Ref:EDN:SCPV:PVSYS:2008/01
Date : 27.11.2008

EXPRESSION OF INTEREST FROM CONTRACTORS CAPABLE OF SYSTEM INTEGRATION AND COMMISSIONING OF MW GRID CONNECTED SOLAR PV POWER PLANTS

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SUBMISSION OF BUDGETARY OFFER FOR 3 MWp SPV GRID CONNECTED PLANT

Introduction about us:

Bharat Heavy Electricals Limited (BHEL) is an ISO-9001:2000, ISO 14001 & ISO 18001 certified premier engineering and manufacturing organization with majority share holding by Govt. of India. BHEL is catering to the core infrastructure sectors of Indian economy viz. Power Generation, Transmission, Industry, Transportation and Renewable Energy. BHEL has been in this business for almost five decades now. In India BHEL has 14 manufacturing units, 4 power sector regions, 8 service centres and 15 regional offices besides host of project sites spread all over India and abroad. BHEL supplied equipments account for more than 65% of the total installed generating capacity in India and contribute approximately 73% of the total power generation in the country. BHEL has been in the field of manufacturing of solar PV cells, modules and systems since 1983. Cumulatively BHEL SPV system installations total upto nearly 18 MW. BHEL SPV modules are IEC 61215 certified and are being exported to various parts of the globe. Due to enhanced business potential in large MW system installations BHEL proposes to empanel vendors for addressing this market.

SC&PV DEPT., BHEL, EDN, BANGALORE is desirous of empanelling vendors of repute as per the scope attached as per Annexure II.

Interested bidders are requested to submit

a. their applications for empanelment along with credentials in support of all the techno commercial as well as general requirements as indicated in the enclosed Annexure I

b. budgetary offer for 3 MWp SPV Grid Connected plant as per technical specifications attached vide Annexure III

BHEL reserves the right to accept or reject any or all the applications and stop processing assessment without assigning any reason thereof. This expression of interest does not bind BHEL to send enquiry to the bidders.

Last date for submission of application and credentials shall be 10th December 2008.

For Bharat Heavy Electricals Limited

AGM (SC&PV-MM)

Communication details :

Agency : BHEL EDN Bangalore
Address : PB # 2606, Mysore Road, Bangalore – 56 0026.
Phone : +91 80 26740158/26998338
Fax : +91 80 26740137
Email : scpv@bheledn.co.in

Annexure – I

PRE-QUALIFICATION CRITERIA

PROJECT : Setting up of MWp sized SPV Grid Connected Power Plant

REFERENCE NO.: EDN:SCPV:PVSYS:2008/01

EXPRESSION OF INTEREST FROM CONTRACTORS CAPABLE OF SYSTEM INTEGRATION AND COMMISSIONING OF MW GRID CONNECTED SOLAR PV POWER PLANTS

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Qualification Criterion:

1. The vendor should have an average minimum Annual Turnover of Rs. 250 million in last three years. The bidders should have earned profit in the last three financial years and should have positive networth as on 31.03.2008.

   Bidders should submit audited Balance Sheet and Profit and Loss Account for the last three financial years in support of above.

   In case audited balance sheet as on 31.03.2008 has not been finalized, bidder may submit audited balance sheet for last three financial years.

2. Vendor should have successfully executed within the past two years atleast 1 MWp (minimum capacity) SPV Grid Connected plant which will contain SCADA system. Credentials of such systems executed with the details of project execution time and the present performance of the system shall be furnished.

3. Vendor shall have the required skilled work force and the necessary tools and tackles along with engineering skills to complete the 1 MWp project.

4. Vendor should furnish information regarding projects in hand, current litigation, order recording exclusions/ expulsion/ black listing etc.

5. Vendor should furnish information regarding organizations manpower strength.

6. Vendor shall submit the details regarding tie-up for supply of Solar cells, modules and other BoS items such as cable quick connects, inverters, SCADA systems etc.

7. Vendor shall be capable of integrating multiple MW size plants including SCADA systems.

Annexure – II

SCOPE OF WORK

PROJECT : Setting up of MWp sized SPV Grid Connected Power Plant

REFERENCE NO.: EDN:SCPV:PVSYS:2008/01

Brief Scope of activities of MW system is as listed below:

1. Site specific system engineering – site analysis, evaluation of performance ratio, preparation of layout drawings, support structure design, cabling schedule, earthing system

2. Supply of Grid Connect inverters along with integrated SCADA system

3. System integration including commissioning of the entire system upto energy feeder

4. Provide support to BHEL through respective OEMs for the supply of mono/multi-crystalline cells (125 sq.mm. or 156 sq.mm.) and PV modules (170 Wp and above) along with Balance of Systems (BoS) which include support structures, power conditioning units consisting of grid connected inverters and SCADA system with field sensors incorporated.

Note :

1. **Please read Technical specifications in conjunction with the scope detailed in the Bid Format**
2. **Civil works and other items which are not called in the bid format shall be ignored while reading the tech specs under Annexure III and are not required to be quoted.**

ANNEXURE - III

SECTION – A
SOLAR PV PLANT - TECHNICAL SPECIFICATION

1.00 SCOPE:-

1.01 This specification covers the design, manufacture, supply, erection, testing and commissioning of two numbers of grid connected solar PV plants each of 3 MWp capacity and grid connecting equipments including all associated civil works required for power evacuation through the existing 11 KV line. One plant is to be established in Yelasandra village in Kolar District and other in Itnal village in Belgaum district.

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1.02 It also covers the operation and maintenance of the plant and power evacuation for a period of one year from the date of commissioning.

2.00 CODES AND STANDARDS

Equipment shall conform to international standards including IEEE for design and installation of grid connected PV system The standards cover various aspects such as PV modules , cable types and selection , temperature considerations, voltage ratings ,BOS wiring, inverter wiring, blocking diodes, bypass diodes, disconnect devices , grounding requirements, surge and transient suppression, load centre, power qualities , protection features and safety regulations in addition to practices as mentioned in Data Sheets.

3.00 DEFINITION

Solar PV energy is an important technology which converts natural light energy in to an useful electrical energy. The photovoltaic modules are made of mono-crystalline / polycrystalline silicon solar cells which are connected in series and series parallel combination of the modules provide panels and sub-arrays to deliver more and more power at higher system voltages.

4.00 SYSTEM FEATURES

4.01 Each 3 MWp capacity solar PV plant shall consist of 12 nos. Of 250 KWp each solar arrays. The respective digital outputs are taken to a supervisory controller located in the control room. The inverter units are provided at the DC input. Necessary LT &HT switch gears such as 11 KV CBs, CTs , PTs are required for HT isolation & protection.

4.02 A 250KWp system will have an independent Data Acquisition System (DAS) which would produce the real time Data as well as event logs

indicating all the supervisory faults also. An integrated SCADA system is incorporated to have data logs of entire 3 MW plant.

4.03 Inverters are connected in parallel to the common utility bus. Depending on the magnitude of the Solar power generated, (which depends on solar radiation) sequentially inverters are switched ON automatically. This ensures better conversion efficiency (>95%) as the solar power generation increases. The system gets into STAND BY MODE where only monitoring logic will be active. The system is to not be switched ON until the solar array generates sufficient power, which is a set point control.

4.04 In the AUTOMATIC MODE all the PV sub arrays are connected after the system has been switched ON. Then the MPPT controller continuously searches for the Max. Power point thus operates at the proper MPP voltage to ensure maximum energy utilization on real time basis.

5.00 GENERAL SCHEME OF EACH 3 MW PLANT

5.01 The general scheme of the Solar Power System shall be a three (3) megawatt peak capacity, installed at one site. Approximately 15 acres will be available for a 3 megawatt installation. The whole installation shall have a minimum of 25 year design lifetime

5.02 The Solar Power System shall be offered in equal sub arrays and the system shall comprise the following major equipments:

5.03 Solar Grid connected inverters of 250 kW capacity each shall be used

5.04 Suitable designed connection to the local 11 kV feeder that will be within approximately 500 metres of the site

5.05 A SCADA / data logging system to enable control and monitoring of the system locally and remotely to be provided.

5.06 The solar modules will be installed on suitable frames with all interconnection cabling. The DC bus voltage will be in the range of 450 to 750 Volts maximum.

5.07 There will be 12 grid connect inverters used at the 3 megawatt site. These will be indoor/outdoor type.

5.08 This is a turn key project with all ancillary items, including construction of plant building compound wall and all systems as needed for the installation, commissioning of the solar plant . 110V DC batteries for DC supply shall be provided for control and protection systems and other auxiliaries.

5.09 Operational Strategy:

5.10 The SPV shall be utilized to feed power to the feeder line as identified by KPCL. The solar power shall be fed to the grid connect inverter such that the output power can be delivered directly to the feeder line

5.11 The inverters shall automatically turn on and off successively as the available solar irradiation varies over the day. The inverters shall have all the necessary synchronization equipment installed as necessary. The inverters shall also be configurable to operate on three, two or one phase depending on the grid

condition at any time. The voltage range shall be -20% to +15%. Capability to do voltage correction will be an advantage.

6.00 SOLAR PHOTO VOLTAIC MODULES

The photovoltaic modules are made of mono-crystalline / poly-crystalline silicon solar cells, which are connected in series to give required output. The interconnected cells are laminated in vacuum to withstand adverse environmental conditions. Module technology having high cell efficiency, reduced size, high reliability, with lesser cost shall be used.

6 01 SOLAR PHOTOVOLTAIC ARRAY

a. SPV modules to be supplied should have minimum declared output of at least 170 watt peak capacity under standard test conditions. The number of modules to be supplied shall be worked out accordingly.

b. Stabilized net output of the Solar PV Array for the Solar Power System should not be less than the Nominal design level for the System under Standard Test Condition. Modules shall be made of poly or mono-crystalline Silicon Solar cells

c. The SPV Module must be provided with acceptable Test & Certified documents. Some examples are IEC 61215 or IEE 1662 or CCEC 503 for crystalline silicon or IEC 616464 OR CEC 503 for crystalline silicon or IEC 61646 OR IEEE 1262 or equivalent and shall have 1000 Volt DC rating.

d. Each solar PV module shall be warranted by the manufacturer for at least 95% of its rated power for 10 years and 85% of its rated power for 25 years from the date of system acceptance."

e. The bidder shall provide the solar PV module electrical characteristics including current-voltage (I-V) performance curves and temperature coefficients of power, voltage and current.

6.02 MODULE MOUNTING STRUCTURE

a. The structure shall be designed for simple mechanical and electrical installation. It shall support SPV modules at a given orientation, absorb and transfer the mechanical loads to the ground properly.

b. The frames and ieg assembles of the array structures shall be made MS hot dip galvanized of suitable sections of Angie, Channel, Tubes or any ether sections as may deemed fit conforming to KPC standards

for steel structure to met the design criteria. Minimum thickness of galvanization should be at least 120 microns. All nuts & bolts shall be made of very good quality stainless steel. The minimum clearance between the lower edge of the modules and the developed ground level shall be 800 mm and confirm to standards.

c. The array structure shall be so designed that it will occupy minimum space without sacrificing the output from SPV panels at the same time it will withstand storm condition with wind speed up to maximum 150 kmph.

d. Nut & bolts, supporting structures including module Mounting Structures shall have to be adequately protected against corrosive atmosphere and saline weather.

6.03 **ARRAY FOUNDATION BASE**

The leg assembly of the module mounting structures will be fixed / tilting type for better output and grouted in foundation bases. The base columns made with reinforced cement concrete as per design based on site related data keeping in mind local conditions. The minimum clearance between lower edge of the Solar PV Panel and GL shall confirm to standards.

