



**Installation of 5MW Solar Plant on LSTK basis alongwith 7 Years O&M at ONGC Hazira Plant**

**Tender No. 8A5RC19003**

**ANNEXURE-IV**

SCOPE OF WORK  
,SPECIFICATION  
& SCC

		Classification of chemically active substances: 3S2
15	Grid Specifications	IEC 61727, VDE 0126
16	Nominal Voltage & Frequency	415 Volts or as per Manufacturer data sheet & 50 Hz
17	Voltage Tolerance	+ 10% and -10%

xxiii. Display:

- a. The PCU shall have local LCD (Liquid crystal display) and keypad for system control, monitoring instantaneous system data, event logs, data logs and changing set points. Control and read-out should be provided on an indicating panel integral to the Inverter. Display should be simple and self-explanatory. Display to show all the relevant parameter relating to PCU operational data and fault condition in form of front panel meters/ LEDs or two-line LCD Display.
- b. PCU front panel shall be provided with display (LCD or equivalent) to monitor the following
  - Instantaneous DC power input
  - DC input voltage
  - DC Current
  - Instantaneous active AC power output
  - Instantaneous reactive AC power output
  - AC voltage (all the 3 phases and line)
  - AC current (all the 3 phases and line)
  - Power Factor
  - kWh Produced during entire day
  - Total kWh produced during its life time
  - Thermal loading (percentage)
- c. PCU must be provided with display and also the same has to be made available at the SCADA monitoring & controlling desk installed in Main Control Room through Universal Open Protocol of Communication.

xxiv. Documentary Requirements & Inspection.

- a. The bill of materials associated with PCUs should be clearly indicated while delivering the equipment.
- b. The Contractor shall provide data sheet containing detailed technical specifications of all the inverters and PCUs to ONGC. The Operation & Maintenance manual should be furnished by the Contractor before dispatch of PCUs.

***Note: ONGC or its authorized representative reserves the right to inspect the PCUs/ Inverters at the manufacturer's site prior to dispatch.***

1.1.16 Cables and Wires



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,SPECIFICATION  
& SCC

- i. All cables and connectors for use for installation of solar field must be of solar grade which can withstand harsh environment conditions for 25 years and voltages as per latest IEC standards.

***Note: IEC standards for DC cables for PV systems of 600- 1800 volts DC for outdoor installations should comply with the EN 50618 for service life expectancy of 25 years)***

- ii. Wires with sufficient ampacity and parameters shall be designed and used so that average voltage-drop at full power from the PV modules to inverter should be 2% (including diode voltage drop). PV Modules should be connected with USE-2/RHW-2 cables array to junction box conductors and junction box to photovoltaic disconnecter with the THHN/THWN-2 sunlight resistant with 90°C wet rated insulation cable. Due consideration shall be made for the de-rating of the cables with respect to the laying pattern in buried trenches / on cable trays, while sizing the cables. The Contractor shall provide voltage drop calculations in excel sheet.
- iii. All cables shall be supplied in the single largest length to restrict the straight-through joints to the minimum number. Only terminal cable joints shall be accepted and no cable joint to join two cable ends shall be accepted. All wires used on the LT side shall conform to IS and should be of appropriate voltage grade. Copper conductor wires of reputed make shall be used. Armoured Aluminium cable connecting SMB and Inverter and also for IT applications are allowed.
- iv. All wires used for connecting the modules and array should conform to the NEC standards. Modules should be connected with USE-2/RHW-2 cables array to junction box conductors and junction box to photovoltaic disconnecter with the THHN/THWN-2 sunlight resistant with 90°C wet rated insulation cable.
- v. All high voltage cables connecting the main junction box/string inverters to the transformers should be PVC insulated grade conforming to IS 1554 and cables shall also conform to IEC 60189 for test and measuring the methods.
- vi. Irrespective of utilization voltage and current rating all type of power cables shall be minimum of 1100 V grade PVC insulated conforming to IS 1554 / IS 694 for working voltage less than 150 V control cable shall be of minimum 600 V grade, the control and power cable has to be laid separately. All LT XLPE cables shall confirm to IS: 7098 Part I. All HT XLPE Cables (up to 33kV) Shall confirm IS: 7098 PART-2& IEC - 60287, IEC-60332 and the Contractor to submit technical data sheet, Voltage drop calculation, Power Loss Calculation and type test report for the approval of client / consultants for two 11KV cable feeders to evacuate 05MW each from solar plant to SS-1A using the existing structure of cable tray with modifications wherever required as per the site condition. The contractor has to submit the details of the scheme i.e. supports & tray for the approval of ONGC / PMC consultant.
- vii. The cables shall be adequately insulated for the voltage required and shall be suitably color coded for the required service. Bending radius for cables shall be as per manufacturer's recommendations and IS: 1255.



