
				Suyog Cables	Vadodara	A	
				Scot Innovation wires and Cables	Baddi	A	
				Anhui Hauling	China	A	
				LS Cable	Korea	A	
				Radiant Cables	Hyderabad	A	
				Tirupati Plastomatics	Jaipur	A	
				Apar Industries	Umbergao n	A	
				Special Cables	Rudrapur	A	
				Advance cable	Bengaluru	A	
				Step Industries	Shahjahanp ur	A	
				Taihan Electric Wire	Korea	A	
				Tbea Shandong	China	A	
				CMI	Baddi	A	