6.04 **JUNCTION BOXES AND PCU**

a. The junction boxes shall be dust, vermin, and waterproof and made of metal or thermoplastic. The junction boxes will have suitable cable entry points fitted with cable glands of appropriate sizes for both incoming and out going cables or alternatively the modules may be provided with connector cables.

b. Each Array Junction Box will have Suitable Reverse Blocking Diodes of maximum DC blocking voltage of 1000 V with suitable arrangement for its connecting. The Array junction Box will also have suitable surge protection such as MOV devices.

c. The efficiency of the PCU shall be more than 95 % at full load. The bidder shall specify the conversion efficiency in the offer.

d. The PCU shall have internal protection arrangement against any sustained fault in the feeder line and against lightning in the feeder line

e. The PCU shall have the required protection arrangements against earth leakage faults.

f. Specifically, the PCU should be three phase power conditioning unit using static solid state components. Both AC & DC lines shall have suitably rated isolators to allow safe start up and shut down of the system. Circuit breakers used in the DC lines must be rated suitably.

g. The PCU shall have provision for galvanic isolation. Each solid state electronic device shall have to be protected to ensure long life of the inverter as well as smooth functioning of the inverter

h. The PCU must have the feature to work in tandem with other similar PCU's and be able to be successively switched "ON" and "OFF" automatically based on solar radiation variations during the day. All sensors and hardware required for measurement and monitoring of solar radiation is to be provided by the bidder. Typical technical features of the grid connected inverter shall be as follows:

Continuous output power rating	250 kW
Nominal output voltage	415 V, 3 Phase, 50 Hz
Output frequency	50 Hz +/- 3 Hz
Maximum Input voltage	750 V DC
MPPT Range	450 V to 750 V DC
THD	Less than 4 %
Efficiency	95% and above
Ambient temperature	0- 45 deg C
Humidity	95 % non- condensing
Enclosure	IP 20 (indoor rated)
Nominal voltage & frequency of Grid	415 Volts, 3 phase, 50 Hz
Grid Frequency tolerance	+/- 3 Hz
Grid Voltage tolerance	- 20% and+ 15%

6.05 The PCU front panel shall be provided with a display (LCD or equivalent) to monitor the following

a. DC Input Voltage
b. DC Input current
c. AC Power output
d. AC voltage (all three phases)
e. AC current (all three phases)
f. AC output frequency
g. Power factor

6.06 An integrated SCADA shall be supplied which should be capable of communicating with 12 nos 250 KW inverters and provide information of the entire 3 MW Solar PV Grid connect power plant. The SCADA shall provide information of the instantaneous output energy and cumulative energy for each of the inverters as well as for the entire power plant.

6.07 The integrated SCADA shall have the feature to be used either locally via a local computer and also remotely via the Web using either a standard modem or a GSM / WIFI modem.

6.08 The bidder must supply all the required hardware to have this web based SCADA operational such that the system can be monitored via the web from a KPCL office as nominated by KPCL.

6.09 Nuts & bolts and the PCU enclosure shall have to be adequately protected taking into consideration the atmosphere and weather prevailing in the area.

6.10 Dimension and weight of the PCU shall be indicated by the bidder in the offer.

7.00 INVERTERS

The solar PV inverter converts DC power into three phase AC power The output of the inverter is synchronized at the LT level and transmitted at 11KV with suitably rated HV transformer (415V/11KV).

a. The power generated is exported to the grid.

b. The inverter output always follows the grid in terms of voltage and frequency. This is achieved by sensing the grid voltage and phase and feeding this information to the feedback loop of the inverter. Thus control variable then controls the output voltage and frequency of the inverter, so that inverter is always synchronized with the grid.

c. Typically conversion efficiency of the PCU is >95%.

d. No-load loss <1% of rated power

e. Self-corn mutated inverter with Pulse width modulation.

f. Wide range of Grid voltage & frequency parameters for synchronization.

g. Sinusoidal current modulation with excellent dynamic response,

h. Optional VAR control

i. Unit wise & integrated Data togging.

j. Dedicated Prefabs / Ethernet for networking

k. Protection against

- Over current
- Sync loss
- Over temp.
- DC bus over voltage

I. Power regulation in the event of thermal overloading

m. Set point pre-selection for VAR control

n. Degree of protection-IP31

o. Bus communication via -interface for integration

p. Remote control via telephone modem or mini web server
q. Integrated protection in the DC and three phase system
r. Insulation monitoring of the PV array with sequential fault location
s. Ground fault detector - which is essential for large PV generators in view of appreciable discharge current with respect to ground.

8.00 PROTECTION FEATURES

a. The injection of DC power into the grid is avoided by using an isolation transformer at the output of the inverter.
b. Over-voltage protection is provided by using varistors at the output of the inverter.
c. Another set of varistors at the input of the inverter provides lightning protection.

9.00 LT POWER INTERFACING PANEL

a. The Panel shall have adequate inputs to take in from individual PCUs & adequate outputs to individual transformers with adequate number of spare terminals.
b. The Panel shall be floor mounted type. All the measuring instruments such as voltmeter, ammeter, frequency meter, Electronic Energy Meter for (for measuring the deliverable units (kwh) for sale, selector switches, Mimic front panel.
c. All the Power cables shall be taken through backside of the Panel and cable shall be avoided from sides.
d. The Panel shall be fitted with suitable rating & size copper bus, HRC fuses /circuit breaker/isolator indicators for all incomer and outgoing terminals, Voltmeter & Ammeter with suitable selector switches to monitor & measure the power to be evacuated.
e. Nut & bolts including metallic cubicle shall have to be adequately protected against atmosphere and weather prevailing in the area.
f. The overall dimension shall be fitted with other Power Conditioning Units of the Power Plant. However, dimension, weight, sheet thickness, painting etc., should be indicated by the Contractor. The bill of material associated with the equipment should be clearly indicated while delivering the equipment.

10.00 PLANT MONITORING DESK:

10.01 Computer Aided Data Acquisition Unit shall have features for simultaneous monitoring and recording of various parameters of different

sub-systems, power supply of the Power Plant at the DC side and AC side.

10.02 Computer Aided Data Acquisition Unit shall be separate & individual system comprising of different transducers to read the different variable parameters. AC/DC converter, Multiplexer, De-multiplexer, Interfacing Hardware & Software, Industrial Type PC, which will be robust and rugged suitable to operate in the Control Room Environment.

10.03 Reliable sensors for Solar Radiation, Temperature & other Electrical Parameters are to be supplied with the data logger unit.

10.04 Required number of PCs shall be provided and PC shall be of industrial type, rugged & robust in nature to operate in an hostile environment and of latest technology adequate memory, RAM facility etc., perfectly compatible to the system. Shall have all latest features with max. power back up.

10.05 The data acquisition system shall perform the following operations:

a. Measurement and continuous recording of (I) Ambient Air Temperature near Array Field (II) Control Room Temperature (111) Module Back Surface Temperature (IV) Wind Speed at the level of Array Plant (V) Solar Radiation incidental to Array Plant (VI) Inverter Output (VII) System Frequency (VIII) DC Bus output (IX) Energy delivered to the GRID in kWh.

b. All data shall be recorded chronologically date wise. The data file should be latest version and compatible. The data logger shall have internal reliable battery backup to record all sorts of data simultaneously round the clock. All data shall be stored in a common work sheet chronologically. Representation of monitored data in graphics mode or in tabulation form. All instantaneous data can be shown in the Computer Screen.

10.06 Bill acquisition system should be housed in a desk made of sheet steel.

11.00 CABLE & WIRES FOR ARRAYS :

11.01 All cables shall be PVC insulated with appropriate grade conforming to IS.

11.02 The wiring for module inters connection shall have hard PVC conduit of approved make. All Tees, Bends etc., shall be approved make. Before procurement, approval for materials should be obtained from KPCL.

11.03 Cables in the array yard shall be laid direct in ground at a depth of 500mm in the excavated trenches along the approved route and covered with sand cushion. A continuous single brick protective layer of first class brick shall be placed over the entire length of the underground cable before refilling the trench with loose soil. Alternatively, 6th wide continuous layer of 1½" thick concrete cable markers may also be provided as protective cable cover. The cables shall be laid inside class-B. Gl pipes of suitable size under road crossings, drains, sewerage lines, entry of exit points of the buildings or where there are chances of mechanical damage Only terminal cable joints shall be accepted. No cable joints to join two cable ends shall be accepted..

11.4 Cables inside the control room shall be laid in suitable Cable Trays of approved type.

11.5 All wires used on the LT side shall conform to IS and should be appropriate voltage grade. Only copper conductor wires of reputed make shall be used.

11.6 Cable terminations shall be made with suitable cable lugs & sockets etc., crimped properly and passed through brass compression type cable glands at the entry & exist point of the cubicles. The panel's bottoms should be properly sealed to prevent entry of snakes / lizard etc., inside the panel.

11.7 All cable/wires shall be marked with good quality letter and number ferrules of proper sizes so that the cables can be identified easily.

11.8 The terminal end of cables and wires are to be fitted with good quality letter and number ferrules of proper sizes so that the cables can be identified easily.

11.9 As-built wiring diagrams shall be provided

11.10 LIGHTNINGS OVER VOLTAGE PROTECTION.

11.11 Lightning Protection for Array Yard.

11.12 The SPV Power plant should be provided with Lightning and over voltage protection connected to proper earth mats. The main aim of over voltage protection is to reduce the over voltage to a tolerable level before it reaches the PV or other sub-system components. The source of over voltage can be lightning or other atmospheric disturbance.

11.13 The Lightning Conductors shall be made as per applicable Indian Standards in order to protect the entire Array Yard Lightning stroke. Necessary concrete foundation for holding the lightning conductor in position to be made after giving due consideration to maximum wind speed and maintenance requirement at site in future.

11.14 The lightning conductor shall be earthed through flats and connected to the Earth mats as per applicable Indian Standards with earth pits. Each Lightning Conductor shall be fitted with individual earth pit as per required Standards including accessories, and providing masonry enclosure with cast iron cover plate having locking arrangement, watering pipe using charcoal or coke and salt as per required provisions of IS.

11.15 The bidder shall ensure adequate lightning protection to provide an acceptable degree of protection as per IS for the array yard. If necessary more numbers of Lightning conductors may be provided. Theoretical design calculations and detailed explanations shall be provided.

11.16 Lightning Protection for Control Room Building.

11.17 The control room building is to be protected from lightning strike with Lightning Conductor as per requirements of IS Standards.

11.18 All Building earth conductor shall be inter connected through the concept of "Earth Mats" for interconnection with separate earth pits.

11.19 For each earth pit, necessary Test Point shall have to be provided.

12.0 EARTHING SYSTEM:

12.1 LT SIDE:

a. The earthing for array and LT power system shall be required as per provisions of IS. Necessary provision shall be made for bolted isolating joints of each earthing pit for periodic checking of each resistance.

b. Each Array structure of the SPV Yard shall be grounded properly. The array structures are to be connected to earth pits as per IS standards.

c. The earthing for the power plant equipment shall be made with as per provisions of IS. Necessary provision shall be made for bolted isolating joints of each earthing pit for periodic checking of earth resistance.

d. The earth conduction shall run through appropriate pipes partly buried and partly on the surface of the control room building.

e. The complete earthing system shall be mechanically & electrically connected to provide independent return to earth. All three phase equipment shall have proper earth connection.

f. An Earth Bus shall be provided inside the control room.

g. For each earth pit, necessary Test Point shall have to be provided.

h. In compliance to Rule 33 and 61 of Indian Electricity Rules, 1956 (as amended up to date), all non-current carrying metal parts shall be earthed with two separate and distinct earth continuity conductors to an efficient earth electrode.

i. Earth resistance of the earth pits shall be tested in presence of the representative of KPCL.

12.02 HT Side :

The 11 KV side equipment and parts shall be earthed as required as per provisions of IS.

GRID CONNECTING EQUIPMENTS

An outline drawing of proposed scheme of power evacuation for planning purpose is enclosed . The bidder shall furnish his proposed design/drawings for power evacuation. It shall be in confirmation with latest standards. The bidder shall also submit the list of all grid connecting equipments.

TRANSFORMERS

13.00 3 Nos of 1250 KVA , 0.415/11 KV ,50 Hz,3 phase Transformers shall be provided to step up the generated voltage to 11 kv . The transformer shall be provided with neutral grounding resistors.

14.00 GENERAL CONSTRUCTIONAL FEATURES

All material used shall be of best quality and of the class most suitable for working under the conditions specified and shall withstand the variations of temperature and atmospheric conditions, overload, over-excitation, short-circuits as per specified standards without distortion or deterioration or the setting up of under stresses in any part and also without affecting the strength and suitability of the various parts for the work which they have to perform.

15.00 TANKS

The exterior of tank and other steel surfaces exposed to the weather shall be thoroughly cleaned and have a priming coat of zinc chromate applied. The second coat shall be of an oil and weather-resistant nature, . preferably of distinct colour from the prime and finish coats. The final coat shall be of a glossy, oil and weather resistant non-fading paint of specified shade. The interior of the tank shall be cleaned by sand blasting and painted with two coats of heat resistant and oil insoluble paint. Steel bolts and nuts exposed to atmosphere shall be galvanised. Unless otherwise stated, the tank together with radiators, conservator, bushings and other fittings shall be designed to withstand without permanent distortion the following conditions: Full Vacuum of 760 mm of Hg, for filling with oil by vacuum. Internal gas pressure of 0.35 Kg/cm2 (5 Ibs/sq.in) with oil at operating level. The tank cover shall be suitably sloped so that it does not retain rain water. The material used for gaskets shall be cork neoprene or approved equivalent.

16.00 CORE

The magnetic circuit shall be constructed from high grade cold-rolled non-ageing grain oriented silicon steei laminations and shall be of 'core' type. The insulation structure for the core to boiis and core to clamp plates shall be such as to withstand a voltage of 2000V for one minute.

17.00 WINDINGS

Windings shall be of copper only. Windings shall be subjected to a shrinking and seasoning process, so that no further shrinkage occurs during service. The completed core and coil assembly shall be dried in vacuum and shall be immediately impregnated with^oil after the drying process to ensure elimination of air and moisture within the insulation.

18.00 INTERNAL EARTHING

The frame work and clamping arrangements of core and coil shall be securely earthed inside the tank by copper strip connection to the tank.

19.00 TERMINATION

Transformers shall be fitted either with bushing insulators or with cable boxes / cable box with disconnection chambers, as specified in Data Sheet A1. The neutral of the star-connected winding shall be brought out to a separate bushing terminal. The neutral bushing shall be provided on the tank side to facilitate lead to earth conductor down to the ground level. Tank-mounted pin type support insulators shall be provided for supporting the[8] neutral earthing bar of specified section, along its run from the neutral bushing to ground level.

20.00 BUSHINGS

Bushings shall be designed and tested to comply with the applicable standards specified in Data Sheet - A2. If type test certificates are not available, these tests shall also be carried out in addition to the routine tests. Bushings rated for 400A and above shall have non ferrous flanges and hardwares. Fittings made of steel or malleable iron shall be galvanised. Bushings will be supplied with terminal connector clamp suitable for connecting the bushing to the PURCHASER'S specified conductor.

21.00 CABLE BOXES AND DISCONNECTING CHAMBER

a) "Cable boxes shall be supplied to suit PURCHASER'S specified cables. The cable boxes shall be complete to suit specified cable with body earth terminals.

b)$_a$ Disconnecting chamber shall be provided to enable the transformer to be removed without unsealing the cables or draining oil from the main tank. The disconnecting chamber shall be air insulated and complete with ssal-off bushings, removable flexible connectors / links and removable covers. Phase to phase and to ground clearances within the chamber shall be such as to enable either the transformer or cable

to be subjected separately to H.V.tests. Clearances shall be subject to the PURCHASER'S approval.

22.00 MARSHALLING BOX

SUPPLIER shall provide a marshalling box and marshal to it all the contacts / terminals of electrical devices mounted on the transformer. It shall be in the SUPPLIER'S scope to provide (a) the interconnection cabling between the marshalling box and the accessory devices by either PVC insulated wires in Gl conduit or PVC insulated, armoured c.able and (b) necessary compression type, brass cable glands at the marshalling box for the above mentioned cables are as well as for terminating the PURCHASER'S incoming cables from remote panels. Marshalling box shall be tank mounted, outdoor, weather-proof, sheet-steel (2mm thick) enclosed, with hinged door having padlocking facility and painted. All doors, covers and plates shall be fitted with neoprene gaskets. Bottom shall be atleast 600 mm from floor level and provided with gland plate and cable glands as required. Top surface shall be sloped.

23.00 ELECTRICAL AND PERFORMANCE REQUIREMENTS

Transformers shall operate without injurious heating at the rated KVA at any voltage within ±10% of the rated voltage of that particular tap. Transformers shall be designed for 110% continuous overloading withstand capability. Overloads shall be allowed within the conditions defined in the loading guide of the applicable standards. Under these conditions, no limitations by terminal bushings, tap changers or other auxiliary equipment shall apply. The neutral terminal of windings with star connection shall be designed for highest over current that can flow through this winding. Every care shall be taken to ensure that the design and manufacture of the transformers shall be such as to reduce noise and vibration to the level obtained in good modern practice. The supplier shall ensure that the noise level shall not be more than 80db. For transformers with tapings, full power tapings shall be provided

24.00 OIL

Transformers shall be supplied complete with transformer oil complying with latest applicable standards.

25.00 FITTINGS AND ACCESSORIES

[8] For oil immersed type transformers, following fittings shall be provided

a) Bushing terminals complete with connector.
b) Neutral bushing terminal complete with connector for earth conductor
c) Inspection cover
d) Rating and terminal marking plate,
ej Two earthing terminals

f) Lifting lugs for
g) Lifting complete transformer with oil and
h) Lifting core and coils
i) Drain cum sampling valve with plug or cover plate.
j) Dehydrating breather
k) Oil level indicator with minimum marking
I) Thermometer along with pocket and necessary fixing arrangement
m) Conservator with oil filling hole with cap and a drain plug.
n) Air release device
0) Jacking lugs
p) Filter valves
q) Explosion vent with diaphragm / pressure relief valve. The device shall Be rain-proof after operation. An equalizer pipe connecting the pressure relief device to the conservator shall be supplied.

26.00 Following additional fittings to be furnished

Gas sampling device at an accessible height and an air release cock for Bucholz relay.

27.00 Winding temperature indicator shall consist of:

a) Temperature sensing element
b) Image coil
c) Bushing or turret mounted CT
d) Local indicating instrument with electrical independent contacts brought out to separate terminals for winding temperature 'high' and 'too high[1] alarms.
e) Off Circuit Tap Changing Mechanism shall comprise:
f) Operating handle or wheel, accessible from ground level
g) Tap position indicator
h) Pad locking arrangement
1) The tap-changer connections and contacts shall be accessible through an access hole having a bolted gasketted cover.

28.00 Valves

a) One (1) top filter valve with blanking plate
b) One (1) bottom filter valve with blanking plate
c) Four plain rollers in place of fixing channels

29.00 TESTS ON TRANSFORMERS

Apart from the routine tests as specified in relevant IS on the assembled transformer, the contractor shall carryout the following tests on one of each type of transformer. Test certificates for having conducted short circuit test on similar rating units shall be furnished for Purchaser's reference

i) Pressure test
ii) Oil leakage test
Hi) Transformer tank test
iv) Vacuum test
v) Pressure test

30.00 LOSSES

a. Load losses and no-load losses should be as per IS and within tolerance limits.

b. Should the losses as measured on the transformer after manufacture are found in excess of the values of the guaranteed losses with plus tolerance indicated in the proposal, SUPPLIER shall pay penalty to the PURCHASER.

31.00 REJECTION

PURCHASER may reject any transformer if during tests or guarantee period any of the following conditions arise:

a) No load loss exceeds the guaranteed value by more than 15%.
b) Load loss exceeds the guaranteed value by more than 15%.
c) Impedance value differs the guaranteed value by more than ±10%.
d) Oil or winding temperature rise exceeds the specified value by 5oC.
e) Transformer fails on impulse test
f) Transformer fails on power frequency voltage withstand test
g) Transformer is provided to have been manufactured not in accordance with the agreed specifications.

32.00 The PURCHASER reserves the right to retain the rejected transformer and take it into service until the SUPPLIER replaces, at no extra cost to PURCHASER, the defective transformer by a new acceptable transformer.

33.00 The BIDDER shall repair or replace the transformer within a reasonable period to the PURCHASER'S satisfaction at no extra cost to the PURCHASER. The conductor shall be limited to such a value that the temperature rise of the conductor does not exceed the values specified by the Contractor. The losses should be such that an optimal operating cost is obtained.

34.00 If bidder is offering equipments conforming to the standards other than those stipulated above, he should establish in the bid that standards adopted by him are comparable with relevant Indian Standards or IEC Standards. Further a comparative statement in respect of only those provisions in standards adopted by him, which are different from those provisions in standards, shall be furnished with bid. Also, the bidder must

supply copies in English language of the standards and codes adopted by him (If these are in different languages, copies translated in 'English' may be furnished).

LIGHTNING ARRESTERS:

35.00 SCOPE:

The specification covers non-linear resister type lightning arrestors for use in effectively earthed system with a nominal voltage of 11KV

36.00 APPLICABLE STANDARD:

Unless otherwise modified in this specification the lightning arrestors shall comply with IS 3070(Pt.1)1974 or the latest version thereof.

37.00 VOLTAGE RATING

The rated voltage of lightning arrestors shall be 9.0KV. This will be applicable to the effectively earthed 11 KV system (co-efficient of earth not exceeding 80% as per IS 4004) with all the transformer neutrals directly earthed.

38.00 NOMINAL DISCHARGE CURRENT RATING

The lightning arrestors shall be of pedestal mounting type suitable for outdoor installation on steel pole mounted structures. All the clamps, bolts, nuts and washers etc., required for mounting the lightning arrestors on the structure shall be supplied along with the arrestors and shall be galvanized.

39.00 TERMINAL ARRANGEMENT

The top metal cap and the base of the lightning arrestors shall be galvanized . The top cap shall be provided with terminal arrangement suitable for both horizontal and vertical take-off. The base of the lightning arrestors shall be provided with two separate terminals distinctly marked to connection to earth.

40.00 SEALING AND PRESSURE RELEASE

The lightning arrestors shall be hermetically sealed to avoid ingress of moisture. A suitable pressure relieving device shall be provided to avoid damage to the external insulator in case of a severe discharge.

41.00 TESTS

Type, acceptance and routine tests as per section IS-3070 shall be carried out. The contractor shall submit the test certificates for the routine tests conducted. Following shall constitute the routine tests:-

a) Dry power frequency voltage spark over test
b) Visual examination of porcelain housing

c) Sealing test.

42.00 11 KV SWITCHGEAR CUBICLE

11KV switchgear system comprises of protection / interlocking / annunciation / inter-tripping / automatic / manual operation schemes for the purpose of satisfactory and efficient operation of the equipment covered under this scope. The specification also includes cable terminations, foundation channels with hardware etc, It is not the intent of this specification to specify herein complete details of design and construction of equipment. However, the equipments offered shall conform to latest standards of engineering, design and workmanship in all respects and be capable of performing in commercial operation in a manner acceptable to the owner. Details of aux. supply for operation/control, protection, alarm, indication etc.

I) DC supply **110 Volts** + **10%** / **-15%**

ii) AC supply 415 Volts +10% three phase 4 wire system .

43.00 DESIGN & CONSTRUCTIONAL FEATURES

All switchgear panels and circuit breakers shall have the following features.

a. Conductor: High conductivity aluminum alloy or copper for the horizontal busbars, vertical droppers and connectors to the fixed end of isolating contacts.

b. Height of the Switchgear Panel: shall not exceed 2700 mm.

c. Insulators Shall be of high strength, non-hygroscopic, non-combustible type and suitable to withstand stresses due to over-voltages and short circuit current. Interpole barrier of inflammable material like hylam are not acceptable.

d. Sealing: Bushing or other sealing arrangement shall be provided between breaker and busbar / cable compartments to avoid air communication around isolating contacts in the safety shutter area with truck in service position.

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44.00 CONSTRUCTION: \

a. The switchgear assembly shall be rodent and vermin proof.

b. In switchgear design where the breaker front itself serves as a door suitable blanking covers one for each size of panel per switch board shall be included.

c. The switchgear enclosure shall be constructed with rolled steel section of rolled sheet of at least 2.0mm thickness.

d. Pressure relief device shall be provided in each high voltage compartment to vent out safely the gases produced in case of a fault.

e. Contractor shall furnish calculation during detailed- engineering stage to establish the adequacy of support insulator and bus bar sizes for the declared continuous & short time current ratings.

f. Breaker trucks shall have a secure locking in SERVICE position so that they are not displaced during a short circuit.

g. Current ratings of all switchgears, circuit breakers, CT's etc. shall be sufficient for carrying the connected load currents without exceeding the permissible temperature limits or reduction in service life. Use of two breakers in parallel to meet the required rating shall not be acceptable.

h. Suitable trolley arrangement, if required, shall be provided. One trolley per switchgear room suitable for each type and rating.

i. HT switchgear shall have atleast two (2) fully equipped spare feeders (one each for highest size of motor/transformer) for any future requirement.

j. Earthing Arrangement

k. Internal earth bus shall be provided which has a capacity to withstand short circuit currents for one second and all enclosures shall be connected to this bus.

I. Earthing arrangement through an integral earth switch or through separate earthing truck shall be provided. Suitable mechanical interlocks shall be provided to prevent the closing of earth switch on live circuit. In case of later arrangement one set of different types of earthing trucks per switch board shall be provided.

m. Earthing switch shall be short time (One second) current withstand capability equal to the breaker.

n. Cable Entry: The switchgear panel shall be suitable for bottom entry and provided with removable gland plates.

o. Instrument transformers: The CTs and VTs shall be provided for protection and metering and shall be cast-resin encapsulated type with insulation class 'E' or better. VTs shall have suitable HRC current limiting fuses on both primary and secondary sides, under voltage relays, timers, etc. for motor tripping and remote annunciation on supply failure. Each switchgear section shall have a three phase VT. In comer from emergency supply shall have open delta winding for earth fault detection. The incomers from station service transformers shall be provided with VT to indicate the incoming voltage before closing the breaker. The complete design including that of selection of

proper CT's// PT's/instruments with proper ratings shall be the responsibility of the vendor only.

& VT's shall be of suitable accuracy class as per IS.

Selection of all types shall be subject to Owner's approval. All relays and timers shall be flush mounted with connections from inside. They shall have transparent & dust tight cover, removable from front, draw out construction for easy replacement from the front. The auxiliary relays and timers may be in non-draw out cases. Relay shall have port for interphasing with SCADA

SF6J monitoring: SF6 gas pressure / density monitoring for low sure alarm shall be provided incase of SF6 breakers.

s. Identification plates: Each panel has to be identified on front as well as back side by a large engraved plate giving detailed feeder description on the fixed portion of the panel. Identification labels/painted (Not stickers) plates to be provided inside each panel.

t. Safety Requirements: The switchgears shall be designed to offer adequate level of safety to operating / maintenance personnel. Means shall be provided to prevent access to the live part to avoid accidents during service as well as maintenance period. Bidder shall bring out the safety means provided to achieve above. A detailed instruction plate suitable for wall mounting shall be provided for each switch gear room describing various safe operating procedure / safety precautions for safe operation and maintenance of switchgear. Rubber mats shall be provided in front of each panel. A clearly visible warning label Isolate elsewhere before earthing "shall be provided on shutters of incoming and other connections which could be energized from other end.

u. Power cable Terminations: Suitable arrangement for power cable termination shall be provided, as required, for switchgear panels and shall be suitable for cable entry from the bottom. The bottom cable entry shall be fitted with removable gland plates of adequate size for fixing the cable glands.

v. The Incomer and all outgoing feeder panels shall be suitable for terminating XLPE cables. Panels shall have adequate space inside, to accommodate the heat shrinkable type cable terminations or Cold type came terminations. Each power cable shall be terminated independently.

w. Detailed interlocking scheme for 11KV switchgear : Proper scheme shall be envisaged for operation of Incoming and bus coupler breakers through source under voltage relay contacts and breaker position contacts. Normally, the two Incoming breakers shall be closed and bus coupler shall be in open position. However, in case of

tripping of any one of the Incoming breakers, the bus coupler shall be closed automatically.

x. Trip circuit supervision scheme shall be provided for each circuit breaker. The scheme shall be such that it will be possible to test the healthiness of the trip circuit irrespective of whether the breaker is in the closed or open condition.

y. When the protection on 11kV Incomer operates to trip the 11kV circuit breaker, it is essential to trip outgoing 11 kVside circuit breaker as well. For this purpose one inter trip relay shall be provided. The output contacts of this trip relay shall be wired up to the terminal block, and one pair of these contacts shall be marked "To energize 11kV side master trip relay." 'NC contact of this trip relay may be wired up in the closing circuit of the respective incomer breaker.

45.00 FEEDERS & EQUIPMENTS TOBE PROVIDED IN 11KV SWITCHGEAR CUBICLE.

46.00 INCOMING FEEDERS

Three incoming feeders of 630 Amps each consisting of following features

"a) 1 No. - Industrial type SF6/VACUUM circuit breaker (ABB/L&T/Siemens/ any other standard make) rated for 630Amps with shunt trip release, suitable rupturing capacity and with standard accessories such as operating handle, auxiliary switch with 4 NO+4NC contacts and the required number of sliding disconnects (minimum 3 sets of 6way disconnects)

b) 3 Nos. Indicating LEDs for ON/OFF/Discrepancy indications.

c) 3 Nos.- Push buttons for ON/OFF/RESET and 1 Nos. Break control switch (spring return type)

d) 3 Nos. current transformers of 75/1A ratio, class of accuracy 1.0 and 1A burden for metering

e) 3 Nos. 1 Ph. Current transducers of dual output type interfacing with SCADA

f) 1 No. Ammeter with suitable scale along with selector switch for indicating the incomer current

g) 1 No.- Microprocessor based Kwh meter suitable for 3 Phase, 4 wire system, 75/1A CT Ratio ,

h) 1 No. Voltmeter of range 0-600 V along with selector switch.

i) 3 Phase, Non-directional over current replay with inverse characteristics, micro processor based. The range of adjustment of

the relay should be between 20 to 200% and rated current 1A for over current protection of incomer.

j) Non-directional single pole earth fault relay, with the setting range 5 to 80% of current rating.

k) 3 Nos. - Under voltage relays of reputed make to monitor 3 phase voltages with setting of pick-up voltage at 90% and drop off voltage at 70% of the supply AC Voltage with suitable timer to initiate tripping of Breaker.

I) 3 Nos. 1 phase - voltage transducers of dual output type giving an output of 4 - 20MA is to be mounted inside the panel at a convenient location for monitoring Bus voltage to be interfaced with SCADA.

m) Set of static auxiliary relays of required range for auto change over scheme & interlocks.

n) 1 No. - Single pole neutral link.

' o) 1 No. - Switch for auto / manual selection,

p) 1 No. - Switch for local / remote selection,

q) 1 No. - Trip / normal / close Switch,

r) 1 No. timer for incomer only,

s) Necessary test blocks for Energy Meter,

t) 1 No. DC supply on/off control switch.

47.00 OUTGOING FEEDERS

a) Two nos. of . outgoing feeders (one as spare) consisting of following features:

b) 1 No. - Industrial type SF6/ VACUUM circuit breaker (ABB/L&T/Siemens/any other standard make) rated for 630Amps with shunt trip release, suitable rupturing capacity and with standard accessories such as operating handle, auxiliary switch with 4 NO+4NC contacts and the required number of sliding disconnects (minimum 3 sets of 6way disconnects)

c) 3 Nos. Indicating LEDs for ON/OFF/Discrepancy Indications.

d) 3 Nos.- Push buttons for ON/OFF/RESET and 1 Nos. break control switch (spring return type)

e).3 Nos. current transformers of 175/1A ratio class of accuracy 1.0 and 1A burden for metering

f) 3 Nos. 1 Ph. Current transducers of dual output type interfacing

g) with SCADA

h) 1 No. Ammeter with suitable- scale along with selector switch for indicating the incomer current \

i) 1 No.- Microprocessor based Kwh meter suitable for 3 Phase, 4 wire system, 175/1A CT Ratio

j) 1 No. Voltmeter of range 0-600 V along with selector switch

k) 3 Phase, Non-directional over current relay with inverse characteristics, micro processor based. The range of adjustment of the relay should be between 20 to 200% and rated current 1A for over current protection of incomer.

I) Non-directional single pole earth fault relay, with the setting range 5 to 80% of current rating.

m) *KVM* meter suitable for three phase four wire system of 175/1 CT ratio.

n) Necessary synchronization relays, protective relays etc., complete in all respects shall be provided.,

48.00 RELAY AND PROTECTION

a) All relays shall be draw out type conforming to all requirements as per IS: 3231 and shall be suitable for operation from CT and VT secondaries as required. All static relays shall conform to IS: 8686.

b) The protective relays, except for lock-out relays shall have self - reset contacts, and shall be suitable for efficient and reliable operation of the protective schemes

c) Protective relays shall be of numerical communicable technology with self monitoring features. A combination of electromechanical & numerical communicable type relays for main protections is not acceptable.

d) d) All relays & timers shall be designed for satisfactory performance under specified tropical and humid conditions.

e) The relays and timer shall operate under extreme conditions of control voltage variation.

f) they shall not have any inbuilt batteries, and shall operate on available DC supply. They shall be provided with hand-reset operation indicators (flags) or LEDs with pushbuttons for resetting for analyzing the cause of breaker operation.

g) Shall have built-in test facilities, or can be provided with blocks and test switches. One testing plug shall be provided for switch board.

h) All equipments shall have necessary protection

49.00 CONTROL SUPPLY

a). Each switchgear shall be provided with necessary arrangement for receiving, isolating, distributing and fusing of 230V AC and 110V DC supplies for various control, lighting, space heating and spring charging circuits. DC supply for control shall be duplicated for each board which shall run through auxiliary bus wires.

b) Necessary hardware shall be provided in the switchgear panel like coupling relays, auxiliary relays, transducers etc. to effect interlocks, exchange of information status and exercise control from remote.

c) 110 D.C. supply required for control and protection relays shall be arranged.

50.00 GENERAL DATA

Earthquake conditions

a) Under the seismic conditions, stipulated in this specification, the 11KV and 415V switchgear panels shall meet the following requirements:

b) The physical alignment of 11KV and 415V switchgear panels along with incoming and outgoing feeder connections, supporting insulators & structures of bus bars should not get disturbed and there should not be any internal flashover and/or electrical fault.

c) All relays, transducers, indicating instruments, devices in switchgear panels should not mal-operate.

d) Current carrying parts, supporting structure, earth connection etc. should not get dislocated and /or should not break or distort.

e) Co-ordination with other systems

f) It will be the responsibility of the contractor to coordinate the 11KV & 415V Switchgear with Computerised Plant Control System (SCADA)- of the power house.

g) Despatch of equipments and Handling of equipment at site

h) Care shall be taken for safe handling of equipments at site during transport, stacking, shifting to erection site, erection at site in order to prevent damages to the equipment.

i) The bidder has to unload the panels in a storage place (store sheds) in the project site area as directed by the Engineer and shall load, re-transport and unload the same from storage place to the erection place at appropriate time.

51.00 TESTS OF SWITCHGEARS

The following type test certificates on each type & rating or switchgear, MCC panel and distribution board shall be submitted.

a) Short time withstand test with circuit breaker mounted inside the switchgear panel
b) Temperature rise test.
c) Type Il-Short circuit co-ordination test for any three rating of MCC module as selected by the Employer.
d) Test sequence-1 & combined test sequence shall be carried out on each rating of circuit breaker mounted inside the panel.
e) Degree of protection tests.
f) The manufacturer shall carry out all routine tests as specified in relevant IS/IEC Standard on all major components and furnish copies of test certificates for Owner's approval.
g) The following tests shall be carried out for panels and its components before despatch at factory in accordance with latest IS/IEC standards and 3(THREE) copies of test certificates shall be supplied. The test certificates shall be approved by the Owner prior to despatch of materials.

52.00 ROUTINE TEST

VISUAL CHECK (as per IS: 8623 Cl. 8.3.1.1, 8.3.1.2)

i. Visual inspection of mounting and connecting of various parts.

ii. Checking of all instruments for their positioning and rating.

iii. Checking of internal wiring according to the approved drawings.

iv. Checking of connections to ensure adequate contacts.

v. Clearance and creepage distance between bus bars, risers and also between bus bars, risers and earth.

vi. Functional checking of all control circuits, closing, tripping, interlock and alarm circuits including proper functioning of component equipment such as ACB, MCCB etc.

53.00 HIGH VOLTAGE TEST-

(as per IS:8623, Cl.8.3.2.1, 8.2.2.4)

i) Phase to ground	-	(as per IS)
ii) Phase to phase	-	(- do -)
iii) for auxiliary circuits	-	(- do -)

54.00 INSULATION RESISTANCE TEST

i) For bus bar

ii) Auxiliary circuits.

55.00 CONTINUITY TEST ..

56.00 A point to point check shall be made to ensure the compliance of the complete wiring as per the approved electrical schematic diagram.

57.00 TEST FOR SF6/ VACUUM CIRCUIT BREAKERS.

a) Checking alignment of breaker trucks for free movement and for correct operations of shutters.

to) Slow closing/ opening operation.

c) Manual operation of breaker.

d) Power Closing/opening operation manually and electrically.

e) Breaker closing and tripping time.

f) Trip free and anti pumping operation.

g) Contact resistance.

h) I R values, resistance & minimum pick up voltage.of coils.

i) Checking of electrical & mechanical interlocks provided such as:

j) Shunt trip release

k) Bimetal release.

I) Under voltage release.

m) Short circuit release.

n) Checks on spring charging motor for correct operation of limit switches & time of charging.

°o) Insulation resistance of each pole of breaker, p) H

V test

q) with switch in close position - Phase to ground and phase to phase with switch in open position between fixed and moving contacts.

r) H V tests on auxiliary circuits as per standard.

s) Maximum terminal voltage drop between terminals at rated currents.

t) Checking of various interlocks.

u) Interchangeability of breakers

58.00 TEST FOR MCCBS

a) For MCCBs, type test reports shall be furnished. MCCBs have to undergo the following sequence of type tests without any maintenance/adjustment, tests to be conducted as per relevant IS

b) Construction test

c) Operation test

d) Trip calibration test

e) Overload test

f) Temperature rise test

g) Endurance test

h) Insulation resistance test

i) High voltage withstand test

j) Short circuit test

59.00 TESTS ON CURRENT TRANSFORMER

1) Meggering between windings and winding terminal to body
2) Polarity test
3) 3 . Ratio test
4) Checking of all ratios on all cores by primary injection of current.
5) Magnetization characteristics, secondary winding resistance.

60.00 TESTS ON RELAYS (RELEASE):

Checking of internal wiring.

a) Meggering of
   i) All terminals to body
   ii) A C to DC terminals

b) Checking operation characteristics by secondary injection.
c) Checking minimum pick up voltage of DC coils.
d) Checking operation of electrical/mechanical targets.
e) Relay setting.

61.00 TESTS ON METERS:

62.00 Type Tests

The test certificates for following type tests, which are already performed, on each type of circuit breaker (as per IS 13118/ IEC-62271-100 or latest revision there-of) shall be furnished..

a) For switchgear assembly and circuit breaker i)
   Dielectric tests as per IEC 60694

   ii) Temperature rise test as per IEC 60694

   &

   iii) Measurement of the resistance of the main circuit

   iv) Short time withstand current and peak withstands current tests as per IEC 60694 & IS 13118.

b) For circuit breaker only

i) Mechanical & environmental tests as per IS 13118 or IEC 62271-100.

Short circuit current making & breaking tests as per IS 13118 or IEC 62271-100.

ii) Site Tests: After complete erection at the site, the following tests shall be performed on 11kV Switchgear panels :

- Measurement of insulation resistance of bus and power circuits.
- Test & checking of control schemes
- Operational tests of breakers-electrical (Local/Remote) & manual
- Testing & checking of interlocking schemes and protection relays.
- All testing equipment shall be arranged by the Contractor at his own cost during the testing.

iii) Tests on associated equipment

All bushings, insulators, bus bars, indicating instruments/devices instrument transformers and associated items of switchgear panels shall be tested by the Contractor in accordance with relevant IS or IEC standard. The test reports shall be furnished for approval before the Routine and Acceptance tests at works

CABLES:

HT Cables

11 KV cables will be unearthed grade suitable for use in medium resistance earthed system, with stranded & compacted aluminium conductors, extruded semi-conducting compound screen, extruded XLPE insulated,....extruded semi-conducting compound with a layer of nonmagnetic metallic tape for insulation screen, extruded PVC (Type ST-2) FRLS inner sheath, Aluminum / galvanized steel round wire armored extruded PVC (Type ST-2) FRLS outer sheathed, single / multicored conforming to IS 7098 (Part II) IEC-60502 for constructional details and tests.

LT Power Cables:

LT Power Cable will be 1100V, grade, single / multicore, stranded aluminum conductor, XLPE, insulated with PVC inner sheath and outer sheath made on FRLS PVC compound. The armouring will be of Aluminum / galvanized steel round wire. The cable used for DC will be of single core type . All other details will be as applicable. Minimum conductor cross section of power cables will be 4 sq. mm.

Control cable

Control cables will be 1100V Grade, multicore, minimum 2,5 sq.mm cross section, stranded copper conductor having 7 strands, PVC insulated, inner PVC sheathed / galvanized steel wire armored and outer sheath made of FRLS PVC compound. In situations where accuracy of measurement or voltage drop in control circuit, warrant, higher cross sections as required will be used. 4 sq.mm copper conductor cables will be used for CT circuits all other specifications remaining same. However, Control cables for soot blower and DCS system of BTG control will be 1.5 sq.mm copper.

63.00 POWER EVACUATION CABLE

3 CORE XLPE Cable, 185sq.mm. aluminum armored cable confirming to IS 7098 carrying nearly 276(e) and 332 amps in air. of required length shall be provided for power evacuation.

64.00 SCADA SYSTEM : The entire plant with grid equipments shall be provided with scada facility.

Scada system shall incorporate integrated system control and data acquisition facilities. The use of a local operator interface and latest technology features shall be incorporated to enable viewing of instantaneous parameter metering, changing of operator modes and review of system logged events. Further, with PC based latest software technology, solar plant shall be monitored remotely via satellite link. The major scada features incorporated in to the control system are listed below.

a) Operator interface of latest technology.

   Instantaneous grid, array, inverter, AC, and metering of all parameters.

b) Integrated AC,DC data point logging.

   Instantaneous logging of all parameters. Including AC parameters, generator run hours and energy details.

c) Fault and system diagnostics with time stamped event logging.

   Selectable event logging resolution for enhanced diagnostics.

d) Remote scada features with specific needs of station monitoring and remote communication are to be incorporated. Remote system access software, secured transmission of data and
. central PC facility provided.

Any other feature required for the plant operation / maintenance shall also be provided In scada.

65.00 D.C. **SUPPLY- BATTERIES**

The contractor shall take the prior approval of the purchaser for all design and make of the batteries and the supporting system equipments.

DC system will be used for electrical control of equipment and indications on the control panel, communication system, DC lighting.. The battery is sized considering the following:

(i) Momentary load for 1 minute
(ii) Emergency load for 2 hours
(iii) Continuous load for 10 hours

Under normal conditions, the battery will be on float charger. The float charger will be connected to a distribution board and meets the requirements of DC load. In case of additional demand of load on AC supply failure, the battery will meet the requirement of DC loads.

The boost charger will charge the fully discharged battery in 12 hours before bringing it back on float charge.

Two sets of 110V, 100AH with float and boost chargers each with an associated direct current switchboard will meet the DC loads. The batteries will be conventional lead acid type. The chargers with modern version of Thirstier controls will be provided.

The batteries provided shall be suitable for the control and protection, emergency lighting, operation of breakers etc. and shall meet all the requirements of the plant wherever DC supply is required.

66.00 ILLUMINATION SYSTEM

The entire solar plant with grid equipments, line bay compound wall, control room, main gate , approach road etc., shall use solar power for providing illumination .A separate 10 kw solar PV system shall be provided to meet the requirement. It can be of BIS system.

The lighting system design shall comply with the acceptable norms and the best engineering practices. The system design shall consider standard principles of lighting.. The lighting layout shall be designed to provide uniform illumination with minimum glare. The layout design shall meet all the statutory requirement, local rules etc.

Features of illumination SYSTEM:

The Design shall take into consideration the appropriate illumination (LUX) levei, applicable standards etc as pef standard..

For the yard lighting, suitable poles, towers distributed suitably shall be provided. The flood light towers shall be made of standard galvanised

structural steel members, suitable ladder for accessing and platform at the lighting fitting levels shall be provided for maintenance

The connector box shall be made of stainless steel, Dust & vermin Proof, which are to be recessed at the base Yard Lighting system. The connector box shall have suitable brass or copper made connector terminal.

CABLE INTERCONNECTION OF YARD LIGHTING SYSTEM:
3 & 7_Z core PVC unarmored 6mm2 Cu cable shall be used for interconnection and supply of power to Yard lighting systems. The connection will be staggered in to three phases uniformly. The cable shall be loop in & loop out from the Connector Boxes of each yard lighting system.

Cables in the array yard shall be laid direct in ground at a depth of 500mm in the excavated trenches along with approved route and covered with sand cushion. A continuous single brick protective" layer of first class brick shall be placed over the entire length of the underground cable before refilling the trench with loose soil. Alternatively, 6" wide continuous •layer of 11/2" thick concrete cable markers may also be provided as protective cable cover. The cables shall be laid inside class B, Gl pipes of suitable size under road crossings, drains, sewerage lines, entry or exist points of the buildings or where there are chances of mechanical damage.

Cable terminations shall be made with suitable cable lugs & sockets etc. crimped properly and passed through brass compression type cable glands at the entry & exist point of the connector box at the entry point to MCB distribution Box for controlling the yard lighting system.

66.01 POINT WIRING:

This shall include all works necessary for wiring to the point of utilization of the load to be applied for the wiring of light, fan or plug point etc., Point wiring shall include all works necessary in complete wiring of a Piano Type switch Circuit of any length from the tapping point from the Junction Box to the following, via the switch.

Ceiling Rose in case of all lighting & fan points

Socket Outlet in case of sockets.

The followings shall be deemed to be included in the point wiring:

Switch & ceiling rose as required

Bushed Conduit or Porcelain tubing or PVC pipe where cable through etc.

Earth wire for three pin socket point to the common earth station (iv) all metal blocks, board & boxes sunk type including those required for

mounting fan regulator bus excluding those under the DB and control switch.

All fixing accessories such as nails, screws, plugs etc., as required. Joint for

junction Boxes & connecting the same as required.

Indoor point wiring will be casing capping type with 1.1 kV PVC insulated 2 x 1.5mm2 copper wire including Wooden switch Board covered with Bakelite Cover, Ceiling Rose supply of wire, casing-capping, appropriate size bare copper earth wire, screw & and other accessories etc., as such where required. The work includes supply of all requisite materials. Standard ISI marked Anchor or equivalent good make materials are to be used for point wiring.

PVC casing capping and all accessories shall be of Heavy gauge Polyphone with all accessories and white in colour. Conduit / buses through wall shall be flash after cutting wall and including mending well the damages. Casing capping on wall shall be fixed with suitable screws at an interval not less than 300mm.

All out door point wiring will be with hard PVC conduits of approved make. Suitable hard PVC bends, saddles, Tees etc., are to be used for outdoor wiring..

66.02 DISTRIBUTION WIRING:

All Distribution wiring shall be as required as per provisions of IS.

66.03 LIGHTING FIXTURES:

All Compact Florescent Lamp fixtures shall be indoor type & pre-wired comprising of Lam;(s) as indicated with lamp holder(s) and Electronic Ballast(s) with metal reflector(s). The lamp fitting shall be covered by Glass or Perspex material. The Lamp Fixture shall be fitted on wall as per direction of Engineer in-charge. The PF of the electronic ballast shall be more than 0.9. The fixtures should be of reputed make like Philips/Bajaj/Crompton/G.E. etc., however, contractor shall submit the sample of lighting fixtures to KPCL for approval before supply & installation. Alternatively. IEDS may be used after submitting detailed descriptions illumination computations and Test certificates from reputed test centers.

67.00 AIR CONDITIONING SYSTEM

AC system for the Control room housing various relay panels, control and protection panels shall be provided with Air conditioner of required tonnage , confirming to standards.

68.00 COMMUNICATION SYSTEM

Effective communication in the plant shall be provided through

The following systems.

(i) P & T line (ii)
V-Sat link (iii)
Mobile phones.

69.00 AIR CIRCULATOR TYPE STAND FAN:

The fan will have atleast 4040 mm sweep, 1420 RPM. The fan shall be fitted with suitable regulator & a power suitable power cord. The fan shall have height adjustable stand. Standard Polar / Khaitan / Usha or similar reputed make shall have to be supplied.

70.00 DANGER NOTICE BOARDS:

Danger notice plates shall be provided wherever necessary Suitable size of each Danger Notice plates shall be provided as per statutory requirement , made of mild steel sheet and at least 2mm thick, and vitreous enameled white on both sides, and with inscription in signal red colours on front side as required. The inscriptions shall be in kannada and English language.

71.00 FIRE FIGHTING SYSTEM:

Firefighting equipment to take care of fire at various locations in line with the guidelines of T.A.C. shall be provided.
Portable fire fighting equipments will also be provided at strategic locations in the solar plant as well as out door yard. Fire detection and alarm system for cable gallery and control room will be provided.

71.01 DRY CHEMICAL FIRE EXTINGUISHERS:

The dry chemical fire extinguisher shall be Upright type of capacity 10 Kg having IS:2171. 7 IS: 10658 marked. The fire extinguisher shall be suitable for fighting fire of Oils, Solvents, Gases, Paints, Varnishes, Electrical Wiring, Live Machinery Fires, All Flammable Liquid & Gas.

71.02 SAND BUCKETS:

The bucket should be wall mounted made from atleast 24 SWG sheet with* bracket fixing on wall conforming to IS 2546.

72.00 ENERGY METERING

PCU and lines will be provided with microprocessor based ABT compliant trivector meters to record energy. The accuracy class of energy meters will be of suitable class.. The lines will be provided with main and check meters. The meter will be capable of metering active & reactive energies both import and export. The meter will indicate maximum demand by integrating the energy for the preset period. The meter will register maximum demand in separate preset periods of the day with provision for recording of tamper/ abnormal events with date and time

stampings in its non-volatile memory. Separate PTs and CTs are provided for line energy meters.

Energy meters shall be approved by the purchaser /

Utility .Meter must be provided with the necessary data cables

73.00 COMPLETNESS OF EQUIPMENT

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

74.00 SCOPE OF THE CIVIL WORKS

The solar plant shall be designed so as to conform with the latest engineering designs , architectural values and aesthetic features etc., in order to establish an ideal solar PV plant.

74.01 **TOPOGRAPHICAL SURVEY**

Topographical survey shall have to be done of the proposed site at suitable interval by Plain Table or any other suitable standard method of survey. All necessary levels as entered in the Field Book have to be submitted along with pre contour layout of the total site. Based on the above survey work a general layout drawing with clear demarcation showing boundary pillars, location of control room, array yard, approach road and general drainage etc. has to be prepared. Two sets of drawings and survey reports along with all relevant documents to be submitted.

74.02 **SOIL TEST**

To ascertain soil parameters of the proposed site for construction of control room. HT lines & array yard, the contractor shall carry out sub soil investigation through certified soil consultant. The scope of sub soil investigation covers: execution of complete soil exploration including boring, drilling, collection of undisturbed soil sample wherever possible, otherwise disturbed soil samples, conducting laboratory test of samples to find out the various parameters mainly related to load bearing capacity, ground water level, settlement and sub soil condition and submission of detail reports with recommendation regarding suitable type of foundation for each bore hole along with recommendation for soil improvement wherever necessary.

The soil test also includes analysis of water sample.

There will be minimum three numbers of boring each with required depth.

74.03 **PLANNING AND DESIGNING**

The bidder has to plan and design the plant building as per the layout drawing enclosed The bidder has to develop general layout drawing of plant array yard, Internal Road & drainage (ensuring no water logging in the Power Plant Compound) along with sanitary plumbing layout etc. The work also includes landscaping & beautification of the entire area of the PV Power Plant including gardening. All design & drawings has to be developed based on specification given in the tender, soil report and relevant IS unless otherwise specified. All details related to internal electrification, water supply and sewerage system should be clearly shown in the drawings.

74.04 The plan should be innovative taking into consideration the following:

a. Land utilization in such a way that complimented with appropriate Array layout for maximum power packaging is done in the proposed site.

b. Plant building design taking in to consideration passive architecture for 10 KW solar PV building integrated solar PV.

c. LED/CFL/FL lighting system arrangements as required

d. An integrated amphi-theatre that can accommodate about 20 persons in the Control Room of innovative and appropriate design and well equipped with all accessories required for presentations, Video projection, Documentary projection etc.

e. A water sprinkler system to clean the modules on a periodic basis

f. All design should be developed considering optimal usage of space, material and labour without compromising the effect of shadow, cooling, ventilation, accessibility, losses during electrical interconnection etc.

g. The layout of the building shall be in line with planning purpose drawing enclosed.

h. The supplier shall submit preliminary drawing for approval & based on any modification or recommendation, if any, the Supplier shall submit six sets of final drawing for formal approval. Approved drawings shall only be used to proceed with construction work.

i. The building shall be with concrete construction in compliance with National Building Code and relevant International standards.

j. Land development as per design formation level.

k. Landscaping work of the entire area of the plant premises shall have to *be* done as per drawing developed by bidder.

74.06 P**LANNING AND DESIGNING**

The area shown for the civil construction is indicative. Finally, size of the shade, building, area of pathways, length of fencing may vary as per

actual equipments to be installed and available area to be found in each project site.

The overall layout of the SPV plant shall comprise of the following .

The plant, office, security guard room, control room, store, security centre and there shall be only one main gate for entrance.

The contractor shall complete drawings fulfilling all requirements with different options of plan and elevation for acceptance and approval by KPC. Final design and drawings are to be prepared for construction as per instruction based on the approved drawings.

The work also includes landscaping & beautification of the entire area of the Solar Power System. All details related to internal electrification, water supply and sewage system should be clearly shown in the drawings.

All design should be" developed considering optimal usage of space, material and labour without compromising the effect of shadow and cooling effects.

The Contractor shall submit preliminary drawing for approval & based on any modification or recommendation, if any, and then the Contractor shall submit six sets of final drawing for formal approval to proceed with construction work.

74.06 **SITE DEVELOPMENT**

Before beginning work including any filling of the Project Site, the bidder must visit the site to assess the actual situation of the land.

Landscaping work of the entire area of the plant premises shall have to be done as per drawing developed by the Contractor and as per approval. All proper attention must be given to the drainage and water run off.

74.07 **PLANT BUILDING**

The design/plan of the plant building shall be indicated.

Construction work for the building shall follow the standard specification.

The control room building shall have to be designed based on topological survey report & soil testing report and relevant building code in consultation with Engineer-ln-Charge. The size plant building, shall be 60x30 sq feet, which is tentative

The control room shall house AC/DC Panels., Inverters, control / protection equipments/panels, SCADA system , operators desk, amphitheatre.

All utilities such as urinals, toilets. Bathroom , kitchen .reading room/library, rest room, recreation hall etc shall be provided.

74.08 **COMPOUND WALL**

A compound wall of brick work of about 6 feet height and having steel structure barricade of about 3 feet height above the brick wall for protection / safety shall be constructed all round the entire solar PV plant. Prior approval of the purchaser for the design, engineering, drawing of the compound wall shall be obtained.

74.09 **WATER SUPPLY SYSTEM INCLUDING STORAGE TANK**

This has to be designed and executed as per relevant BIS and as per requirement.

74.10 **APPROACH ROAD** & **PATH WAYS**

These shall be designed and constructed based on general layout. Main approach shall be so designed so as to carry the equipments as per relevant specification.

75.00 OFFICE FURNITURE

Adequate and appropriate furniture for the Control Room and Amphitheatre shall be included in the offer. The furniture should be chosen in such a way that it merges with the eco-friendly concept of Solar Energy. A glimpse of such furniture shall be provided.

76.0 DATA TO BE FURNISHED BY VENDOR AFTER AWARD OF CONTRACT

76.1 **DRAWINGS**

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

b) General arrangement and dimensioned layout

c) Drg. showing the requirement of sv panel, transformers. Mounting etc.

d) Drawing showing the terminal connection between the SV plant, transformer, 11KV switchgear cubicle, lines etc.,.

e) Structural drawing along with foundation details for the structure

f) Arrangement of the power pack unit.

g) Drawing showing details of CTs, PTs, SF6 breakers and external connection details

h) Itemised bill of material for complete 3V plant covering all the components and associated accessories

i) Genera! arrangement of equipment within the V.T. and surge protection cubicle and the neutral cubicle.

j) Overall layout showing SV PLANT

76.02 **TEST CERTIFICATES**

a) Type test certificates for all the tests specified for the factory built SV PLANT MODULES, and the component parts shall be submitted by the CONTRACTOR. Available type test certificates for component parts shall be submitted within 15 days.

b) Routine test certificates for all the tests specified for the factory and the component parts shall be submitted by the CONTRACTOR .

c) Equipment shall not be despatched unless the test certificates are duly approved by the PURCHASER/ENGINEER.

d) The specified number of copies of the compiled and approved test certificates shall be submitted to the PURCHASER.

76.03 **INSTRUCTION MANUALS**

a) The Contractor shall furnish specified no. of copies of the instruction manual which would contain detailed instructions for all operation and maintenance requirements. The manual shall be furnished at the time of dispatch of the equipment and shall include the following aspects:

b) Outline dimension drawings showing relevant cross sectional views, earthing details and constructional features.

c) Rated voltages, current and all other technical information[8] which may be necessary for the correct operation of the SV plant.

d) Catalogue numbers of all the components which are liable to be replaced during the life of the SV plant and all the component parts.

e) Unpacking

f) Handling at site.

g) Erection drawings with written assembly instructions that would enable the PURCHASER to carry out erection with his own personnel.

h) If applicable detailed instructions for the installation operation and maintenance.

i) Pre-commissioning tests, j) Maintenance procedures, k) Precautions to be taken during operation and maintenance work.