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**ANNEXURE-IV**

SCOPE OF WORK  
, SPECIFICATION  
& SCC

**Table 1-4 Relevant Codes & Standards for Cable**

Sr.	Item	Relevant IS	Relevant IEC
1	Conductors of Insulated Cables	IS: 8130 – 1984	IEC: 228
2	Impulse tests on cables and their accessories		IEC: 230
3	Extruded solid dielectric-insulated power cables for rated voltage from 1 KV upto 30 KV.		IEC: 502
4	Test methods for insulations and sheaths of electric cables and chords.		IEC: 540
5	Test on cable over a sheath which has special protective functions and are applied by extrusion.		IEC: 229
6	Calculations of continuous current rating of cables (100% load factor).		IEC: 287
7	Cross-linked polyethylene insulated PVC sheathed cable for voltage from 3.3 KV upto 11 KV.	IS: 7098 (Part II)	
8	PVC insulation & sheath of electrical cables.	IS: 5831 – 1984	
9	Mild steel wires, formed wires and tapes for armoring of cables.	IS: 3975	
10	Electrical test methods for electric cables partial discharge test.		IEC: 885(2) - 1987 (Part II)
11	Methods of test for cables.	IS: 10810	
12	Common test methods for insulating and sheathing materials of electric cables.		IEC: 811
13	Impulse test on cables & other accessories		IEC: 230
14	Cable termination for gas insulated switchgear.		IEC: 859

**1.1.17 Technical Specification of LT XLPE Cables**

**General Constructional Features**

The medium voltage cables shall be supplied, laid, connected, tested and commissioned in accordance with the drawings, specifications, relevant Indian Standards specifications, manufacturer's instructions. The cables shall be delivered at site in original drums with manufacturer's name, size, and type, clearly written on the drums.

**A. Material**



**Installation of 5MW Solar Plant on LSTK basis alongwith 7 Years O&M at ONGC Hazira Plant**

**Tender No. 8A5RC19003**

**ANNEXURE-IV**

SCOPE OF WORK  
, SPECIFICATION  
& SCC

Medium voltage cable shall be **XLPE insulated. PVC sheathed, aluminium or copper conductor, armoured conforming** to IS: 7098 Part I.

**B. Type**

The cables shall be circular, multi core, annealed copper or aluminium conductor, XLPE insulated and PVC sheathed, armoured.

**C. Conductor:**

Uncoated, annealed copper, of high conductivity upto 4 mm<sup>2</sup> size, the conductor shall be solid and above 4 mm<sup>2</sup>, conductors shall be concentrically stranded as per IEC: 228.

**D. Insulation:**

XLPE rated 90°C extruded insulation.

**E. Core Identification:**

Two core	: Red and Black
Three core	: Red, Yellow and Blue
Four core	: Red, Yellow, Blue and Black
Single core	: Green cable with Yellow strips for earthing

*Note: Black shall always be used for neutral.*

**F. Assembly:**

Two, three or four insulated conductors shall be laid up, filled with non-hygroscopic material and covered with an additional layer of thermoplastic material.

**G. Armour:**

Galvanised steel flat strip / round wires applied helically in single layers complete with covering the assembly of cores.

- **For cable size upto 25 Sq. mm.: Armour of 1.4 mm dia G.I. round wire**
- **For cable size above 25 Sq. mm. Armour of 4 mm wide 0.8 mm thick G.I strip**

**H. Sheath:**

The cable shall be rated extruded for XLPE 90 deg.c. Inner sheath shall be extruded type/ PVC ST and shall be compatible with the insulation provided for the cables.

Outer sheath shall be of an extruded type layer of suitable PVC material compatible with the specified ambient temp 50 deg. C and operating temperature of cables. The sheath shall be resistant to water, ultraviolet radiation, fungus, termite and rodent attacks. The colour of outer sheath shall be black. Sequential length marking required at every 1.0-meter interval on outer sheath shall be available. The



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**Tender No. 8A5RC19003**

**ANNEXURE-IV**

SCOPE OF WORK  
,SPECIFICATION  
& SCC

contractor has to furnish resistance / reactance / capacitances of the cable in the technical datasheet.

**I. Rating:**

Up to and including 1100 Volts.

**1.1.18 Technical Specification of HT XLPE Cables**

**General Constructional Features**

**A. Conductors:**

The conductor shall be of circular stranded Aluminium confirming to IS: 8130 & IEC: 228. It shall be clean, reasonably uniform in size & shape smooth & free from harmful defects. Any other form of conductor may also be accepted if in line with modern trends.