76.04 **PRELIMINARY CHECK LIST**

a) Project management / site management with all installation like electricity, light, telephone/fax etc., including all necessary material and works.

b) Delivery, installation and operation of containers for the construction team including all necessary material and works

c) Delivery, installation and operation of storage facilities for all .components, material and tools, etc., including all necessary material and works.

d) Delivery, installation and operation of containers with bathroom/lavatory facilities including all necessary material and works.

e) Delivery, installation and operation of temporary power generator for electricity on site, including all necessary materials and works.

f) Delivery, installation and operation of containers for the collection of waste, including all necessary material and works.

77.0 SCOPE OF COMPREHENSIVE OPERATION & MAINTENANCE

77.1 The Contractor shall operate the Solar PV Power Plant including its associated grid connecting equipments, plant room building, Array Yard, Garden etc., for a period of one year from the date of commissioning.

77.2 Zero data of operation shall begin on the date of actual commissioning of the Power Plant and grid connection to the 11KV feeder.

77.3 Operation work includes day to day operation of PV Power Plant including, maintenance of LT lines, HT lines and maintenance of all Civil works.

77.4 The Contractor will furnish necessary details regarding technical competence, qualification and number of different grades of personnel to be posted at site along with proposed maintenance (Preventive) schedule for a period of one year from the date of commissioning.

77.5 The maintenance staff of the Contractor shall be available in the Power Plant for 24 hours every day irrespective of whether the plant is in operation or not unless otherwise instructed by the Purchaser in writing.

78.00 SCOPE OF OPERATION OF THE POWER PLANT:

The supplier shall provide his staff(s) at the power Plant for day-to-day operation and maintenance. The maintenance personnel(s) shall be qualified, appropriately certified and well trained so that they can handle any type of operational problems quickly and timely.

The security of the Power Plant will rest with the Supplier till such time, operation and maintenance of the power plant is not handed over to the purchaser.

The Maintenance personnel(s) shall be in a position to check and test all the equipment regularly, so that, preventive maintenance, could be taken well in advance to save any equipment from damage. Any abnormal behavior of any equipment shall be brought to the notice of purchaser immediately.

All repairing & replacement works are to be completed by the contractor within 24 hours from the time of occurrence of fault or defect. If it is not possible to set right the equipment within this time, the Contractor shall notify the purchaser indicating nature of fault & cause of damage etc., within 12 hours from the time of occurrence of the fault.

During operation if there is any loss or damage of any component of the power plant due to miss management / miss handling or due to any other reasons, what so ever, the Supplier shall be responsible for immediate replacement / rectification. The damaged component may be repaired, if it is understood after examination that after repairing performance of the components shall not be degraded, otherwise the defective components shall have to be replaced by new one without any extra cost.

The scope of preventive maintenance work shall include the following:

77.6 Regular operation and maintenance of the SPV Power Plants (3 MWp grid connected with associated power evacuation system) ., for a period of one year after commissioning, submission of daily performance data of the power plant. The contractor shall keep a Record Book in this respect clearly indicating date of checking &comments for action etc.

77.7 The scope of operation includes providing power to the 11 KV feeder cable as per instruction of KPCL. Proper records of operation of Power Plant System are to be kept as per direction of KPCL..

77.8 Cleaning of the Power Plant including array yard on regular basis and as and when required. .

77.9 Normal and preventive maintenance of the Power Plant such as cleaning of module surface, tightening of all electrical connections, Line accessories, Transformers and associated switch gear on the HT side.

77.10 Keeping & recording daily log sheet as per approved format for the Power Plant as per format to be supplied after commissioning of the Power Plant.

77.11 Operation of the power plant is in accordance with the availability of Solar Energy and feeding to the grid. Under no circumstances, the operator shall run the power plant damaging the substation grid.

77.12 The Contractor shall carryout landscaping of the whole plant area within the security fencing as per direction of Engineer-in-Charge. Take necessary action for supply & planting of trees, cleaning, watering of plants.

77.13 Contractor's employees shall use no part of the power plant buiiding for residential or any other purpose except for running the plant.

77.14 The supplier shall submit monthly Performance report of SPV Power Plant indicating cumulative energy generation data as per approved format within 15 days of the following month.

77.15 The supplier shall preserve all recorded data both in manual and through computer and shall submit to KPCL quarterly.

77.16 The supplier shall develop & maintain the garden, which will be developed by the contractor himself as per landscaping including daily watering and menuring as and when necessary and on regular basis.

77.17 During maintenance period, the Contractor shall refill the Dry Chemical fire Extinguisher as per manufacturer's recommendation before expire.

79.00 SCOPE OF CIVIL MAINTENANCE: *

Cleaning of surface drain, sewerage line, septic tank, urinal, drainage outfall, down pipes, soil pipes & water pipe lines.

Maintenance of building, periodic painting, cleaning etc. to maintain the plant in neat & tidy condition.

Repairing or replacement, whatever necessary, and cleaning of all joineries as and when necessary.

Repairing or replacement; whatever necessary or door, window fixtures, Toilet accessories as and when necessary.

Cleaning & maintaining of Power Plant Area.

Painting of all steel surface including door window grills, gates as and when required..

Painting of compound wall.

Painting of concrete & brick surfaces once in a year.

Painting of iron parts of array structures posts once in a year.

All tit bit repair maintenance in case of building and all other structures as and when required as per instruction of Engineer-in-Charge.

The Contractor's representatives/employees shall conform to all general regulations in force at site and to any special conditions affecting by local administration issued by KPCL. All employees of the Contractor living at site shall be deemed to be aware of damages and risks incidental to the conditions of the purchaser's land and works from time to time and the purchaser shall not be responsible for any injury arising there from.

KPCL reserves the right to ask the contractor to remove / transfer any staff of the contractor from site without assigning any reason whatsoever, Instructions issued in writing to the contractor in this matter shall be binding and the contractor shall replace the transferred / removed person with a suitable replacement immediately.

All persons deployed by the contractor for regular maintenance & operation must remain in proper uniform while on duty. The contractor shall supply uniforms, raincoats, toolset, gloves, gumboats and other; items required for carrying out the services

KPCL shall have power to disallow any personnel, if found unsuitable. The Contractor shall have to replace such persons within 24 hours.

The contractor shall maintain attendance register for all their staff deployed for carrying out jobs on regular basis.

SECTION B

SOLAR PV POWER PLANTS

SPECIFIC REQUIREMENTS

1.00 EQUIPMENT TO BE SUPPLIED:

The scope of the work includes The Design, manufacture, supply, erection, testing and commissioning of two numbers of 3MWp capacity grid interactive solar PV plant and the grid connecting equipments including all associated civil works required for the power evacuation through the existing 11 KV line at Yelasandra village in Kolar District and Itnal village in Belgaum District of Karnataka. Equipment shall be complete with all fittings and accessories as detailed herein.

1.01 DETAILED SCOPE OF WORK

a) SOLAR PV PLANTS

"The Design, Engineering, manufacture, Quality surveillance, Testing at; manufacturer's works, Packing and Supply of two solar PV units each of 3MWp capacity grid interactive plant including comprehensive insurance, Storage, intra site transportation, erection, testing and commissioning of the system including all connected civil works. Each plant shall consist of required numbers of 250 KW solar PV arrays.

b) GRID CONNECTING EQUIPMENTS

The Design, Engineering, manufacture, Quality surveillance, Testing at manufacturer's works, Packing, supply, erection, testing and commissioning including comprehensive insurance of the grid connection equipments viz., 11KV Switching cubicle with switchgears, and protection system, transformers, lightning arrestors, isolators, SCADA system etc., required for the power evacuation through the existing 11 KV line, including all associated civil works.

c) Operation and maintenance of the grid connected SPV plants for a period of one year from the date of commissioning.

2.00 ASSOCIATED CIVIL WORKS:

2.01 Cutting and clearing of trees, plants etc., in about 15 acres of land to ensure shadow free area.

2.02 Site grading, levelling, exploratory drills if necessary and consolidation of the area pertaining to the installation of SPV modules of solar plant.

2.03 Embedment of structures suitable for mounting PV modules on ground in about 15 acres of land Laying of earthing equipments / structures and connecting to the main ground mat as per the statutory requirements.

2.4 Cutting of cable trenches wherever necessary, construction of all round, compound wall for the entire plant including the power evacuation line; bay and providing suitable gates, (as specified)

2.5 Formation of roads, wherever necessary, providing foundation for transformers, structures and water drainage ducts, lightning, arrestors etc

2.6 Construction of plant building is about 60x30 Sq. feet area to house, control, protection, SCADA system and panels, as per enclosed drawing

3.00 SOLAR PV PLANT

Each SOLAR PV Unit shall consist of following equipments:

1. Solar PV arrays with modules of suitable rating.

2. Inverters with SCADA ,
4. Mounting structures
5. Cables and hardwares
6. Junction box and distribution boxes
7. Earthing kit
8. Lightning arrestors
9. PVC pipes and accessories
10. Toolkit
11. Control room and civil pedestals
12. 12 Spares for 2 years

4.00 GRID CONNECTING EQUIPMENTS:

1) 1250 KVA.0.415/11 KV, 3 phase, 50Hz Transformer

2) Lightning arrestor, of rating 9 KV , suitable for 11 KV system

3) 11 KV Cubicle consisting of Current Transformer, Potential Transformer, SF6/ Vacuum circuit Breaker, Bus bar, isolators, protection system etc with incoming and outgoing feeders.

4) 11 kV isolators .

5) 3 CORE XLPE Cable ,185sq.mm, aluminum armoured cable confirming to IS 7098 carrying nearly 276 amps(earth) and 332 amps in (air) of required length for power evacuation (about 500m.) length.

5.00 Supply, erection, testing and commissioning of SCADA system for the remote operation of the plant.

6.00 Operation and maintenance of SPV Plant along with grid connecting equipments for a period of one year from the date of commissioning

Training of KPCL personnel for smooth operation & Maintenance of the Plant.

7.0 OTHER WORKS:

7.1 Supply and providing illumination for the proposed SPV plant, evacuation system, intermediary area upto11 KV Line. The illumination of the plant, yard and compound wall shall make use of solar power. A separate battery supported .10 KW solar PV building integrated system shall be provided for illumination of the plant.

7.2 Supply and erection of galvanized steel ground wire of suitable dia. with hard ware for lightning protection of the SPV Plant and switchyard equipment and grounding as per statutory requirement.

7.3 Providing all round compound wall for the entire SPV plant for its safety/protection.

7.4 Supply of all miscellaneous materials like hardwares, clamps and connectors, glands, lugs etc., and supply of essential spares for the SPV plant and the grid connecting bay required for trouble free operation for two years.

7.05 Supply and installation of suitable fire protection equipments as per statutory requirement.

7.6 Supply and installation of battery banks with main and standby and battery chargers as per specification.

7.7 Supply and installation of adequate air conditioning system for control and protection equipments Computers., scada system etc.,

7.8 Supply and installation of danger boards, sign boards, hoardings etc., as per statutory needs.

7.9 Supply and installation of effective communication system as specified

8.00 TRANSFORMER:

3 nos. 1250 KVA, 415/11000V, 3 phase, 50 Hz Dyn11 connected, 5% impedance voltage, outdoor type transformers .and accessories.

9.00 11 KV SWITCHGEAR CUBICLE

The 11KV switch gear cubicle comprising of protection/ interlocking / annunciation / inter-tripping / automatic / manual operation schemes for the purpose~T5fsatisfactory and efficient operation of the equipment.

9.01 GENERAL DESIGN AND OPERATING CONSIDERATIONS .

11KV switch gear cubicle shall consist of current transformers, potential transformers, sf6/ vacuum circuit breaker, bus bar , isolators .protective devises etc.

The Switchboard/panel foundations and fixing devices shall be strong enough to withstand the forces in normal operation and in abnormal conditions with forces superimposed due to occurrence of earthquake and short circuit simultaneously.

The copies of type test reports for similar type of switchgears/ accessories and foundation equipments, if tested earlier, should be furnished along with I the bid. If these types of switchgears have not been type tested earlier, the / same has to be arranged by the contractor at his own cost and test reports/ to be furnished for review. *'"r* *t*

9.02 APPLICABLE STANDARDS

Unless otherwise specified elsewhere in this specification, the rating, performance and testing of 11 KV cubicle and associated panels shall conform to the latest revision of standards.:

10.00 Features of 11 KVcubicle

a) Alternating current Circuit breakers :
b) Voltage transformers ""
c) Current transformers: -^
d) AC disconnectors (isolators) and earthing switches. ^
e) AC metal enclosed Switchgear & Control gear for rated voltages
f) Direct acting Indicating digital ele. Measuring Instruments & accessories. '
g) AC Energy meters '
h) AC Watt hour meters
i) Electrical Relays for power system protection
j). Static protective relays
k). Push button /switches
I) Bushings,
m) Common spec, for high voltage Switchgear & Control gear standards
n) High voltage alternating current circuit breakers o) Current transformers & Voltage transformers p) Degree of protection provided by enclosure (IP code)

11.00 If bidder is offering equipments conforming to the standards other than those stipulated above, he should establish in the bid that standards adopted by him are comparable with relevant Indian Standards or IEC Standards. Further a comparative statement in respect of only those provisions in standards adopted by him, which are different from those provisions in standards, shall be furnished. Also, the bidder must supply copies in English language of the standards and codes adopted by him (If these are in different languages, copies translated in 'English' may be furnished) to latest standards of engineering, design and workmanship in all respects shall be capable of performing in commercial operation in a manner acceptable to the owner.

12.00 SPARES

Bidder shall supply the essential spares along with main equipment for two years trouble free operation and maintenance.

13.0 MAINTENANCE REQUIREMENT

13.1 Easy access shall be provided for all components in the SPV plant and grid connecting equipments. Maintenance platform shall be provided for easy inspection of all the equipments.

13.2 If special tools are required for installation and maintenance, the bidder shall indicate the same and to be supplied free of cost.

13.03 The Vendor shall furnish operating and maintenance instruction manual to enable the purchaser to carry out maintenance of equipment effectively and safely,

14.0 TEST AND TEST REPORTS

14.1 The Supplier shall carryout all routine tests as specified in relevant standards on all major components in presence of the purchasers representative at works before despatch and furnish copies of test reports for purchaser's approval, If required, stage inspection will be carried out by the purchaser.

14.2 SUPPLIER shall carryout all routine and functional tests as specified in the relevant standards on the assembled SPV Plant and grid connecting equipments with all accessories of the equipment in the presence of the PURCHASER'S representative before despatch and furnish copies of the test reports for approval before despatch.

14.3 **TESTS ON TRANSFORMERS** :

All routine tests, pressure test and oil leakage tests shall be conducted.

The following shall be conducted transformer tank : Vacuum test: Pressure test:

14.04 All auxiliary equipment shall be tested as per the relevant standards. Test certificates shall be submitted for bought out items. All relevant tests as per IS shall be conducted.

14.05 XLPE cable shall be tested as per IS.

15.00 COMPLETNESS OF EQUIPMENT

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

16.00 LAYOUT REQUIREMENTS

The overall dimensions of the SPV Plant and grid equipments shall suit the space provided for the layout requirements. The arrangement to suit this space is to be intimated at the time of approving the general arrangement drawing of the equipments, shall be agreed upon by the Vendor without any commercial / delivery implications.

17.00 DELIVERY AND COMPLETION PERIOD:

The SPV plant and grid equipments including all accessories and spares shall be delivered within 6 months from the date of LOA.

The entire work including erection, testing , commissioning and handing over the plant to purchaser as indicated in the scope shall be completed within 9 months in all respects.

18.00 GUARANTEE

The CONTRACTOR shall guarantee the material and workmanship of all components and operation of the equipment and shall meet the requirement of the specification.

Should the performance test result at works deviate from the guaranteed values including the specified tolerance the CONTRACTOR shall correct his equipment at no extra cost to the PURCHASER and repeat the performance tests within a reasonable period as agreed to by the PURCHASER. As regard to the component clauses if the CONTRACTOR fails to meet the guaranteed values subject to tolerances specified, the PURCHASER will levy a penalty.

19.00 TENDER EVALUATION

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

b) The PURCHASER reserves the right to split the order. BIDDER shall specifically confirm that the unit price quoted by them are valid for any increase or decrease in the quantity specified.

20.0 ERECTION, TESTING AND COMMISSIONING

20.1 Scope of erection, testing and commissioning shall cover the following.

1. Receipt and unloading at site.
2. Transportation from place of unloading to stores
3. Storage
4. Transportation from stores to place of erection .
5. Erection, testing and commissioning.

20.02 The Supplier shall carry out pre-commissioning checks/ tests on instrument transformer as per the standard commissioning procedures.

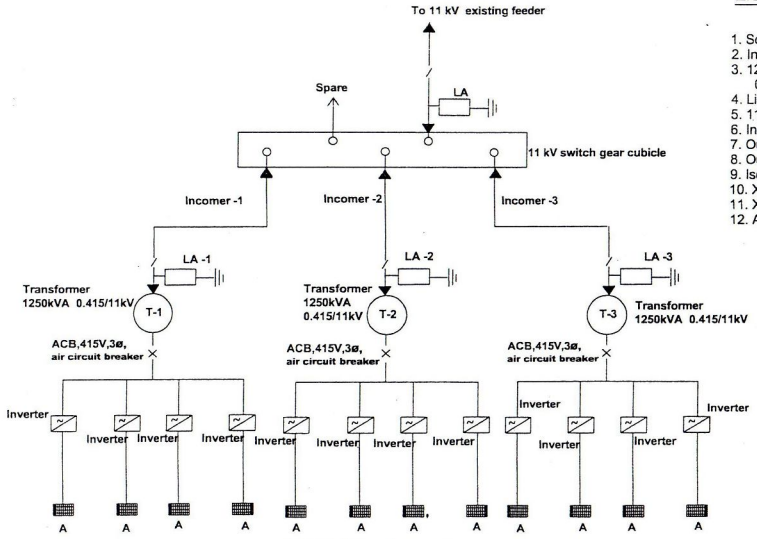
21.00 GENERAL

Unit prices quoted in the price schedule shall hold good for any additions/deletions during detailed engineering stage. The Bidder shall comply with the SPV Plant particulars as specified in Data Sheet. No credit will be given during the tender evaluation if design particulars better than those specified are offered by the Bidder. Bidder shall submit the design and performance data of the equipment offered by filling up data sheet-B in Section-D. Tenderer shall follow the tender specification strictly and conditional tenders will be rejected.

22.00 ARRANGING WATER AND POWER SUPPLY

Water and power required during construction and O&M period shall be arranged by the contractor. A borewell shall be installed for water source to the plant. Adequate capacity of power supply for construction/operation and maintenance of the plant shall be arranged by the contractor.

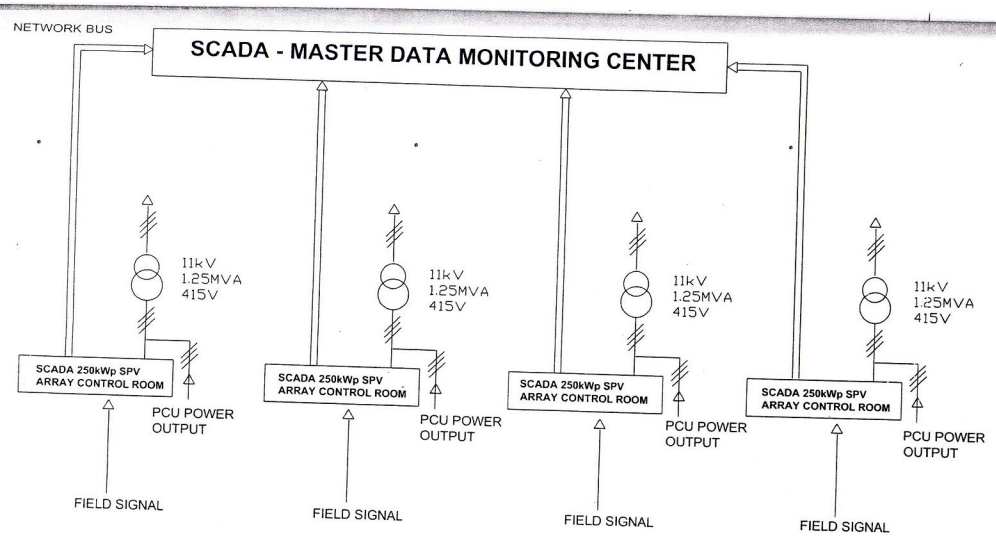
SOLAR POWER PLANT - POWER EVACUATION SCHEME



List of equipments

1. Solar PV arrays 250 kVA - 12 Nos.
2. Inverters - 12 Nos.
3. 1250kVA step up transformers 0.415/11kV - 3 Nos.
4. Lightning arrester 9kV - 4 Nos
5. 11kV switchgear cubicle - 1 No
6. Incoming feeders - 3 Nos.
7. Outgoing feeders - 1 No.
8. Outgoing feeders - 1 spare
9. Isolators 11kV(group operated) - 4 Nos.
10. XLPE cable 11 kV - apprx. 800 mtr.
11. XLPE cable from transformer to cubicle - 300mtr
12. ACB, 415V, 3phase - 3 nos.

Drawing is only for planing purpose



FOR PLANING PURPOSE

solar power project & SCADA system outline

REF: Ref:EDN:SCPV:PVSYS:2008/01

BID FORMAT FOR BUDGETARY QUOTE - 2 X 3 MWp GRID CONNECTED POWER PLANTS

Sl. No.	Description of Power Plant Items to be supplied, integrated and commissioned	Quantity (per 3 MWp plant)	Rate (Rupees)	Remarks if any
A	Solar PV array for 3 MWp SPV Power plant – to be offered as follows:			
A1	Monocrystalline/Polycrystalline PV modules 24 V of minimum rating 170 Wp for 3 MWp PV array			
A2	Monocrystalline/Polycrystalline PV cells of rating 2.5 W for manufacture of PV modules of 3 MWp capacity / Providing assistance in sourcing Monocrystalline/Polycrystalline Silicon wafers for manufacture of PV modules of 3 MWp capacity			
B	Power conditioning Unit (PCU) of rating 250 KVA/415 V,3 ph/50 Hz with SCADA	12 nos.		
C	Outdoor transformer 1250 KVA,11kV/415V	3 nos		
D	Substation with 11 KV Switchgear and SCADA for above	1 set		
E	Balance of System (BOS) for 3 MWp SPV plant consisting of the following:			
E1 a)	PV Module support structures of either alternative type as follows :			
b)	Mild steel structural support, hot dip galvanized to 120 microns and SS304 assembly hardware and foundation hardware			
	Anodized Aluminium extrusion structure with SS304 assembly hardware and foundation hardware			
E2	Reinforced Cement Concrete (RCC) pedestals for mounting module structures			
E3 a)	Cables for system wiring			
	For SPV system upto PCU output			

Sl. No.	Description of Power Plant Items to be supplied, integrated and commissioned	Quantity (per 3 MWp plant)	Rate (Rupees)	Remarks if any
b)	For interconnection of PCUs with transformer, switch gear as required			
c)	HT cabling for transformer, switch gear cabling to feeder			
E4	Junction boxes for cabling as required			
E5	Lightning arrestors for SPV array			
F	Storage of items at site till completion			
G	System integration, Erection and commissioning			

NOTE :

1. Bidders may quote for all the items listed above from A to G.

2. BHEL reserves the right to empanel for entire scope as above OR for one or more of the above items/activities.

3. Please attach Proposed Schedule (Bar chart) for the activities listed as above.