**B. Semi-Conductor Barrier Tape/Tapes:**

The semi-conducting barrier tape/tapes shall be provided over the conductors.

**C. Conductor Screen:**

The conductor screen shall consist of an extruded layer of thermosetting semi-conducting compound which shall be extruded simultaneously with the core insulation.

**D. Insulation:**

The insulation shall be super clean XLPE compound applied by extrusion and vulcanized to form a compact homogenous body.

**E. Insulation Screen:**

- a. Each insulation have an insulation screen in two parts consisting of:
- b. A water barrier tape/Non-metallic semi-conducting swellable tape part and a metallic screen part.
- c. The non-metallic part shall be directly applied upon the insulation of each core and may consist of an impregnated but nylon/PVC tape or a similar approved material or, an extruded semi-conducting material extruded simultaneously with the conductor screen and insulation (triple extrusion).
- d. The semi-conductor shall be readily strippable and must not be bonded in such a manner that it has to be shaved or scraped to remove.
- e. The metallic part shall consist of a copper tape helical applied with a 30% overlap over the water barrier tape/blocking tape. A binder tape of copper shall be applied over the copper wire metallic screen.

**F. Laying Up:**



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**Tender No. 8A5RC19003**

**ANNEXURE-IV**

SCOPE OF WORK  
,SPECIFICATION  
& SCC

- a. The cores shall be identified on the non-metallic part of the insulation screen by legible printing on the length of each conductor or, by the inclusion of a marker tape.
- b. The cores shall be laid up with a right hand direction of lay.
- c. Binder tape/Moisture barrier:
- d. During layup, a suitable open spiral binder may be applied, at the manufacturer's discretion, before the application of an extruded inner covering.

**G. Fillers:**

Fillers shall be polypropylene.

**H. Inner Covering/Sheath:**

The inner covering shall be extruded over the laid up cores to form compact and circular bedding for the metallic layer.

**I. Metallic Layer:**

The metallic layer shall be galvanised steel wire.

**J. Outer Sheath:**

The tough outer sheath, black coloured best resisting PVC polyethylene compound type ST-2 as per IS: 5831 for the operating temperature of the cable shall be provided over the armour as specified in relevant standards by extrusion process.

**K. Cable Marking:**

- i. Embossing on outer sheath:
  - ONGC-SPVPP-5MW
  - Voltage grade
  - Year of manufacture
  - Manufactures name
  - Successive Length
  - Size of cable
  - ISI mark
- ii. The following particulars shall be properly legible embossed on the cable sheath at the intervals of not exceeding one meter throughout the length of the cable. The cables with poor and illegible embossing shall be liable for rejection.
- iii. Packing and marking shall be as per clause No. 18 of IS 7098 (part I)/1988 amended up to date.
- iv. Cables inside the control room and in the Switchgear shall be laid in Galvanized



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, SPECIFICATION  
& SCC

Cable Trays mounted on mild steel supports duly painted, in constructed trenches with RCC raft and brick sidewalls and provided with removable RCC covers.

- v. Cable terminations shall be made with suitable cable lugs & sockets etc, crimped properly and passed through brass compression type cable glands at the entry & exit point of the cubicles.
- vi. All cable/wires shall be provided with Punched Aluminium tags only. The marking on tags shall be done with good quality letter and number ferrules of proper sizes so that the cables can be identified easily.
- vii. The wiring for modules interconnection shall be in the GI pipe /HD Pipe of approved make.
- viii. Data sheets of individual cable sizes (HT & LT) shall be submitted for approval by the Company. Drum numbers and drum length details shall be submitted with each consignment.
- ix. Cable end terminations and joint kits shall comply with the latest version of the relevant IS standard.
- x. The cable ends shall be terminated with adequate size copper lugs and sockets etc, single/double compression cable glands. Cable glands shall be of robust construction capable of clamping cable and cable armor (for armored cables) firmly without injury to insulation. The metallic glands shall be earthed at two locations. Suitable lock type crimping lugs shall be used for cable end terminations. Where cables are raising from ground, suitable PVC pipe guarding shall be provided for cable raising with sealing of the guarding PVC pipe including a suitable clamp.
- xi. HT cable termination kits and straight through joints shall be selected as per the cable specifications. Installation shall be as per the instructions given in the manufacturer's manual. Heat shrinkable type kits only shall be used for HT and LT cables.
- xii. Data sheets of the joints and kits shall be submitted for approval by ONGC or its Authorized representative.

**1.1.19 UPS**

- i. The UPS and all components shall be designed, manufactured and tested in accordance with the latest applicable standards as follows. Where a conflict arises between these documents and statements made herein, the statements in this specification shall govern.

Safety

- a. IEC 62040 or EN 62040
- b. EN 60950

Emission and Immunity: