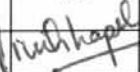




BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION PROJECTS ENGINEERING MANAGEMENT

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TYPE OF DOC.	TECHNICAL SPECIFICATION 1.1 kV Control & Aux Power Cables			NAME	RD	VK	AG
TITLE				SIGN			
				DATE	10/04/19	10/04/18	
				GROUP	TBEM	W.O. No	88005
CUSTOMER	UTTAR PRADESH TRANSMISSION CORPORATION LTD (UPPTCL)						
PROJECTS	400/220/132 kV GIS SUBSTATION AT RASARA, BALLIA						

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SECTION 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 SCOPE

This Specification covers the requirements of design, manufacture, testing at manufacturer's Works, packing, supply, and delivery at site of 1.1 kV Aux Power & Control Cables as listed under this specification. This section covers the specific technical requirements of 1.1 kV Aux Power & Control Cables. This constitutes minimum technical parameters for the above item as specified by the customer (UPPTCL). The offered equipment shall also comply with the General Specification for the project as detailed under section-3 of this specification.

In case of any conflict between the technical details mentioned in this section and the remaining sections of this document, then Section-1 shall prevail and is to be considered as binding requirement.

The specification comprise of following sections:

- Section-1: Scope, Specific Technical Requirements and Quantities.
- Section-2: Equipment Specification.
- Section-3: Project Details and General Technical Requirements.
- Section-4: Checklist.

Note: The term 'Owner' appearing in this specification shall refer to UPPTCL, the term 'Purchaser' shall refer to BHEL and the term 'Contractor' shall refer to the successful Bidder.

1.1 THE EQUIPMENT IS REQUIRED FOR THE FOLLOWING PROJECT

Name of Customer: Uttar Pradesh Transmission Corporation Ltd (UPPTCL)

Name of the Projects: 400/220/132 kV GIS Substation at Rasara, Ballia

Refer Section - 3 for Project Details and General Specifications.

1.2 SPECIFIC TECHNICAL REQUIREMENTS

1.2.1 As per Section-2 (UPPTCL specification, 21 pages).

- 1.2.2 (a) ~~Strip armouring method (a) mentioned in Table 5, Page-6 of IS: 1554 (Part 1) - 1988 shall not be accepted for any of the control cables.~~
- (b) ~~Strip armouring method (a) mentioned in Table 6, Page-6 of IS: 7098 (Part 1) - 1988 shall not be accepted for any of the auxiliary power cables.~~

1.3 QUANTITIES

Sl. No.	Type of Cables	Quantity (km)
A.	Type of XLPE Auxiliary Power Cables	
1	1C x 630 sq mm XLPE/Aluminium, Armoured Auxiliary Power Cables	2.5
2	3.5C x 300 sq mm XLPE/Aluminium, Armoured Auxiliary Power Cables	1.5
B.	Type of PVC Auxiliary Power Cables	
3	1C x 150 sq mm PVC/Aluminium, Armoured Auxiliary Power Cables	1.0
4	3.5C x 70 sq mm PVC/Aluminium, Armoured Auxiliary Power Cables	9.0
5	3.5C x 35 sq mm PVC/Aluminium, Armoured Auxiliary Power Cables	2.5
6	4C x 16 sq mm PVC/Aluminium, Armoured Auxiliary Power Cables	26.5
7	4C x 6 sq mm PVC/Aluminium, Armoured Auxiliary Power Cables	8.5
8	2C x 6 sq mm PVC/Aluminium, Armoured Auxiliary Power Cables	1.0
C.	Type of PVC Control Cables	
9	4C x 4 sq mm PVC/Copper, Armoured Control Cables	17.5
10	4C x 10 sq mm PVC/Copper, Armoured Control Cables	21.5
11	2C x 2.5 sq mm PVC/Copper, Armoured Control Cables	4.5
12	4C x 2.5 sq mm PVC/Copper, Armoured Control Cables	18.5
13	6C x 2.5 sq mm PVC/Copper, Armoured Control Cables	11.0
14	10C x 2.5 sq mm PVC/Copper, Armoured Control Cables	26.5
15	14C x 2.5 sq mm PVC/Copper, Armoured Control Cables	38.0

Note:

1) The above quantities are tentative and the length of total cables procured may be subject to a change of $\pm 50\%$ before the placement of order. Quantity variation on the total ordered cables shall be $\pm 50\%$ at contract stage.

2) Manufacturing Clearances shall be given in two lots (Lot-I and Lot-II) as per actual site requirement.

All Control and Power Cables shall be supplied in drum length of 1000 m, unless otherwise specified. For power cable with conductor cross sectional area 300sqmm and above may be supplied in 500m drums. Owner shall have the option of rejecting cable drums with shorter lengths. The cable length per drum is allowed a tolerance of $\pm 5\%$. However, the total quantity of cables after taking into consideration of all cable drums for each size shall be within the tolerance of $\pm 2\%$.

1.4 TESTS

Cables shall conform to type tests including additional type tests as per technical specification and shall be subject to routine & acceptance tests in accordance with requirements stipulated under respective sections.

The reports for all type tests and additional type tests as per technical specification shall be furnished by the bidder along with the tender documents.

The bidder will conduct the routine tests on each drum length. All the type and acceptance tests shall be conducted as per specification and relevant standards/ approved MQP. These tests will be witnessed by owner/purchaser/purchaser's representatives.

All type tests as per relevant IS/IEC and as per this TS shall be performed **on each type and size of cables** as a part of acceptance tests & price for conducting the same shall be included in the offered price for individual cables.

1.5 QUALITY PLAN

The manufacturer shall carry out contract works in accordance with sound quality management principles which shall include items such as controls which are necessary to ensure full compliance to all requirements of the specification & applicable international standards. These quality management requirement shall apply to all activities during design, procurement, manufacturing, inspection, testing, packaging, shipping, inland transportation, storage, site erection & commissioning. Manufacturer shall submit detailed Quality Plan for BHEL / customer's approval.

1.6 PACKING

1.6.1 All equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and outdoor storage (for a minimum period of one year) at site till the time of erection. While packing all the materials, the limitations from the point of view of availability of transportation facilities in India should be taken into account. The Bidder shall be responsible for any loss or damage during transportation, handling and storage.

1.6.2 The Bidder shall include and provide for security, protection and packing the equipment so as to avoid loss or damage during transport by any mode.

1.6.3 All packing shall allow for easy removal and checking at site. Wherever necessary, proper arrangement for attaching slings for lifting shall be provided. All packages shall be clearly marked for with signs showing 'UP' and 'DOWN' side of boxes, and handling and unpacking instructions as considered necessary. Special precautions shall be taken to prevent rusting of steel and iron parts during transit and storage. Gas seals or other methods proposed to be adopted for protection against moisture during transit shall be to the satisfaction of the purchaser.

1.6.4 The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbols i.e. FRAGILE, HANDLE WITH CARE, USE NO HOOKS etc.

1.6.5 Each package delivered under the contract shall be marked by the Bidder at his expense and such marking must be distinct (all previous irrelevant marking being carefully obliterated). Such marking shall show the description and quantity of contents, the name of consignee and address, the gross and net weights of the package, the name of Bidder with a distinctive number of mark sufficient for purpose of identification. All markings shall be carried out with such materials as to ensure quickness of drying, fastness and legibility.

1.6.6 Each Package shall contain a note quoting specifically the name of the Bidder, the number and date of contract or order and the name of office placing the contract, nomenclature of the stores and include a schedule of parts for each complete equipment giving the parts number with reference to the General Arrangement/ Assembly drawing and the quantity of each part, drawing number and tag numbers.

1.6.7 All equipment/ material shall be suitably packed for transport, carriage at site and outdoor storage during transit. The Bidder shall be responsible for any damage to the equipment during transit. The contents of each package shall bear marking that can be readily identified from the package list and packing shall provide complete protection from moisture, termites and mechanical shocks etc.

1.6.8 Any material found short inside the packing cases shall be supplied by the Bidder without any extra cost.

1.6.9 Notwithstanding anything stated in this clause the Bidder shall be entirely responsible for any loss, damage or depreciation to the stores.

1.7 TECHNICAL REQUIREMENT

1.7.1

i) Applicable for PVC Control Cable:

The manufacturers, whose PVC control cables are offered, should have designed, manufactured, tested and supplied in a single contract at least 100 kms of 1.1 kV grade PVC insulated control cables as on the original scheduled date of opening of tender, i.e. 17.04.18. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 27C x 2.5 Sq.mm or higher size as on the original scheduled date of opening of tender, i.e. 17.04.18.

ii) Applicable for PVC Power Cable:

The manufacturer, whose PVC Power Cables are offered, should have designed, manufactured, tested and supplied in a single contract at least 100 kms of 1.1 kV or higher grade PVC insulated power cables as on the original scheduled date of opening of tender, i.e. 17.04.18. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 1C x 150 Sq. mm or higher size as on the original scheduled date of opening of tender, i.e. 17.04.18.

iii) Applicable for XLPE Power Cables:

The Manufacturer, whose XLPE Power cables are offered, should have designed, manufactured, tested and supplied in a single contract at least 25 kms of 1.1 kV or higher grade XLPE insulated power cables as on the original scheduled date of opening of tender,

i.e. 17.04.18. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 1C x 630 Sq. mm or higher size as on the original scheduled date of opening of tender, i.e. 17.04.18.

1.7.2

A) OPERATIONAL EXPERIENCE

Offered equipment should have given three years of proven trouble free operational service in tropical climate. However in case of equipment manufactured in India under valid foreign collaboration, operating experience# in tropical climate of offered collaborator's equipment, shall also be acceptable provided copy of valid collaboration agreement for the offered equipment is submitted with the proposal. Further in case of offer of imported equipment, three year operating experience# shall be considered in respect of those areas only which are similar to the tropical conditions prevailing in India.

AND

B) MANUFACTURING EXPERIENCE

The indigenous manufacturers or their foreign collaborator must have manufactured at least 20% of the total specified quantities of each item of identical or similar equipment. **

AND

C) TESTING FACILITIES

The manufacturer must have all necessary facilities at their works for carrying out such routine and acceptance tests as prescribed in the relevant ISS/IEC and any other routine and acceptance test as specified in the specification. Documentary evidence of existence of such facilities will be submitted along with the proposal.

AND

D) TYPE TEST FOR INDIGENOUS OR FULLY IMPORTED EQUIPMENTS

The offered equipments must have been fully type tested as per relevant ISS and/or any other specified international standards, during the last five (5) years period to be reckoned from the original scheduled date of opening of tender, i.e. 17.04.18. Photo copy of such type test reports/ certificates must be submitted along with the proposal. The test certificates of proto type manufactured and tested by foreign collaborators of the tenderers at their works shall not be acceptable for indigenously manufactured equipment.

#: **Operating experience** means certificate issued by the Employer/ Utility certifying the operation without any adverse remark.

** : 20% of the specified quantities of each item of identical or similar equipment means 20% of the specified total quantity of Cables.

Note: The bidder must satisfy all of Sl. No. 1.7.1 i), ii), iii) (as applicable for respective type of cables) and 1.7.2 A), B), C), D) mentioned above.

Please note: Forms of undertaking if any (as per customer/BHEL format) shall be furnished to successful bidder during contract stage.

SECTION - 2

POWER AND CONTROL CABLES

POWER AND CONTROL CABLES

CONTENTS

Clause No.	Description
1.0	Scope
2.0	Standards
3.0	Criteria for Selection of Power & Control Cables
4.0	Cable Laying
5.0	General Requirements
6.0	Acceptance of Vendor
7.0	Guarantee Technical Particulars
8.0	Technical Requirement
9.0	33KV XLPE Cable
10.0	Cable Drums
11.0	Identification Markings
12.0	Type Tests

**TECHNICAL SPECIFICATION
OF
~~11KV~~ & 1.1 KV GRADE POWER & CONTROL CABLES**

1.0 SCOPE

- 1.1 This specification covers the design, manufacturing, testing at manufacturer's works before dispatch, packing supply and transportation to site, installation, testing and commissioning of **FIRE RETARDANT LOW SMOKE** type power and control cables, cable channels, cable trays and associated accessories.
- 1.2 The Bidder shall quote for the quantities of various types and sizes of cables mentioned in Price Schedule. However the contractor shall supply total quantity of cables as required for testing and commissioning of complete ~~220KV~~ substation as per the approved drawings during detailed engineering. Payments are based on unit quoted prices applicable for the quantities actually received/ installed at site.
- 1.3 Any material or accessory which may not have been specifically mentioned but which is necessary for satisfactory and trouble free operation of the substation shall be supplied without extra charges.
- 1.4 The contractor shall supply all brand new equipment and accessories as specified herein with such modification and alteration as agreed upon in writing, after mutual discussion.

2.0 STANDARDS

2.1.0 CODES & STANDARDS

- 2.1.1 The design manufacture testing and performance of cables covered under this specification shall comply with latest edition of the following standards including amendments:

IS:7098 (Part-I)	XLPE insulated PVC sheathed cables for working voltage up to & including 1100 Volts
ISS 130	Conductors for insulated electrical cables & flexible cords.
IS: 5831	PVC insulation & sheath of electrical cables.
IS: 3975	Mild steel wires strips & tapes for arm armoring of cables.
IS: 10418	Specification of drums for electric cables
IS: 1554	PVC insulated (heavy duty) electric cables for working

voltage (part-I) up to and including 1100 V.

ASTMD Measuring & minimum oxygen concentration to support
2683 candle like combustion of plastic (oxygen index).

2.1.2 Cables complying with other internationally accepted standards such as IEC, VDE, JPCEA etc., will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard/ standards adopted and furnish a copy of English version of the latest revision of the standard(s) along with the tender & shall clearly bring out the salient features for comparison.

2.1.3 In case of any conflict between the referred specifications codes or standards & this technical specification, the latter shall prevail to the extent of such difference.

✓ 2.1.4 1.1 KV grade power & control cables to be supplied under this package shall be ISI approved & marked as such. Non-compliance of above shall not be accepted.

2.1.5 However, if cables to be supplied under this package are manufactured outside India conform to other internationally accepted equivalent or superior standards the above specification not be applicable.

2.1.6 The Indian Standards mentioned in Clause 2.1 can be obtained from: -

Bureau of Indian Standards
Manak Bhavan,
9. Bahadur Shah Zafar Marg,
New Delhi - 110002.
INDIA.

3.0 CRITERIA FOR SELECTION OF POWER & CONTROL CABLES

3.1 Aluminium conductor XLPE insulated armoured cables shall be used for main power supply purpose from from LT Aux. Transformers to control room, between distribution boards.

3.2 Aluminium conductor PVC insulated armoured power cables shall be used for various other applications in switchyard area/control room except for control/ protection purposes.

3.3 For all control/ protection/ instrumentation purposes PVC insulated armoured control cables of minimum 2.5 sq.mm. size with stranded Copper conductors shall be used.

3.4 Bidders are to estimate the quantity of cables and quote accordingly. The sizes of power cables to be used per feeder in different application shall be as follows:

S.No.	From	To	Cable Size	Cable
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				Type
1.	LT Transformer	Main Switch Board	2-1C X 630 mm ² per phase 1-1C x 630 mm ² for neutral	XLPE
2.	D.G. Incomer Panel	AC Distribution Board	1-1C x 630 mm ²	XLPE
3.	Main Switch Board	AC Distribution Board	2-3½C x 300 mm ²	XLPE
4.	Main Switch Board	Oil Filtration Unit	1-3½C x 300 mm ²	XLPE
5.	Main Switch Board	Colony Lighting	1-3½C x 300 mm ²	XLPE
6.	Main Switch Board	HVW pump LCP	1-3½C x 300 mm ²	XLPE
7.	Main Switch Board	Main Lighting Distribution Board	1-3½C x 300 mm ²	XLPE
8.	AC Distribution Board	Air Conditioning Board	1-3½C x 300 mm ²	XLPE
9.	AC Distribution Board	D.G. Set AMF Panel	2-3½C x 300 mm ²	XLPE
10.	AC Distribution Board	Emergency Lighting Distribution board	1-3½C x 70 mm ²	PVC
11.	AC Distribution Board	ICT MB	1-3½C x 70 mm ²	PVC
12.	AC Distribution Board	Bay MB	3½C x 70 mm ²	PVC
13.	AC Distribution Board	Battery Charger	3½C x 70 mm ²	PVC
14.	DC Distribution Board	Battery	2-1C x 150 mm ²	PVC
15.	DC Distribution Board	Battery Charger	2-1C x 150 mm ²	PVC
16.	DC Distribution Board	Protection/PLCC Panels	1-4C x 16 mm ²	PVC
17.	Main Lighting Distribution Board	Panel in Control Room	1-3½C x 35 mm ²	PVC
18.	Main Lighting Distribution Board	Lighting Panel in Outdoor Switchyard	1-3½C x 70 mm ²	PVC
19.	Main Lighting Distribution Board	Receptacles in Control Room	1-3½C x 35 mm ²	PVC
20.	Main Lighting Distribution Board	Receptacles in Outdoor Switchyard	1-3½C x 70 mm ²	PVC
21.	Lighting Panel	Sub lighting Panels	1-4C x 16 mm ²	PVC
22.	Lighting Panel	Street lighting Poles	1-4C x 16 mm ²	PVC
23.	Lighting Panel/ Sub Lighting Panels	Lighting Fixtures in Outdoor Switchyard	1-2C x 6 mm ²	PVC
24.	Bay MB	Equipments	1-4C x 16 mm ² /1-4C x 6 mm ² /1-2C x 6 mm ²	PVC

- 3.5 Bidder may offer sizes other than the sizes specified above. In such case and for other application where sizes of cables have not been indicated in the specification, sizing of power cables shall be done keeping in view continuous current, voltage drop and short-circuit consideration of the system. Relevant calculations shall be submitted by bidder during detailed engineering for Purchaser's approval.

4.0 CABLE LAYING

- 4.1 The contractor shall prepare cable schedule for all the power control cables. The cabled shall be laid conforming to IS:1255.

- 4.2 While preparing cable schedules for control/protection purpose following shall be ensured:
1. Cables shall be laid conforming to IS: 1255.
 2. Separate cables shall be used for AC & DC.
 3. Separate cables for DC Distribution Board..
 3. Separate cables shall be used for DC1 & DC2.
- 4.3 For different cores of CT & VT separate cable shall be used
- 4.4 Atleast one (1) cores shall be kept as spare in each Copper Control Cable of 4C, 5C or 7C size whereas minimum no. of spare cores shall be two (2) for control cables of 10 core or higher size.
- 4.5 For control cabling, including CT/VT circuits, 2.5 sq.mm. size copper cables shall be used per connection. However, if required from voltage drop/VA burden consideration additional cores shall be used. Further for potential circuits of energy meters separate connections by 2 cores of 2.5 sq.mm. size shall be provided.

5.0 GENERAL REQUIREMENTS

- 5.1. Before dispatch, the cables offered shall be made available for inspection to a duly authorized representative of the UPPTCL. Inspection may also be made at any stage of manufacture at the option of the UPPTCL and the cables found unsatisfactory due to the material used or poor workmanship shall be rejected. The Contractor shall guarantee free access to the places of manufacture to the UPPTCL's representative at all time when the work is in progress. The Contractor shall inform the UPPTCL in advance the time of starting of manufacture and the progress of manufacture of the cables offered by him, so that arrangement can be made for inspection.
- 5.2 Inspection and acceptance of cables by the UPPTCL or his authorized representative shall not relieve the Contractor of his obligation of furnishing cables in accordance with the specification and shall not prevent subsequent rejection, if such cables are later found to be defective.
- 5.3 The cables shall comply with type tests stipulated in Section-Cables/relevant standards. Valid Test reports for all type tests shall be submitted along with the bid. In case type tests are to be conducted for the cables offered, these shall be conducted and these test charges shall be borne by the contractor.
- 5.4 All type and size of cables shall be subjected to routine and acceptance tests in accordance with the requirements stipulated in this Section/relevant standards without any extra cost to the UPPTCL. Cables should not be dispatched until the test reports are duly approved by the UPPTCL or his authorized representative.
- 5.5 The UPPTCL reserves the right to insist on any additional tests as per standards of reasonable nature to be carried out at site or at manufacturer's works or at any other place in addition to the aforesaid type and routine tests to comply with the

specification free of cost.

- 5.6 Four copies of test reports shall be supplied for approval. The reports shall indicate clearly the governing standards and the standard values specified for each test, to facilitate checking of the test reports. Four bound copies of the test reports shall be submitted after approval of test reports along with the cables.

6.0 ACCEPTANCE OF VENDOR

Notwithstanding anything stated elsewhere, UPPTCL reserves the right to assess the manufacturer's capability and capacity to supply/perform the contract should the circumstances warrant such assessment in the overall interest of the UPPTCL before accepting the vendor for the cables.

7.0 GUARANTEE TECHNICAL PARTICULARS

The Bidder shall furnish all the guaranteed and other technical particulars for the cables offered by him as called for in Schedule of Guaranteed Technical Particulars in Bidding Schedules.

8.0 TECHNICAL REQUIREMENT

8.1 General

- 8.1.1 The cables shall be suitable for laying in racks, ducts, trenches, conduits and underground buried installation with uncontrolled back fill and chances of flooding by water.
- 8.2.2 They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating conditions. The XLPE / PVC insulated LT. Power cables of sizes 40 sq.mm and above shall withstand without damage a 3 phase fault current of at least 45 kA for at least 0.12 second, with an initial peak of 105 kA in one of the phases. The armour for these power cables shall be capable of carrying 45 kA for at least 0.12 seconds without exceeding the maximum allowable temperature of PVC outer sheath.
- 8.2.3 The XLPE insulated cables shall be capable of withstanding a conductor temperature of 250°C during a short circuit without any damage. The PVC insulated cables shall be capable of withstanding a conductor temperature of 160°C during a short circuit.
- 8.2.4 The Aluminium/Copper wires used for manufacturing the cables shall be true circular in shape before stranding and shall be uniformly good quality, free from defects. All aluminium used in the cables shall be of H2 grade.
- 8.2.5 The fillers and inner sheath shall be of non-hygrosopic, fire retardant material, shall be softer than insulation and outer sheath shall be suitable for the operating temperature of the cable.

- 8.2.6 Progressive sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of all cables.
- 8.2.7 Strip wire armouring method (a) mentioned in Table 5, Page-6 of IS : 1554 (Part 1) – 1988 shall not be accepted for any of the cables. For control cables only round wire armouring shall be used.
- 8.2.8 The cables shall have outer sheath of a material with an oxygen index of not less than 29 and a temperature index of not less than 250°C.
- 8.2.9 All the cables shall pass fire resistance test as per IS:1554 (Part-I)
- 8.2.10 The normal current rating of all PVC insulated cables shall be as per IS:3961.
- 8.2.11 Repaired cables shall not be accepted.
- 8.2.12 Allowable tolerance on the overall diameter of the cables shall be plus or minus 2 mm.

8.2 XLPE POWER CABLES

- 8.2.1. The XLPE insulated cables shall be of ^{FRLS} ~~FR~~ type, ^{C2} ~~C1~~ category conforming to IS:7098 (Part-I) / IS: 7098 (Part-II) (~~for 11KV Cable for Aux. supply~~) and its amendments read alongwith this specification. The conductor shall be stranded aluminium circular/ sector shaped and compacted. In multicore cables, the core shall be identified by red, yellow, blue and black coloured strips or colouring of insulation. A distinct inner sheath shall be provided in all multicore cables. For XLPE cables, the inner sheath shall be of extruded PVC to type ST-2 of IS:5831. When armouring is specified for single core cables, the same shall consist of aluminium wires/strips. The outer sheath shall be extruded PVC to Type ST-2 of IS:5831 for all XLPE cables.

8.3. PVC Power Cables

- 8.3.1. The PVC (70°C) insulated 1100V grade power cables shall be of ^{FRLS} ~~FR~~ type, ^{C2} ~~C1~~ category, conforming to IS: 1554 (Part-I) and its amendments, read alongwith this specification and shall be suitable for a steady conductor temperature of 70°C. The conductor shall be stranded aluminium. The Insulation shall be extruded PVC to type-A of IS: 5831. A distinct inner sheath type; ST-2 shall be provided in all multicore cables. For multicore armoured cables, the inner sheath shall be of extruded PVC. The outer sheath shall be extruded PVC to Type ST-1 of IS: 5831 for all cables.

8.4. PVC Control Cables

- 8.4.1. The 1100V grade control cables shall be of ^{FRLS} ~~FR~~ type ^{C2} ~~C1~~ category conforming to IS: 1554 (Part-1) and its amendments, read alongwith this specification. The

conductor shall be stranded copper. The insulation shall be extruded PVC to type A of IS: 5831. A distinct inner sheath type ST-2 shall be provided in all cables whether armoured or not. The outer sheath shall be extruded PVC to type ST-1 of IS: 5831 and shall be grey in colour except where specifically advised by the Purchaser to be black.

- 8.4.2. Cores shall be identified as per IS: 1554 (Part-1) for the cables up to five (5) cores and for cables with more than five (5) cores the identification of cores shall be done by printing legible Hindu Arabic Numerals on all cores as per clause 10.3 of IS 1554 (Part-1).

9.0 33KV XLPE CABLE (NOT IN BIDDER'S SCOPE)

33KV XLPE cable for connection from 60MVA Transformer to 33KV GIS modules shall be supplied as per the specification below:
(For details, please refer Technical Specification_33KV XLPE cables)

9.1 33 KV XLPE CABLE & ACCESSORIES: (NOT IN BIDDER'S SCOPE)

33 KV XLPE cable shall be manufactured in dry cure process and shall be manufactured in accordance with the Internationally accepted standard and also confirm to the requirement of relevant IS/ IEC. The cable shall be suitable for laying in an area likely to be flooded by water and shall be designed to be protected against rodent and termite attack.

The cable size shall be suitable to carry the load current on 33 KV continuously followed by 20 per cent over loading capacity for 2 hours without exceeding maximum conductor temperature of 65 degree Celsius.

10.0 CABLE DRUMS

- 10.1. Cables shall be supplied in non-returnable wooden or steel drums of heavy construction. Wooden drum shall be properly seasoned sound and free from defects. Wood preservative shall be applied to the entire drum.
- 10.2. Standard lengths for each size of power and control cables shall be 500/1000 meters. The cable length per drum shall be subject to a tolerance of plus or minus 5% of the standard drum length. The Purchaser shall have the option of rejecting cable drums with shorter lengths. However, the total quantity of cables after taking into consideration of all cable drums for each size shall be within the tolerance of $\pm 2\%$.
- 10.3. A layer of water proof paper shall be applied to the surface of the drums and over the outer most cable layer.
- 10.4. A clear space of at least 40 mm shall be left between the cables and the lagging.

- 10.5. Each drums shall carry the manufacturer's name, the UPPTCL's name, address and contract number and type, size and length of the cable, net and gross weight stenciled on both sides of drum. A tag containing the same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.
- 10.6. Packing shall be sturdy and adequate to protect the cables, from any injury due to mishandling or other conditions encountered during transportation, handling and storage. Both cable ends shall be sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation and erection.

11.0 IDENTIFICATION MARKINGS

To identify the cables as Owner's property it is necessary to emboss or print Purchaser's name (abbreviation as given by the UPPTCL) and also the Name or trade mark of the manufacturer alternatively at everyone meter interval on all the cables.

12.0 TYPE TESTS

- 12.1. All cables shall conform to all type, routine and acceptance tests listed in the relevant IS.
- ✓ 12.2. The type tests on cables shall be conducted on each type and size of cables offered.
- 12.3. Following type tests as per IS: 7098 (Part 1) – 1988 including its amendments and additional type tests shall be carried out on 1.1 kV grade XLPE insulated cables:
- a) Tests on conductor
 - i) Annealing test (for Copper)
 - ii) Tensile test (for aluminium)
 - iii) Wrapping test (for aluminium)
 - iv) Resistance test
 - b) Test for armouring wires/strips
 - c) Test for thickness of insulation and sheath
 - d) Physical tests for insulation
 - i) Tensile strength and elongation at break
 - ii) Ageing in air oven
 - iii) Hot set test
 - iv) Shrinkage test

- e) Physical tests for outer sheath
 - i) Tensile strength and elongation at break
 - ii) Ageing in air oven
 - iii) Loss of mass in air oven
 - iv) Shrinkage test
 - v) Hot deformation
 - vi) Heat shock test
 - vii) Thermal stability
- f) Insulation resistance (volume resistivity test)
- g) High voltage test
- h) Flammability test
- i) Oxygen index and temperature index test on outer sheath
- j) Short time current test on power cables of sizes 240 sq.mm and above.
 - i) On conductor(s).
 - ii) On armours.

12.4. Following type tests as per IS: 1554 (Part 1) - 1988 including its amendments and additional type tests shall be carried out on 1.1 kV grade PVC insulated cables:

- a) **Tests on conductor**
 - i). Annealing test (for Copper)
 - ii). Tensile test (for aluminium)
 - iii). Wrapping test (for aluminium)
 - iv). Conductor Resistance test
- b) Test for armouring wires/strips
- c) Test for thickness of insulation and sheath
- d) Physical tests for insulation and outer sheath
 - i) Tensile strength and elongation at break
 - ii) Ageing in air oven
 - iii) Shrinkage test
 - iv) Hot deformation
 - v) Loss of mass
 - vi) Heat shock test
 - vii) Thermal stability
- e) Insulation resistance
- f) High voltage test (water immersion test only a.c. test as per clause no. 16.3.1)
- g) High voltage test at room temperature
- h) Flammability test

- i) Oxygen index and temperature index test on outer sheath
- j) Short time current test on power cables of sizes 240 sq.mm and above.

- i) On conductor(s).
- ii) On armours.

k) FRLS Test on Outer Sheath

12.5 All type tests as per IS: 7098 (Part 2 & 3) - 1993 including its amendments and additional type tests shall be carried out on XLPE insulated HT cable up to 33kV earthed system:

- a) Tests on conductor
 - i) Annealing test (for Copper)
 - ii) Tensile test (for aluminium)
 - iii) Wrapping test (for aluminium)
 - iv) Resistance test
- b) Test for armouring wires/strips
- c) Test for thickness of insulation and sheath
- d) Physical tests for insulation
- e) Physical tests for outer sheath
- f) Partial discharge test
- g) Bending test
- h) Dielectric power factor test
- i) Heating cycle test
- j) Impulse withstand test
- k) High voltage test
- l) Oxygen index and temperature index test on outer sheath
- m) FRLS Test on Outer Sheath

12.6 Contractor shall also submit following type test reports as per ~~clause no. 2.2 of Technical Specification, Section: GTR.~~ SECTION - 3.

12.6.1. 1.1 kV grade PVC insulated cables

- a) High voltage test (water immersion d.c. test as per clause no. 16.3.2 of IS: 1554 (Part 1) - 1988)

12.6.2. 1.1 kV grade XLPE insulated cables

- a) Water absorption (gravimetric) test as per IS: 7098 (Part 1) - 1988

12.6.3. Terminating/jointing accessories as per IEC 60840:1999 (N.A.)

- a) Partial discharge test at ambient temperature;
- b) Heating cycle voltage test
- c) Partial discharge tests
 - At ambient temperature
 - At high temperature
- d) Impulse voltage test followed by power frequency test
- e) Test of outer protection for buried joints

**STANDARD TECHNICAL DATA SHEET
(1.1 kV GRADE XLPE POWER CABLES)**

S.No.	Name of manufacturer:		
	Cable Sizes	1 C x 630	3½ C x 300
1	Manufacturer's type designation	A2XWaY	A2XWY
2	Applicable standard	IS: 7098/PT-I/1988 & its referred specifications	
3	Rated Voltage(volts)	1100 V grade	
4	Type & Category	FRLS FR & C2	FRLS FR & C2
5	Suitable for earthed or unearthed system	for both	
6	Continuous current rating when laid in air in a ambient temp. of 50°C and for maximum conductor temp. of 70 °C of PVC Cables [For information only]	732	410
7	Rating factors applicable to the current ratings for various conditions of installation	As per IS-3961-Pt-II-67	
8	Short circuit Capacity		
	a) Guranteed Short Circuit Amp. (rms) KA for 0.12 sec duration at rated conductor temperature of 90 degree C, with an initial peak of 105 KA	45 KA	45 KA
	b) Maximum Conductor temp. allowed for the short circuit duty (deg C.) as stated above	250 °C	
9	Conductor		
	a) Material	Stranded Aluminium as per Class 2 of IS : 8130	
	b) Grade	H 2 (Electrolytic grade)	
	c) Cross Section area (Sq.mm.)	630	300/150
	d) Number of wires(No.)minimum	53	30/15
	e) Form of Conductor	Stranded compacted circular	Stranded compacted / Circular sector shaped
	f) Direction of lay of stranded layers	Outermost layer shall be R.H lay & opposite in successive layers	
10	Conductor resistance (DC) at 20°C per km-maximum	0.0469	0.1 / 0.206
11	Insulation		
	a) Composition of insulation	Extruded XLPE as per IS-7098Part(1)	
	b) Nominal thickness of insulation(mm)	2.8	1.8/1.4
	c) Minimum thickness of insulation	2.42	1.52/1.16
12	Inner Sheath		
	a) Material	Extruded PVC type ST-2 as per IS-583184	
	b) Calculated diameter over the laid up cores, (mm)	NA	52

	c) Thickness of Sheath (minimum) mm	N.A	0.6
	d) Method of extrusion	NA	Pressure/ Vacuum extrusion 13 Armour
	a) Type and material of armour	Al. Wire [H4 grade]	Gal. Steel wire
	b) Direction of armouring	left hand	
	c) Calculated diameter of cable over inner sheath (under armour), mm	33.9	53.2
	d) Nominal diameter of round armour wire (minimum)	2	2.5
	e) Guranteed Short circuit capacity of the armour for 0.12 sec at room temperature	45 KA	45 KA
	f) DC resistance at 20°C (Ω/Km)	\$	0.577
14	Outer Sheath		
	a) Material (PVC Type)	ST-2& FRLS	ST-2& FRLS
	b) Calculated diameter under the sheath	38.3	59.50
	c) Min.thickness of sheath(mm)	1.72	2.36
	d) Guaranteed value of minimum oxygen index of outer sheath at 27°C	Min 29.0	Min 29.0
	e) Guranteed value of minimum temperature index at 21 oxygen index	Min 250	Min 250
	f) colour of sheath	Black	Black
15	a) Nominal Overall diameter of cable	\$	\$
	b) Tolerance on overall diameter (mm)	+2/-2 mm	
16	Cable Drums	shall conform to IS 10418 and technical specification	
	a) Max./ Standard length per drum for each size of cable (single length) with ±5% Tolerance (mtrs)	1000/500	1000/500
	b) Non standard drum lengths	Maximum one(1) non standard lengths of each cable size may be supplied in drums only over & above the standard lengths as specified above. (if required for completion of project)	
17	Whether progressive sequential marking on outer sheath provided at 1 meter interval	YES	
18	Identification of cores		
	a) colour of cores	As per IS 7098 Part(1)	
	b) Numbering	N.A.	
✓ 19	Whether Cables offered are ISI marked	YES	
20	Whether Cables offered are suitable for laying as per IS 1255	YES	

\$'- As per manufacturer design data

**STANDARD TECHNICAL DATA SHEET
(1.1 kV GRADE PVC POWER CABLES)**

S.No.	Name of manufacturer	✓	✓	✓	✓	✓	✓
	Cable Sizes	1 C x 150	3.5 C x 70	3.5 C x 35	4 C x 16	4C x 6	2 C x 6
1	Manufacturer's type designation	AYWaY	AYFY	AYFY	AYFY	AYWY	AYWY
2	Applicable standard	IS: 1554/PT-I/1988 & its referred standards					
3	Rated Voltage(volts)	1100 V grade					
4	Type & Category	FR & C ₁	FR & C ₁	FR & C ₁	FR & C ₁	FR & C ₁	FR & C ₁
5	Suitable for earthed or unearthed system	for both					
6	Continuous current rating when laid in air in a ambient temp. of 50°C and for maximum conductor temp. of 70°C of PVC Cables[For information only]	202	105	70	41	24	28
7	Rating factors applicable to the current ratings for various conditions of installation	As per IS-3961-Pt-II-67					
8	Short circuit Capacity						
	a) Short Circuit Amp. (rms)KA for 1 sec duration	11.2	5.22	2.61	1.19	0.448	0.448
	b) Conductor temp. allowed for the short circuit duty (deg C.)	160 °C					
9	Conductor						
	a) Material	STRANDED ALUMINIUM					
	b) Grade	H 2 (Electrolytic grade)					
	c) Cross Section area (Sq.mm.)	150	M-70 N-35	M-35 N-16	16	6	6
	d) Number of wires (No.)	as per Table 2 of IS 8130					
	e) Form of Conductor	Non-compact Stand ed circular	shaped conductor	shaped conductor	shaped conductor	Non-compact Stand ed circular	Non-compact Stand ed circular
	f) Direction of lay of stranded layers	Outermost layer shall be R.H lay & opposite in successive layers					
10	Conductor resistance (DC) at 20°C per km -maximum	0.206	0.443/ 0.868	0.868/ 1.91	1.91	4.61	4.61
11	Insulation						
	a)Composition of insulation	Extruded PVC type A as per IS-5831-84					
	b) Nominal thickness of insulation	2.1	1.4/	1.2/	1.0	1.0	1.0

	(mm)		1.2	1.0			
	c) Minimum thickness of insulation	1.79	1.16/ 0.98	0.98/ 0.8	0.8	0.8	0.8
12	Inner Sheath						
	a) Material	Extruded PVC type ST-2 as per IS-5831-84					
	b) Calculated diameter over the laid up cores, (mm)	N.A	27.6	20.4	15.7	11.6	9.6
	c) Thickness of Sheath (minimum)mm	N.A	0.4	0.3	0.3	0.3	0.3
13	Armour	as per IS 3975/88					
	a) Type and material of armour	Al. Wire[H4 grade]	Gal.steel strip	Gal.steel strip	Gal.steel strip	Gal. Steel wire	Gal. Steel wire
	b) Direction of armouring	left hand					
	c) Calculated diameter of cable over inner sheath (under armour), mm	18	28.4	21	16.3	12.2	10.2
	d) Nominal diameter of round armour wire/strip	1.6	4 x 0.8	4 x 0.8	4 x 0.8	1.4	1.4
	e) Number of armour wires/strips	Armouring shall be as close as practicable					
	f) Short circuit capacity of the armour along for 1 sec-for info only	$K \times \sqrt{t}$ (K Amp) (Where A= total area of armour in mm ² & t= time in seconds), K= 0.091 for Al & 0.05 for steel					
	g) DC resistance at 20 oC (Ω/Km)	0.44	2.57	3.38	3.99	3.76	4.4
14	Outer Sheath						
	a) Material (PVC Type)	ST-1& FRLS	ST-1& FRLS	ST-1& FRLS	ST-1& FRLS	ST-1& FRLS	ST-1& FRLS
	b) Calculated diameter under the sheath	21.2	30.1	22.6	17.9	15	13
	c)Min.thickness of sheath(mm)	1.4	1.56	1.4	1.4	1.4	1.24
	d) Guaranteed value of minimum oxygen index of outer sheath at 27°C	Min 29.0	Min 29.0	Min 29.0	Min 29.0	Min 29.0	Min 29.0
	e) Guranteed value of minimum temperature index at 21 oxygen index	Min 250	Min 250	Min 250	Min 250	Min 250	Min 250
	f) colour of sheath	Black	Black	Black	Black k	Black	Black
15	a) Overall diameter of cable	-----\$-----					
	b) Tolerance on overall diameter (mm)	+2/-2 mm					
16	Cable Drums	shall conform to IS 10418 and technical specification					
	a) Max./ Standard length per drum for each size of cable (single length) with ±5% Tolerance (mtrs)	1000/ 500	1000/ 500	1000/ 500	1000/ 500	1000/ 500	1000/ 500
	b) Non standard drum lengths	Maximum one(1) non standard lengths of each cable size may be supplied in drums only over & above the standard lengths as specified above. (if required for completion of project)					
17	Whether progressive sequential marking on outer sheath provided	YES					
18	Identification of cores						

	a) colour of cores	Red	R,Y,Bl &Bk	R,Y,Bl &Bk	R,Y,Bl &Bk	R,Y,Bl &Bk	Red & Bk
	b) Numbering	N.A.					
19	Whether Cables offered are ISI marked	YES					
20	Whether Cables offered are suitable for laying as per IS 1255	YES					

\$'- As per manufacturer design data

**TECHNICAL DATA SHEET
(1.1 kV GRADE PVC CONTROL CABLES)**

S.No.	Name of manufacturer	✓	✓	✓	✓	✓	✓	✓	✓
	Cable Sizes	2C x 2.5	3C x 2.5	5C x 2.5	7C x 2.5	10C x 2.5	14C x 2.5	19C x 2.5	27C x 2.5
1	Manufacturer's type designation	YWY	YWY	YWY	YWY	YWY	YWY	YWY	YWY
2	Applicable standard	IS: 1554/PT-I/1988 & its referred standards							
3	Rated Voltage(volts)	1100							
4	Type & Category	FRLS PR & CE <i>CE 2</i>							
5	Suitable for earthed or unearthed system	for both							
6	Continuous current rating when laid in air in a ambient temp. of 50°C and for maximum conductor temp. of 70°C of PVC Cables [For information only]	22	19	19	14	12	10.5	9.7	8
7	Rating factors applicable to the current ratings for various conditions of installation:	As per IS-3961-Pt-II-67							
8	Short circuit Capacity								
	a) Short Circuit Amp. (rms) KA for 1 sec-for information only	0.285	0.285	0.285	0.285	0.285	0.285	0.285	0.285
	b) Conductor temp. allowed for the short circuit duty (deg C.)	160°C							
9	Conductor								
	a) Material	Plain annealed High Conductivity stranded Copper (as per IS 8130/84)							
	b) Grade	Electrolytic							
	c) Cross Section area (Sq.mm.)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	d) Number of wires(No.)	as per Table 2 of IS 8130							
	e) Form of Conductor	Non-Compacted stranded circular conductor							
	f) Direction of lay of stranded layers	Outermost layer shall be R.H lay							
10	Conductor resistance (DC) at 20 °C per km(maxm)	7.41	7.41	7.41	7.41	7.41	7.41	7.41	7.41
11	Insulation								
	a)Composition of insulation	Extruded PVC type A as per IS-5831-84							
	b) Nominal thickness of insulation(mm)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
	c) Minimum thickness of insulation	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
12	Inner Sheath								

	a) Material	Extruded PVC type ST-2 as per IS-5831-84							
	b) Calculated diameter over the laid up cores,(mm)	7.2	7.8	9.7	10.8	14.4	15.9	18	22.1
	c) Thickness of Sheath (minimum) mm	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
13	Armour	as per IS 3975/99							
	a) Type and material of armour	Gal. Steel wire	Gal. Steel wire	Gal. Steel wire	Gal. Steel wire	Gal. Steel wire	Gal. Steel wire	Gal. Steel wire	Gal. Steel wire
	b) Direction of armouring	left hand							
	c) Calculated diameter of cable over inner sheath (under armour), mm	7.8	8.4	10.3	11.4	15	16.5	18.6	22.7
	d) Nominal diameter of round armour wire / dimensions of armour strip	1.4	1.4	1.4	1.4	1.6	1.6	1.6	1.6
	e) Number of armour wires	Armouring shall be as close as practicable							
	f) Short circuit capacity of the armour and duration-for info only	$0.05 \times A \sqrt{t}$ (K Amp)(where A = total area of armour in mm ² & t = time in seconds)							
	g) DC resistance at 20 oC (Ω /Km) & Resistivity of armour	As per IS 1554 Part(1), wherever applicable & IS 3975-1999							
14	Outer Sheath								
	a) Material (PVC Type)	ST-1& FRLS	ST-1& FRLS	ST-1& FRLS	ST-1& FRLS	ST-1& FRLS	ST-1& FRLS	ST-1& FRLS	ST-1& FRLS
	b) Calculated diameter under the sheath	10.6	11.2	13.1	14.2	18.2	19.7	21.8	25.9
	c)Min.thickness of sheath (mm)	1.24	1.24	1.24	1.24	1.4	1.4	1.4	1.56
	d) Guaranteed value of minimum oxygen index of outer sheath	Min 29.0	Min 29.0	Min 29.0	Min 29.0	29.0 Min 29.0	Min 29.0	Min 29.0	Min 29.0
	e) Guranteed value of minimum temperature index at 21oxygen index	Min 250	Min 250	Min 250	Min 250	Min 250	Min 250	Min 250	Min 250
	f) colour of sheath	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey
15	a) Overall diameter of cable	-----\$-----							
	b) Tolerance on overall diameter (mm)	+2/-2 mm							
16	Cable Drums	shall conform to IS 10418 and technical specification							
	a) Max./ Standard length per drum for each size of cable (single length) with $\pm 5\%$ Tolerance (mtrs)	1000/500	1000/500	1000/500	1000/500	1000/500	1000/500	1000/500	1000/500
	b) Non standard drum lengths	Maximum one(1) non standard lengths of each cable size may be supplied in drums only over & above the standard lengths as specified above. (if required for completion of project)							

17	Whether progressive sequential marking on outer sheath provided	YES							
18	Identification of cores								
	a) colour of cores	R & Bk	R, Y & BI	R, Y, BI, Bk & G	Grey	Grey	Grey	Grey	Grey
	b) Numbering	N.A.	N.A.	N.A.	Numerals in black ink	Numerals in black ink	Numerals in black ink	Numerals in black ink	Numerals in black ink
19	Whether Cables offered are ISI marked	YES							
20	Whether Cables offered are suitable for laying as per IS 1255	YES							

\$- As per manufacturer design data

SECTION-3

PROJECT DETAILS & GENERAL SPECIFICATION

SITE INFORMATION

	Particular	Details
a)	Owner	UPPTCL
b)	Customer	UPPTCL
c)	Project Title	400/220/132 kV GIS at Rasara, Ballia
d)	Location	Uttar Pradesh
e)	Transport Facilities	Nearest rail head - Ballia
SITE CONDITIONS		
a)	Max. Ambient air temp.	50°C
b)	Min. Ambient air temp.	0°C
c)	Max. design ambient emp.	50°C
d)	Design reference temp.	50°C
e)	Average Humidity	Max. 100%
f)	Special corrosion conditions	No
g)	Solar Radiation	
h)	Atmospheric UV radiation	High
i)	Altitude above sea level	Less than 1000meter
j)	Pollution Severity	High Pollution level
k)	Seismic Zone	As per the seismic zone defined in the relevant BIS / IEC-62271-300 but not less than 0.3g horizontal
WIND DATA		
	Wind load	195kg/ sq m
	Average No. of thunderstorm days per annum	As per IS

1. GENERAL

This Chapter covers Technical Requirements and requirements of auxiliary items.

- 1.1 Equipments furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories specified &/or normally provided with such equipment and/ or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the Technical Specifications.

Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the substation unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost All similar standard components/ parts of similar standard equipment provided, shall be inter-changeable with one another.

- 1.2 The Bidder shall supply type tested (including special test as per technical specification) equipments and materials. The test reports/details shall be furnished by the Bidder in the bid.

In the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes or due to non-compliance with the requirement stipulated in the Technical Specification and/or IEC/ IS, same shall be carried out without any additional cost implication to the Purchaser. The Purchaser reserves the right to get any or all type tests conducted/ repeated.

The reports for all type tests and additional type tests as per technical specification furnished by the Bidder shall be of the tests conducted within last 05(five) years prior to the date of bid opening. The type tests conducted should have either been conducted in accredited laboratory (accredited based on ISO/ IEC Guide 25/ 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by UPPTCL or representative authorized by UPPTCL or Utility or representative of accredited test lab or reputed consultant.

2. SYSTEM PARTICULARS

	Rated System voltage	420 kV, 245kV, 145kV, 36kV
	System frequency	50 Hz, This may vary by $\pm 5\%$
	Number of phases	Three
	Neutral	Effectively Earthed
	Auxiliary power supply:-	
	Auxiliary electrical equipment shall be suitable for operation on the following supply system:	
(a)	Power device (Like drive motors)	400V, 3Phase, 4Wire 50Hz Effectively earthed AC system.
(b)	Lighting fixtures, space heaters, fractional Horse Power motors and control devices.	250V, 2wire, 50Hz, AC supply with one point grounded.
(c)	DC alarm, Control and Protective Devices from sub station batteries as under	2 wire ungrounded DC supplies (i) 400 kV S/S : 220V DC (ii) 220/132kV S/S : 110V DC (iii) Communication : 48 V DC The above supply voltage is subject to variation as follows: All devices must be suitable for a continuous operation over the entire range of voltage variations : (i) AC Voltage may vary by $\pm 10\%$. Frequency by $\pm 5\%$ Combined Voltage & frequency by $\pm 10\%$. (ii) DC a) 220 V may vary between 187 & 242 V b) 110 V may vary between 93 & 121 V c) 48 V may vary between 41 & 53 V

3. System parameters

Sl. No.	Description of Parameters	400 kV System	220 kV System	132 kV System	33 kV System
1	Nominal system voltage	400kV	220kV	132kV	33kV
2	Maximum operating voltage of the system (rms)	420kV	245kV	145kV	36kV
3	Rated frequency	50Hz	50Hz	50Hz	50Hz
4	No. of phase	3	3	3	3
5	Rated short time current	50 kA for 3 Sec.	40 kA for 3 SEC	40 kA for 3 SEC	25 kA for 3 SEC
6	Dry and wet one minute power frequency withstand voltage	680 kV	460 kV	275 kV	95 kV
7	Dry and wet impulse withstand voltage positive and negative	1550 kVp	1050 kVp	650 kVp	250 kVp
8	Corona extinction voltage	320 kV	156 kV	105 kV	-
9	Max. Radio interference voltage for frequency between 0.5 MHz and 2 MHz at 508 kV rms for 765kV, 320kV rms for 400kV system and 156kV rms for 220kV system & 92kV rms for 132kV system	1000 microvolt	1000 microvolt	500 microvolt	-
10	Minimum total creepage	25mm/kV (10500 mm)	25mm/kV (6125 mm)	25mm/kV (3625 mm)	25mm/kV (1300 mm)
11	Min. clearances				
	i. Phase to phase	4000mm (for Conductor-conductor)	2100 mm	1300 mm	320 mm
		4200mm (for rod - Conductor)			
	ii. Phase to earth	3500 mm	2100 mm	1300 mm	320 mm
	iii) Sectional clearances	6500 mm	5000 mm	4000 mm	3000 mm
12.	System neutral earthing	Effectively Earthed			

4. SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

- 4.1 All equipments shall perform satisfactorily under various electrical, electromechanical and meteorological conditions of the installation site.

- 4.2 All equipment shall be able to withstand all external and internal mechanical thermal and electromechanical forces due to various factors like wind load temperature variation, ice & snow (wherever applicable) short circuit etc for the equipment.
- 4.3 The Bidder shall design the various forces which the terminal connectors of the equipment are required to withstand.
- 4.4 All outdoor EHV equipments except marshalling kiosks shall be suitable for hot line washing.
- 4.5 To facilitate erection of equipment, all items to be assembled at site shall be "match marked".

5. SUPPORT STRUCTURES (If in the scope of Bidder)

The base design of all the equipments, to be installed on auxiliary structures, shall conform to the standard auxiliary structure designs presently being used in UPPTCL at 400/220/132/33kV Substations.

All equipment support structures shall be supplied along with brackets, angles, stools etc. for attaching the operating mechanism, control cabinets and marshalling box (wherever applicable) etc. The support structures should be hot dip galvanised with minimum 610 gram/sq.m net of zinc.

6. STANDARDS

- 6.1 Except as modified by this Bid specification, all material and equipment shall conform to the requirement of the latest editions of relevant ISS/ IEC and other applicable standards. The equipments/ works shall be designed, engineered, manufactured, built, tested and commissioned shall be carried out in accordance with the Acts, Rules, Laws and Regulations in force in India.
- 6.2 In addition to meeting the specific requirements called for in the respective sections of the Technical Specification, the equipment shall also conform to the general requirement of the relevant standards which shall form an integral part of the specification. When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.
- 6.3 In the event of the Bidder offering equipment conforming to standards other than ISS/IES standards, which ensure equivalent or better performance than that specified in the standards, the salient point of comparison between the standards adopted and relevant ISS/ IEC standards shall be indicated clearly in the proposal, along with English language version of such standard or relevant extract of the same. The equipment conforming to standards other than IS/IEC shall be subject to Purchaser's approval.
- 6.4 The standards mentioned in the respective equipment specifications are not mutually exclusive or complete in themselves. The equipment &/or work shall also conform to any other applicable standard, even if not specifically mentioned in these specifications.
- 6.5 Should the Bidder wish to depart from the provisions of the specifications, either on

accounts of manufacturing practices or for any other reason, he shall clearly mention the departure and submit complete justification supported by information, drawings etc. as will enable to assess the suitability of equipment(s) offered. In the event of the Bidder's specifications, drawings, forms and tables etc. being found to disagree with the requirement of the Bid specifications at any stage, Bid specifications shall be binding, unless the departures have been duly approved in writing by the purchaser.

6.6 REFERENCE OF STANDARDS

Reference	Abbreviation	Name and Address
BS	British Standards,	British Standards Institution, 101, Penton villa Road, N-19-ND UK
ISO	International Organization	Danish Board of Standardization Danish Standardising Sraat, Aurehoegvej-12, DK-2900, Heelprup, DENMARK
NEMA	For Standardization, National Electric Manufacture Associate	115, East 44th Street, New York NY 10017 U.S.A
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7. ENGINEERING DATA AND DRAWINGS

7.1 SUBMISSION AND APPROVAL OF DRAWINGS/ DOCUMENTS

- 7.1.1 The Bidder shall follow a well-defined coding system for proper and quick identification of all systems/ sub-systems/ equipments/ assemblies/ sub-assemblies/ accessories/ other plant material/ spare parts/ special tools and plants and drawings for the execution of the plant and later for its operation and maintenance.

Copies of coding documents defining the above shall be supplied along with drawings to understand the system.

- 7.1.2 All drawings submitted by the Bidder shall be in sufficient details to indicate the type, size arrangement, weight of each component, details for packing and shipment, the external connections, fixing arrangements, dimensions required for installation arrangement, dimensions required for installation and interconnections with other equipment and other information specifically, as called for in the drawing schedules. All the equipments tapping points etc. shall be numbered according to pre-determined scheme/ system which shall be subject to approval of Purchaser.
- 7.1.3 Each drawing shall be clearly marked with the name of the Purchaser, unit designation, UPPTCL's Contract No. and the name of the project. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawings shall be in English. All the dimensions should be in metric units.
- 7.1.4 If any dimension figures on a drawing or a plan differs from those obtained by scaling the drawing or plan, the dimensions as mentioned in figures on the drawing or plan shall be taken as correct.

7.2 Submission and distribution of drawings/ documents

All the drawings which do not require approval shall be submitted along with reproducible in required number and those requiring approval shall be initially submitted for comments/ approval before submitting along with reproducible as per "Document Distribution Schedule".

7.3 APPROVAL OF DRAWINGS

- 7.3.1 The Purchaser shall return to the Bidder one set of drawings, plans and technical data requiring approval after marking them with their comments/ corrections, if any, either (a) marked 'Approved' or (b) marked 'Approved subject to incorporation of comments' or (c) marked 'Not Approved' with comments requiring resubmission of drawings etc. in 14 days or (d) marked 'Approval not required', where drawing is for information only. In case of (a) no further revision of drawings will be required. In case of (b) Bidder can proceed with the work but will resubmit the drawings incorporating the corrections as per comments only within fourteen (14) days. In case of (c) Bidder can proceed with the work only after resubmitting the drawings within fourteen (14) days and getting approval under (a) or (b) categories above. In case of (d) the Bidder drawing is deemed to have been received only for information purpose.
- 7.3.2 The Purchaser shall have the right to ask the Bidder to make any change in the design/ drawing which may be necessary to make equipment conform to the provisions and intent of the contract, without any extra cost to the Purchaser.

The drawings submitted shall be re-viewed by the Purchaser and shall be modified by the Bidder as required. The Bidder shall incorporate such modifications and/or corrections and submit the final drawings for approval/ reference.

- 7.3.3 No deviation from the approved drawings shall be permitted without the written approval of the Engineer.

- 7.3.4 The review of drawings/ data by the Purchaser will cover only general conformance of the data of the specifications and document, interfaces with the equipment provided under the specifications, external connections and the dimensions which might effect substation layout.

This review by the Purchaser may not indicate thorough review of all dimensions, quantities and details of the equipment, wiring, materials, any devices or items indicated or the accuracy of the information submitted. This review and/ or approval by the purchaser shall not be considered by the Bidder, as limiting any of his responsibilities specified under these specifications and documents.

Approval/ comments conveyed as above shall neither relieve the Bidder of his contractual obligations and his responsibilities for correctness of dimensions, material of construction, quantities, design details, assembly fits, performance particulars, guarantees and conformity of the supplies with the specifications, schemes, systems and statutory laws, nor does it limit the Purchasers right under the contract.

- 7.3.5 Should any minor revision be made after 'approval', at the time of erection/ commissioning the Bidder shall redistribute prints and reproducible, clearly certifying the changes incorporated in the drawing and marking it in a block. Every revision shall be marked by a revision number, date and subject, in a revision block provided in the drawing, clearly marking the changes incorporated.
- 7.3.6 The Bidder shall be responsible for and shall pay for any alterations of the work due to any discrepancies, errors and omissions in the drawings or other particulars supplied by him, whether such drawings or particulars have been approved by Engineer or not.

No extension of delivery periods shall be granted on this account.

7.3.7 As- built drawings

Drawings of all equipments as detailed in technical specifications of respective equipments necessarily including schematic drawings and terminal block drawings wherever applicable whether mentioned in respective technical specifications or not.

8. NAME PLATE, MARKING OF PARTS, LABELS

- 8.1 All equipment shall have metal name plates fixed in suitable position with full particulars engraved legibly thereon and not painted.
- 8.2 Each main and auxiliary item of plant is to have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which is to be engraved identifying manufacturer's name, equipment type or serial number, rating together with details of the loading/ operating conditions under which the item or plant in question has been designed to operate and such diagram plates as may be required by the Engineer.
- 8.3 Each item of plant is to be provided with a name plate or label designating the service of the particular equipment. These inscriptions are to be approved by the Engineer or as detailed in the appropriate sections of the technical specifications.
- 8.4 Such name plates or labels are to be white non hygroscopic material with engraved block

lettering or, alternatively, in the case of indoor equipments of transparent plastic material with suitably colored lettering engraved on the back

- 8.5 Each bay module in GIS room will have a clear marking showing the name of bay, identification, name and rating plate marking for each individual equipment like circuit breaker, disconnectors grounding switches, current transformer, voltage transformers and bushings etc. as per relevant IEC to facilitate identification during routine operation/ maintenance.
- 8.6 All such name plates, instruction plates, lubrication charts etc. shall be bilingual with Hindi inscription first followed by English. Provisions shall be made to fit in name plates, lubrication/ connection diagram plates etc.
- 8.7 In order to facilitate identification, the parts of the equipment shall be suitably marked.

9. INSTRUCTION MANUALS

- 9.1 The Bidder shall submit to the Engineer 'Descriptive Manuals', i.e. system design concept, detailed catalogues of equipment and typical equipment instructions for this project, for all major systems and equipment, covered under this contract along with dispatch of equipment.
These initial copies of descriptive manuals shall be in sufficient details, bringing out detailed internal construction, characteristics, performance parameters, principles of operation, maintenance requirements, replacement and renewals needed, erection and overhauling procedure, testing and operation procedure etc. for various equipment.
- 9.2 The integrated instruction manuals, fully defining the interfaces between various systems and complete in all respects shall be submitted by the Bidder one month before scheduled date of commissioning. The instruction manuals shall contain full details of designation and drawings of all the equipment furnished, the erection procedure, testing procedure, operation and maintenance procedure of the equipment, single line diagrams, and schematics. After the commissioning and initial operation of the plant, modifications/ additions/ changes, wherever required shall be incorporated in the instruction manuals and drawings shall be submitted by the Bidder to the Purchaser.
- 9.3 The manuals shall be specific to the equipment supplied and not of general nature.

10. DOCUMENTS AND ERECTION DRAWINGS

The Bidder shall submit within a reasonable time but at least four (4) weeks before dispatch of equipment (as per distribution schedule) the following drawings/ documents and instruction manuals etc. to the consignee and the Engineer.

- I. List of item-wise equipment as proposed to be dispatched by the Bidder.
- II. Erection drawings along with reproducible prints of each drawings.
- III. Instruction books for proper handling/ checking of material on receipt at site/storage,
- IV. erection and assembly of all equipment and necessary instruction for checking and
- V. recording proper assembly of the plant.
- VI. Instruction sheets for proper balancing, alignment, adjustment, checking and calibrations
- VII. as may be necessary.

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- VIII. Descriptive literature and drawings to illustrate the working principals, methods of
 - IX. assembly and dismantling of plants and equipment.
 - X. Testing/commissioning format for recording data during erection/testing/
 - XI. commissioning and trial run. These formats/data sheets shall clearly indicate the results
 - XII. obtained during shop tests and permissible deviations.

11. QUALITY CONTROL PROGRAMME

To ensure that the equipment construction work and the services covered under this job are in accordance with the specifications and conform to the high standard of workmanship. It is obligatory on the part of the Bidder to adopt a suitable quality control program. Such a program shall include suitable hold point for check for major equipments during manufacture at supplier's work, during erection at site and during the construction stage such that material checks for attaining proper strength and dimensional checks for attaining close tolerances required for equipment installation can be obtained.

In order to attain the above objectives, the Bidder shall draw out a plan listing all quality control checks in detail, including all hold points at which the quality checks shall be applied, also specifically mentioning those hold points where the Purchaser shall also participate in the quality check to assure him of the quality of the products supplied. Such a program shall be outlined by the Bidder for the acceptance by the Purchaser. The Bidder shall furnish detailed information regarding his quality control program and its strict implementation. Following information shall be included in the proposal along with others regarding quality control program:

- I. The quality control organizations and the proposal of its implementation.
- II. The system for controlling drawings and documents for correctness.
- III. The system of quality control for raw materials, process control and maintaining
- IV. tolerances during manufacturing, assembly and fabrication.
- V. Quality control during purchase of components, sub-systems and assemblies.
- VI. Methods for ensuring selection of proper vendors/ sub-vendors.
- VII. Inspection of testing at shop after assembly.
- VIII. Control of accuracy during calibration of measuring and testing equipments.
- IX. Preservation and quality control during the transit.
- X. Procedure for inspection before erection and quality control during erection.
- XI. System for storage and delivery.

Bidder shall be wholly responsible for the quality control and quality assurance for the manufacture, supply, erection, testing and commissioning etc.

During inspection, destructive testing and non destructive test evaluation shall be done wherever applicable, in presence of Purchaser's representative in accordance with established norms. Directions of Purchaser shall be rigorously followed.

12. INSPECTION & TESTING

- 12.1 The Purchaser reserves the right to inspect any machinery and material to ensure that

approved Q.A.P. is being strictly implemented by the Bidder or his Sub Bidder/ Supplier under this contract and to reject any item found defective in workmanship or design or otherwise unsuitable for the use and purpose intended or which is not in accordance with the intent of this contract. The Bidder should on demand by the Purchaser, rectify or replace such defective or unsuitable equipment, or the Purchaser may at the Bidder's expense, rectify or replace such defective or unsuitable equipment whether before or after supply.

- 12.2** That Bidder shall, for purpose of clause 15 of the annexed conditions of contract Form-A inform to the Purchaser places of manufacture, testing and inspection of various equipment offered by him. Unless specifically provided otherwise, all tests shall be carried out at the Bidder's work or for bought out items at sub-vendors works before dispatch.
- 12.3** The Bidder shall advise the Purchaser at least 4 weeks in advance as to when the equipment will be ready for stage/ final inspection at the Bidder's works or at his Sub-Bidder's works.

PENAL CHARGES

In case the equipment is not available for inspection at the time of arrival of inspection officers, the Bidder shall pay to UPPTCL towards futile journey a sum decided by Chief Engineer (765 KV DU), UPPTCL and demanded by "Engineer of Contract". This amount shall be paid within 10 days from the date of demand. Further action for inspection of the material shall be taken only after the said amount is deposited.

- 12.4** During inspection, the Purchaser's Inspecting Engineers at all times have access to all part of shops where the equipment is being manufactured and also shall be provided with all reasonable inspection facilities by the Bidder and/ or sub-Bidders. Even without scheduled inspection, the Engineer and/or his duly authorized representative shall have at all reasonable times access to the Bidder's premises, works or site and shall have the power to inspect and examine the materials and workmanship of the works during it's manufacture or erection.
- 12.5** All plants equipment/ parts, sub-assemblies/ assemblies shall comply with the requirement of type tests and shall be subjected to the routine/ acceptance tests specified in the set of standards adopted and to such other tests as are stipulated in the respective technical specifications.

The Purchaser reserves to himself the right of having at his own expense any inspection or special test of a reasonable nature at Bidder's premises or at site, in addition to those Prescribed in applicable standards and the enclosed technical specifications.

- 12.6** The Engineer shall either depute his representative to witness the tests as applicable and inspect the material or shall waive the inspection. In case of waiver the Bidder or his sub-Bidder shall carryout the all applicable tests in absence of Purchaser's representative. In both the cases i.e. either inspection or waiver the test certificates shall

be submitted to Engineer of Contract for approval and issue of dispatch authorization. In case of inspection the test certificates must bear signatures of the Purchaser's inspecting officer.

The Engineer of Contract, within 10 days of receipt of test certificates, shall issue approval/ dispatch authorization, if test certificates are found satisfactory.

In case test certificates are not found satisfactory the Engineer of Contract, within 10 days of receipt of test certificates, shall communicate his objections and actions required to be taken in writing to the Bidder. The Bidder shall take remedial action and shall re-submit the test certificates or re-offer the material for inspection as asked for by the Engineer. Subsequent actions shall follow as in case of fresh offer for inspection. No extension of delivery/ completion period shall be granted on this account.

12.7 REJECTON

Purchaser reserves the right to reject any equipment if during the tests at works or site, the test value achieved do not comply with the respective standard/ specifications and exceeds that tolerable limits. Rejection of any equipment will not be held as a valid reason for delay in timely completion of the work.

12.8 No equipment to be furnished or used in connection with this contract shall be dispatched, until factory inspection and acceptance test have been carried out satisfactorily and dispatch authorization issued by Engineer of Contract. Such factory inspection of the equipment or approval of acceptance tests shall not however, relieve the Bidder from full responsibility for supplying equipment conforming to the requirements of this contract, nor prejudice any claim, right or privilege which the Purchaser may have because of the use of defective or unsatisfactory equipment. Should Purchaser waive the right to inspect any equipment, such waiver shall not relieve the Bidder in any way from his obligations under this contract. The inspection/waiver by Engineer and/ or approval of test certificates shall in no way limit the liabilities and responsibilities of the Bidder in respect of the agreed quality assurance program, and the desired performance of the equipment.

12.9 In all cases where the contract provides for tests whether at the premises or works of the Bidder or of any Sub-Bidder, the Bidder shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably required to carry out effectively, such tests on the equipment in accordance with the contract and shall give facilities to the Engineer or to his authorized representative to accomplish inspection.
All the expenses incurred for testing including material consumed in testing shall be to the Bidder's account.

12.10 Purchaser will not entertain any request for waiver of inspection on the ground that sub vendors are not agreeing for the Purchaser's inspection. It is the responsibility of the Bidder to ensure that all the requirements of the Purchaser as envisaged in the technical specifications are incorporated.

12.11 The Bidder is required to record the following certificates on the invoices and challans of

each and every consignment:

"Certified that material being dispatched against the above invoices and challan has been inspected and tested by the representative of Engineer of the contract on (date) and all the test results were satisfactory, as per approved test certificate enclosed."

Or

Certified that inspection of material being dispatched against the above invoice and challan has been waived off by Engineer of Contract vide letter No.....Dt..... (Copy enclosed) and all the acceptance and routine tests as per relevant standards and those provided in Contract, have been conducted and all the test results were found satisfactory as per test certificates enclosed."

- 12.12** In case the inspection or testing of the material is to be carried out outside India, all the expenditure including boarding and lodging etc. of the inspecting officer/ officers shall be borne by the contractor and information regarding inspection has to given at least 8 weeks in advance.

13. PACKING

- 13.1** All equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection.
While packing all the materials, the limitations from the point of view of availability of transportation facilities in India should be taken into account. The Bidder shall be responsible for any loss or damage during transportation, handling and storage.
- 13.2** The Bidder shall include and provide for security protection and packing the plant so as to avoid loss or damage during transport by any mode.
- 13.3** All packing shall allow for easy removal and checking at site. Wherever necessary, proper arrangement for attaching slings for lifting shall be provided. All packages shall be clearly marked for with signs showing 'UP' and 'DOWN' side of boxes, and handling and unpacking instructions as considered necessary. Special precautions shall be taken to prevent rusting of steel and iron parts during transit and storage. Gas seals or other methods proposed to be adopted for protection against moisture during transit shall be to the satisfaction of the engineer.
- 13.4** The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbols i.e. FRAGILE, HANDLE WITH CARE, USE NO HOOKS etc.
- 13.5** Each package delivered under the contract shall be marked by the Bidder at his expense and such marking must be distinct (all previous irrelevant marking being carefully obliterated). Such marking shall show the description and quantity of contents, the name of consignee and address, the gross and net weights of the package, the name of Bidder with a distinctive number of mark sufficient for purpose of identification. All markings shall be carried out with such materials as to ensure quickness of drying, fastness and legibility.

- 13.6 Each Package shall contain a note quoting specifically the name of the Bidder, the number and date of contract or order and the name of office placing the contract, nomenclature of the stores and include a schedule of parts for each complete equipment giving the parts number with reference to the General Arrangement/ Assembly drawing and the quantity of each part, drawing number and tag numbers.
- 13.7 All equipment/ material shall be suitably packed for transport, carriage at site and outdoor storage during transit. The Bidder shall be responsible for any damage to the equipment during transit. The contents of each package shall bear marking that can be readily identified from the package list and packing shall provide complete protection from moisture, termites and mechanical shocks etc.
- 13.8 Any material found short inside the packing cases shall be supplied by the Bidder without any extra cost.
- 13.9 Notwithstanding anything stated in this clause the Bidder shall be entirely responsible for any loss, damage or depreciation to the stores.

14. DESPATCH OF EQUIPMENT

- 14.1 Detailed dispatch instructions will be intimated to the Bidder. All materials shall be dispatched by road.
- 14.2 The Bidder shall intimate, at least thirty (30) days in advance to the consignee as well as the concerned Superintending Engineer at site, the probable date when the equipment will be ready for dispatch from the works. Notification of delivery or dispatch in regard to each and every consignment shall be made to the Purchaser immediately after dispatch or delivery. The supplier shall further supply to the consignee a priced invoice and packing account of all stores delivered or dispatched by him. All packages, containers, bundles and loose materials forming parts of each and every consignment shall be described fully in the packing account, and full details of the contents of packages and quantity of material shall be given to enable the consignee to check the stores on arrival at destination.
- 14.3 A list in duplicate containing details of equipment for verification at site shall also be placed inside each package and shall correspond with the advice note. One additional copy of each of the package lists shall also be sent to the consignee.

15. TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

The Bidder shall supply type tested (including special test as per technical specification) equipments and materials. The test reports/details shall be furnished by the Bidder in the bid.

In the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes or due to non-compliance with the requirement stipulated in the Technical Specification and/or IEC/ IS, same, shall be carried out

without any additional cost implication to the Purchaser. The Purchaser reserves the right to get any or all type tests conducted/ repeated.

The reports for all type tests and additional type tests as per technical specification furnished by the Bidder shall be of the tests conducted within last 10 (ten) years prior to the date of bid opening. The type tests conducted should have either been conducted in accredited laboratory (accredited based on ISO/ IEC Guide 25/ 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by UPPTCL or representative authorized by UPPTCL or Utility or representative of accredited test lab or reputed consultant.

15.1 Pre-commissioning Tests

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Purchaser and the Contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The list of pre-commissioning tests to be performed are given in respective chapters and shall be included in the Contractor's quality assurance programme.

15.2 Commissioning Tests

- 15.2.1 The available instrumentation and control equipment will to be used during such tests and the Purchaser will calibrate, all such measuring equipment and devices as far as practicable.
- 15.2.2 Any special equipment, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Contractor, free of cost.
- 15.2.3 The specific tests requirement on equipment have been brought out in the respective chapters of the technical specification.
- 15.2.4 The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning the equipment and the switchyard. However necessary fee shall be reimbursed by POWERGRID on production of requisite documents.

16. MATERIAL WORKMANSHIP

16.1 General Requirement

Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is understood that the same must be new, of highest grade of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended.

The design of the works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned

and restrained to fulfil their required function. In general screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Purchaser.

Whenever possible, all similar part of the Works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall also be interchangeable and shall be made of the same materials and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practices will be accepted. Installation shall be considered as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, leveling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances, instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacturer's limits.

Suitable guards shall be provided for the protection of personnel on all exposed rotating and/ or moving machine parts and shall be designed for easy installation and removal for maintenance purposes. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

The Bidder shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Bidder shall apply all operational lubricants to the equipment installed by him.

All oil, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the Bidder has any special requirement for the specific application of a type of oil or grease not available in India. In such is the case he shall declare in the proposal, where such oil or grease is available. He shall help Purchaser in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

A cast iron or welded steel base plate shall be provided for all rotating equipment which are to be installed on a concrete base unless otherwise agreed to by the Purchaser. Each base plate shall support the unit and its drive assembly, shall be of design with pads for anchoring the units and shall have a raised up all around and shall have threaded in air connections, of so required.

16.2 Provisions For Exposure to Hot and Humid climate

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favourable to the growth of fungi and mildew. The indoor equipments located in non-air conditioned areas shall also be of same type.

16.3 Space Heaters

The heaters shall be suitable for continuous operation at 240V AC supply. On-off switch and fuse shall be provided for the heater.

One or more adequately rated thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the lower portion of the compartment and electrical connections shall be made sufficiently away from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

The heaters shall be suitably designed to prevent any contact between the heater wire and the air and shall consist of coiled resistance wire centred in a metal sheath and completely encased in a highly compacted powder of magnesium oxide or other material having equal heat conduction and electrical insulation properties, or they shall consist of resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and the air. Alternatively, they shall consist of a resistance wire mounted into a tubular ceramic body built into an envelope of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in glaze. The surface temperature of the heaters shall be restricted to a value which will not shorten the life of the heater sheaths or that of insulator wire or other component in the compartments.

16.4 FUNGI STATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on parts which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interface with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

16.5 Ventilation opening

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds and suitable provision shall be made so as to avoid any communication of air/ dust with any part in the enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc.

16.6 Degree of Protection

The enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc. to be installed shall provide degree of protection as detailed here under:

-
- a) Installed out door: IP- 55
 - b) Installed indoor in air conditioned area: IP-31
 - c) Installed in covered area: IP-52
 - d) Installed indoor in non air conditioned area where possibility of entry of water is limited: IP-41.
 - e) For LT Switchgear (AC & DC distribution Boards) : IP-52

The degree of protection shall be in accordance with IS: 13947 (Part-I) / IEC-60947(Part-I) / IS 12063 / IEC-60529. Type test report for degree of protection test, shall be submitted for approval.

16.7 RATING PLATES, NAME PLATES AND LABELS

Each main and auxiliary item of substation is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading conditions under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the Purchaser. The rating plate of each equipment shall be according to IEC requirement.

All such nameplates, instructions plates, rating plates CB, CT, VT, SA, Isolators and Relay & Protection panels/ equipments shall be bilingual with Hindi inscription first followed by English.

Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.

16.8 FIRST FILL OF CONSUMABLES, OIL AND LUBRICANTS

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, soldering/brazing material for all copper piping of circuit breakers and essential chemicals etc. which will be required to put the equipment, covered under the scope of the specifications, into successful operation, shall be furnished by the Bidder unless specifically excluded under the exclusions in these specifications and documents.

17. Surface finish

All interiors and exteriors of tanks, control cubicles and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter. All steel surfaces in contact with insulating oil as far as accessible shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paints.

All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or otherwise protected. All paints shall be carefully selected to

withstand tropical heat and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling.

All external painting shall be as per shade No. 631 of IS: 5.

18. HOT DIP GALVANISING

All ferrous parts including all sizes of nuts, bolts, plain and spring washers, support channels, structures, shall be hot dip galvanized conforming to latest version of IS: 2629 or any other equivalent authoritative standard. However, hardware less than M12 size shall be electrogalvanized.

Minimum weight of zinc coating shall be 610 gm/ sq.mm and minimum thickness of Coating shall be 85 microns for all items thicker than 6 mm. For items lower than 6mm Thickness, requirement of coating shall be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sq. m minimum.

The galvanized surfaces shall have a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

After galvanizing, no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

Galvanised material must be transported properly to ensure that galvanised surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

19. PAINTING

- 19.1** All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS-6005 "Code of practice for phosphating iron and sheet". All surfaces, which will not be easily accessible after shop assembly, shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swaf shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.
- 19.2** After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed, stoving type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be stoved.

- 19.3** After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting.
- 19.4** The exterior and interior colour of the paint in case of new substations shall preferably be RAL 7032 for all equipment, marshalling boxes, junction boxes, control cabinets, panels etc. unless specifically mentioned under respective sections of the equipments. Glossy white colour inside the equipments /boards/panels/junction boxes is also acceptable. The exterior colour for panels shall bematching with the existing panels in case of extension of a substation. Each coatof primer and finishing paint shall be of slightly different shade to enable inspection of the painting. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments.
- 19.5** In case the Bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures, like electrostatic painting etc., the procedure shall be submitted alongwith the Bids for Purchaser's review & approval.

The colour scheme as given below shall be followed for Fire Protection and Air Conditioning systems

S. No.	PIPE LINE	Base colour	Band colour
Fire Protection System			
1	Hydrant and Emulsifier system pipeline	FIRE RED	-
2	Emulsifier system detection line – water	FIRE RED	Sea Green
3	Emulsifier system detection line – Air	FIRE RED	Sky Blue
4	Pylon support pipes	FIRE RED	
Air Conditioning System			
5	Refrigerant gas pipeline – at compressor suction	Canary Yellow	-
6	Refrigerant gas pipeline – at compressor discharge	Canary Yellow	Red
7	Refrigerant liquid pipeline	Dark Admiralty Green	-
8	Chilled water pipeline	Sea Green	-
9	Condenser water pipeline	Sea Green	Dark Blue

19.6 COLOUR SCHEME AND CODES FOR PIPE SERVICE

The Bidder shall propose a colour scheme for the those equipments/ items for which the colour scheme has not been specified in the specification. For the approval of

- | | | |
|--------|---|--|
| a) | For connecting ACSR/ AAC conductor | Aluminum alloy casting conforming to designation A6 of IS:617 and shall be tested for all tests as per IS:617 |
| b) | For connecting equipment terminals made of copper or ACSR conductor | Bimetallic connectors made from aluminum alloy casting conforming to designation A6 IS: 617 with 4mm thick cast copper lines and shall be tested as per IS:617 |
| c) | For connecting G.I.Shield wire | Malleable iron casting. |
| d) | Bolts, nuts and plain washers. | Hot dip galvanising mild steel |
| 20. e) | Spring washers for items 'a' to 'c' | Electrogalvanised-suitable for at least 3 service conditions as per IS:3063 & IS:1573 |
| f) | Misc. | Mild steel. |

21. CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

21.1 All power clamps and connectors shall conform to IS:5561 & NEMA CC1 and shall be made of materials listed below:

- | | | |
|-------|--|---|
| a | For connecting ACSR conductors | Aluminum alloy casting, conforming to designation A6 of IS:617 and all test shall conform to IS:617 |
| b | For connecting equipment terminals made of copper with ACSR conductors | Bimetallic connectors made from aluminum alloy casting, conforming to designation A6 of IS:617 with 2mm thick bimetallic liner and all test shall conform to IS:617 |
| c | For connecting G.I | Galvanised mild steel shield wire |
| d) i) | Bolts, nuts & Plain, washers galvanised. | i) Electrogalvanised for sizes below M12, for others hot dip |
| ii) | Spring washers | ii) Electro-galvanised mild for |

	items 'a' to 'c' IS:1573	steel suitable for atleast service condition-3 as per
21.2	Necessary clamps and connectors shall be supplied for all equipment and connections. The requirement regarding external corona and RIV as specified for any equipment shall include its terminal fittings. If corona rings are required to meet these requirements they shall be considered as part of that equipment and included in the scope of work.	
21.3	Where copper to aluminum connections are required, bi-metallic clamps shall be used, which shall be properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to parts which are not current carrying or subjected to stress.	
21.4	Low voltage connectors, grounding connectors and accessories for grounding all equipment as specified in each particular case, are also included in the scope of Work.	
21.5	No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanised. Copper alloy liner of minimum 2 mm thickness shall be cast integral with aluminum body or 2 mm thick bi-metallic strips shall be provided for Bi-metallic clamps.	
21.6	All casting shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.	
21.7	Flexible connectors, braids or laminated straps made for the terminal clamps for bus posts shall be suitable for both expansion or through (fixed/sliding) type connection of 4" IPS AL. tube as required. In both the cases the clamp height (top of the mounting pad to centre line of the tube) should be same.	
21.8	Clamp shall be designed to carry the same current as the conductor and the temperature rise shall be equal or less than that of the conductor at the specified ambient temperature. The rated current for which the clamp/connector is designed with respect to the specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/connector, except on the hardware.	
21.9	All current carrying parts shall be designed and manufactured to have minimum contact resistance.	
21.10	Clamps and connectors shall be designed to be corona controlled.	
21.11	Tests	
	Clamps and connectors should be type tested as per IS:5561 and shall also be subjected to routine tests as per IS:5561. Following type test reports shall be submitted for approval as per clause 9.2 above except for sl. no. (ii) & (iii) for which type test once conducted shall be applicable (i.e. the requirement of test conducted within last ten years shall not be applicable).	
	I. Temperature rise test (maximum temperature rise allowed is 35°C over 50°C ambient)	
	II. Short time current test	
	III. Corona (dry) and RIV (dry) test (for 220 KV and above voltage level clamps)	

IV. Resistance test and tensile test

**22. CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES
& MARSHALLING BOXES FOR OUTDOOR EQUIPMENT**

- 22.1** All types of boxes, cabinets etc. shall generally conform to and be tested in accordance with IS- 5039/ IS-8623, IEC-60439, as applicable, and the clauses given below.
- 22.2** Control cabinets, junction boxes, marshalling boxes and terminal boxes shall be made of sheet steel or aluminum enclosure and shall be dust, water and vermin proof. Sheet steel used shall be at least 2.0 mm thick cold rolled or 2.5 mm hot rolled. The box shall be properly braces to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of aluminum enclosed box, the thickness of aluminum shall be such that it provides adequate rigidity and long life as comparable with sheet steel of specified thickness.
- 22.3** Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements. A canopy and sealing arrangements for operating rods shall be provided in marshalling boxes/ Control cabinets to prevent ingress of rain water.
- 22.4** Cabinet/boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of the gasket shall be such that it does not get damaged/cracked during the operation of the equipment.
- 22.5** All doors, removable covers and plates shall be provided gasket all around with suitably profiled EPDM/Neoprene gaskets. The gasket shall be tested in accordance with approved quality plan, IS: 11149 and IS: 3400. The quality of gasket shall be such that it does not get damaged/cracked during 10 (ten) years of operation of the equipment or its major overhaul whichever is earlier.
- All gasketed surfaces shall be smooth straight and reinforced if necessary to minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters, the screen shall be fine wire mesh made of brass.
- 22.6** All boxes/ cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate projecting at least 150 mm above the base of the marshalling kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland plate. Gland plate shall have provision for some future glands to be provided later, if required.
- 22.7** A 240V, single phase, 50 Hz, 15 amp AC plug and socket shall be provided in the cabinet with ON-OFF switch for connection of hand lamps. Plug and socket shall be of

industrial grade.

- 22.8** For illumination, a 20 Watts fluorescent tube or 15 watts CFL/LED bulb shall be provided. The switching of the fittings shall be controlled by the door switch.

For junction boxes of smaller sizes such as lighting junction box, manual operated earth switch mechanism box etc., plug socket, heater and illumination is not required to be provided.

- 22.9** All control switches shall be of rotary type. Toggle piano switches shall not be accepted.

- 22.10** Positive earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire/ strip shall be terminated on to the earthing pad and secured by the use of self etching washer. Earthing of hinged door shall be done by using a separate earth wire.

- 22.11** The bay marshalling kiosks shall be provided with danger plate and a diagram showing the numbering/connection/ earthing by pasting the same on the inside of the door.

- 22.12** The following routine tests along with the routine tests as per IS: 5039 shall also be conducted:

Check for wiring
Visual and dimension check

The enclosure of bay marshalling kiosk, junction box, terminal box shall be type tested for IP-55 as per IS: 13947. After IP-55 test, 2.5 kVrms for 1 (one) minute, insulation resistance and functional test should be conducted.

22.13 Auxiliary Switches

All the auxiliary switches shall be fully type tested as per relevant IS.

The following type test reports on auxiliary switches shall be submitted:

- a) Electrical endurance test - A minimum of 2000 operation for 2A D. C. with a time constant greater than or equal to 20 millisecond with a subsequent examination of mV drop/visual defects/temperature rise test.
- b) Mechanical endurance test. A minimum of 1,00,000 operations with a subsequent checking of contact pressure test/visual examination.
- c) Heat run test on contacts.
- d) IR/HV test etc.

23. TERMINAL BLOCKS AND WIRING

- 23.1** Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All interphase and external connections to equipment or to control cubicles will be made through terminal blocks.

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- 23.2 Terminal blocks shall be 1100 V grade and have continuous rating to carry the maximum expected current on the terminals. These shall be of moulded piece, complete with insulated/barriers stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals.
- 23.3 But preferably the terminal blocks shall be non-disconnecting stud type of Elmex type CATM4, phoenix cage clamp type or equivalent. The insulating material of terminal block shall be nylon which shall be free of halogens, fluorocarbons etc.
- 23.4 Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.
- 23.5 The terminals shall be such that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally.
- 23.6 The conducting part in contact with cable shall preferably be tinned or silver plated, however Nickel plated copper or zinc plated steel shall also be acceptable.
- 23.7 The terminal blocks shall be of extensible design.
- 23.8 The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.
- 23.9 The terminal blocks shall be fully enclosed with removable covers of transparent, non-deterioration type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.
- 23.10 Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.
- a) All circuits except CT circuits - Minimum of 2 nos. of 2.5 sq. mm copper flexible
 - b) All CT circuits - Minimum of 4 nos. of 2.5 sq.mm copper flexible
- 23.11 The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live.
- 23.12 At least 20% spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminal rows.
- 23.13 There shall be minimum clearance of 250 mm between the first bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm.
- 23.14 The Bidder shall furnish all wire, conduits and terminals for the necessary interphase electrical connections (where applicable) as well as between phases and common terminal boxes or control cabinets.
-

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- 23.15** All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The Bidder shall also provide necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

24. LAMPS & SOCKETS

24.1 Lamps

All incandescent lamps shall use a socket base as per IS-1258, except in the case of signal lamps.

24.2 Sockets

All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round Standard Indian plugs. They shall be switched sockets with shutters.

24.3 Hand Lamp

A 240 Volts, single Phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON- OFF Switch for connection of hand lamps.

24.4 Switches and Fuses

Each panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signalling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breaker/ switchfuse units. Selection of the main and Sub-circuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses.

All fuses shall be of HRC cartridge type conforming to IS-9228 mounted on plug-in type fuse bases. Miniature circuit breakers with thermal protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints to the fuse rating and voltage. All control switches shall be of rotary type. Toggle piano switches shall not be accepted.

25. Bushings, Hollow Column Insulators, Support Insulators:

- 25.1** Bushings shall be manufactured and tested in accordance with IS:2099 & IEC-60137 while hollow column insulators shall be manufactured and tested in accordance with IEC-62155/IS:5621. The support insulators shall be manufactured and tested as per IS:2544/IEC-60168 and IEC-60273. The insulators shall also conform to IEC-60815 as applicable. The bidder may also offer composite hollow insulators, conforming to IEC-61462.

- 25.2** Support insulators, bushings and hollow column insulators shall be manufactured from

high quality porcelain Porcelain used shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.

- 25.3** Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.
- 25.4** Support insulators/bushings/hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.
- 25.5** When operating at normal rated voltage there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the insulators/bushings when operating at the normal rated voltage.
- 25.6** Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps and the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.
- 25.7** All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued up porcelain parts by grinding and metal parts by machining. Insulator/bushing design shall be such as to ensure a uniform compressive pressure on the joints.

25.8 Tests

In bushing, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests in accordance with IS: 2099 & IS:2544 & IS : 5621.

26. MOTORS

Motors shall be "Squirrel Cage" three phase induction motors of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment and shall be subjected to routine tests as per applicable standards. The motors shall be of approved make.

26.1 Enclosures

- a) Motors to be installed outdoor without enclosure shall have hose proof enclosure equivalent to IP-55 as per IS: 4691. For motors to be installed indoor i.e. inside a box, the motor enclosure, shall be dust

proof equivalent to IP-44 as per IS: 4691.

- b) Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of earthing conductor.
- c) Motors shall have drain plugs so located that they will drain water resulting from condensation or other causes from all pockets in the motor casing.
- d) Motors weighing more than 25 Kg. shall be provided with eyebolts, lugs or other means to facilitate lifting.

26.2 Operational Features

- a) Continuous motor rating (name plate rating) shall be at least ten (10) percent above the maximum load demand of the driven equipment at design duty point and the motor shall not be over loaded at any operating point of driven equipment that will rise in service.
- b) Motor shall be capable at giving rated output without reduction in the expected life span when operated continuously in the system having the particulars as given in Clause 15.0 of this Section.

26.3 Starting Requirements:

- a) All induction motors shall be suitable for full voltage direct-on-line starting. These shall be capable of starting and accelerating to the rated speed alongwith the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops down to 80% of the rated voltage.
- b) Motors shall be capable of withstanding the electrodynamic stresses and heating imposed if it is started at a voltage of 110% of the rated value.
- c) The locked rotor current shall not exceed six (6) times the rated full load current for all motors, subject to tolerance as given in IS:325.
- d) Motors when started with the driven equipment imposing full starting torque under the supply voltage conditions specified under Clause 15.0 shall be capable of withstanding atleast two successive starts from cold condition at room temperature and one start from hot condition without injurious heating of winding. The motors shall also be suitable for three equally spread starts per hour under the above referred supply condition.
- e) The locked rotor withstand time under hot condition at 110% of rated voltage shall be more than starting time with the driven equipment of minimum permissible voltage by at least two seconds or 15% of the accelerating time whichever is greater. In case it is not possible to meet the above requirement, the Bidder shall offer centrifugal type speed switch mounted on the motor shaft which shall remain closed for speed lower than 20% and open for speeds above 20% of the rated speed. The speed switch shall be capable of withstanding 120% of the rated speed in either direction of rotation.

26.4 Running Requirements:

- a) The maximum permissible temperature rise over the ambient temperature of 50 degree C shall be within the limits specified in IS:325 (for 3 - phase induction motors) after adjustment due to increased ambient temperature specified.
- b) The double amplitude of motor vibration shall be within the limits specified in IS: 4729. Vibration shall also be within the limits specified by the relevant standard for the driven equipment when measured at the motor bearings.
- c) All the induction motors shall be capable of running at 80% of rated voltage for a period of 5 minutes with rated load commencing from hot condition.

26.5 TESTING AND COMMISSIONING

An indicative list of tests is given below. Contractor shall perform any additional test based on specialities of the items as per the field Q.P./Instructions of the equipment Contractor or Purchaser without any extra cost to the Purchaser. The Contractor shall arrange all instruments required for conducting these tests alongwith calibration certificates and shall furnish the list of instruments to the Purchaser for approval.

- (a) Insulation resistance.
 - (b) Phase sequence and proper direction of rotation.
 - (c) Any motor operating incorrectly shall be checked to determine the cause and the conditions corrected.
-

CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1.0 General

Unless otherwise stipulated, all equipment together with its associated connectors, where applicable, shall be tested for external corona (for 400 kV & above) both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and by measurement of radio interference voltage (RIV) for 132 kV above.

2.0 Test Levels

The test voltage levels for measurement of external RIV and for corona extinction voltage are listed under the relevant clauses of the specification.

3.0 Test Methods for RIV

3.1 RIV tests shall be made according to measuring circuit as per International Special-Committee on Radio Interference (CISPR) Publication 16-1(1993) Part -1. The measuring circuit shall preferably be tuned to frequency with 10% of 0.5 MHz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The results shall be in microvolts.

3.2 Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107-1964, except otherwise noted herein.

3.3 In measurement of, RIV, temporary additional external corona shielding may be provided. In measurements of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.

3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, and 110% of the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 400kV, 220kV, 132kV is listed in the detailed specification together with maximum permissible RIV level in microvolts.

3.5 The metering instruments shall be as per CISPR recommendation or equivalent device so long as it has been used by other testing authorities.

3.6 The RIV measurement may be made with a noise meter. A calibration procedure of the frequency to which noise meter shall be tuned shall establish the ratio of voltage at the high voltage terminal to voltage read by noise meter.

4.0 Test Methods for Visible Corona

The purpose of this test is to determine the corona extinction voltage of apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised

and lowered to determine their precise values. The test voltage shall be raised to 110% of specified corona extinction voltage and maintained there for five minutes. In case corona inception does not take place at 110%, test shall be stopped, otherwise test shall be continued and the voltage will then be decreased slowly until all visible corona disappears. The procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which visible corona (negative or positive polarity) disappears. Photographs with laboratory in complete darkness shall be taken under test conditions, at all voltage steps i.e. 85%, 100%, and 110%. Additional photographs shall be taken at corona inception and extinction voltages. At least two views shall be photographed in each case using Panchromatic film with an ASA daylight rating of 400 with an exposure of two minutes at a lens aperture of f/5.6 or equivalent. The photographic process shall be such that prints are available for inspection and comparison with conditions as determined from direct observation. Photographs shall be taken from above and below the level of connector so as to show corona on bushing, insulators and all parts of energised connectors. The photographs shall be framed such that test object essentially, fills the frame with no cut-off.

For recording purpose, modern devices utilizing UV recording methods such as image intensifier may also be used.

- 4.1 The test shall be recorded on each photograph. Additional photograph shall be taken from each camera position with lights on to show the relative position of test object to facilitate precise corona location from the photographic evidence.
- 4.2 In addition to photographs of the test object preferably four photographs shall be taken of the complete test assembly showing relative positions of all the test equipment and test objects. These four photographs shall be taken from four points equally spaced around the test arrangement to show its features from all sides. Drawings of the laboratory and test set up locations shall be provided to indicate camera positions and angles. The precise location of camera shall be approved by Purchaser's inspector, after determining the best camera locations by trial energisation of test object at a voltage which results in corona.
- 4.3 The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.
- 4.4 However, both test shall be carried out with the same test set up and as little time duration between tests as possible. No modification on treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of Purchaser's inspector if, in his opinion, it will not prejudice other test.

5.0 Test Records

In addition to the information previously mentioned and the requirements specified as per CISPR or NEMA 107-1964 the following data shall be included in test report:

- a) Background noise before and after test.
- b) Detailed procedure of application of test voltage.
- c) Measurements of RIV levels expressed in micro volts at each level.

- d) Results and observations with regard to location and type of interference sources detected at each step.
- e) Test voltage shall be recorded when measured RIV passes through 100 microvolts in each direction.
- f) Onset and extinction of visual corona for each of the four tests required shall be recorded.

ANNEXURE – B

SEISMIC WITHSTAND TEST PROCEDURE

The seismic withstanding test on the complete equipment (for 132 kV and above) shall be carried out alongwith supporting structure.

The Bidder shall arrange to transport the structure from his Contractor's premises/UPPTCL sites for the purpose of seismic withstand test only.

The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the Terminal Pad of the equipment and any other point as agreed by the Purchaser. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the Purchaser.

Project: 400/220/132 kV GIS Substation at Rasara, Ballia
Customer: Uttar Pradesh Transmission Corporation Ltd (UPPTCL)
Consultant: -----
Technical Specification: 1.1 kV Control & Aux Power Cables

Bharat Heavy Electricals Limited
Document No. TB-404-510-034

SECTION-4

CHECK LIST FOR INFORMATION TO BE FURNISHED WITH OFFER RETURN THIS CHECKLIST AS PART OF THE OFFER DULY SIGNED

The offer may not be considered if the following information and this Checklist are not enclosed with the Offer.

BHEL ENQUIRY. NO:

BIDDER OFFER REFERENCE:

A)

(1) S.No.	(2) Parameters	(3) Data	(4) Yes / No	(5) Remarks in case reply in Col (4) is <i>NO</i>
1.0	Applicable Standard	Latest IS -1554, 5831, 8130, 7098, 3975, 613, ASTM-D2843, ASTM-D2863, IEC60754, IEC60332, IS3961, IS 10418, SS4241475, NEMA WC-70, IEEE-383		
2.0	Type	FRLS		
3.0	Construction feature for PVC Control and Aux Power cable			
3.1	Material of Conductor for Control cables	Plain Annealed, High Conductivity, Stranded, untinned Copper (with minimum 7 strands), Grade EC		
3.2	Material of Conductor for Power cables	Stranded Aluminium, Grade H2 /H4		
3.3	Conductor Insulation for Control and Power cables	Extruded PVC, Type-A		
3.4	Inner sheath	Extruded PVC, Type ST-2		
3.5	Armouring for Control Cables	Galvanised Steel Round wire / formed wire for multicore cables		
3.6	Armouring for Aux Power Cables	Aluminium round wire for Single core And Galvanised Steel round wire/formed wire for Multi-core cables (As per Section-2)		
3.7	Outer sheath for Control and Power cables	PVC extruded, FRLS, Type ST-1, Category C2		

Project: 400/220/132 kV GIS Substation at Rasara, Ballia
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(1) S.No.	(2) Parameters	(3) Data	(4) Yes / No	(5) Remarks in case reply in Col (4) is NO
4.0	Construction feature for XLPE Aux Power cable			
4.1	Material of Conductor for Power cables	Stranded Aluminium (with minimum 7 strands), Grade H2 /H4		
4.2	Conductor Insulation	XLPE		
4.3	Inner sheath	Extruded PVC, Type-ST2		
4.4	Armouring for Aux Power Cables	Aluminium round wire/strip for Single core And Galvanised Steel round wire/ formed wire for Multi-core cables		
4.5	Outer sheath	PVC extruded, FRLS, Type ST-2, Category C2		
5.0	FRLS properties of Outer sheath			
5.1	Minimum Oxygen index	29		
5.2	Minimum Temperature index	250°C		
5.3	Acid gas emission	Max 20% by weight		
5.4	Smoke density rating	Max 60%		
6.0	Tolerance on overall diameter	± 2mm		
7.0	Chemicals added to outer sheath to protect from rodent, vermin and termite attack	Yes		
8.0	Drum lengths shall be 500m for cables with conductor cross section area less than 300 sq mm	Yes		
9.0	Tolerance on total quantity	± 2%		
10.0	Minimum bending radius for multicore cables	12 x D		

Project: 400/220/132 kV GIS Substation at Rasara, Ballia
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 Consultant: -----
 Technical Specification: 1.1 kV Control & Aux Power Cables

Bharat Heavy Electricals Limited
 Document No. TB-404-510-034

(1) S.No.	(2) Parameters	(3) Data	(4) Yes / No	(5) Remarks in case reply in Col (4) is NO
11.0	Core Identification	By colour coding as per IS 1554 (Part-I)/ IS 7098 Part-I for the cables upto five (5) cores; and for the cables with more than five (5) cores, by printing legible Hindu Arabic numerals on all cores as per Clause 10.3 of IS 1554 (Part-1).		
12.0	The fillers and inner sheaths shall be of non-hygroscopic, fire retardant material, shall be softer than insulation and outer sheath shall be suitable for the operating temperature of the cable	Yes		

B) TYPE TESTS

i) All type tests as per relevant IS/IEC shall be performed on each type and size of cables as a part of acceptance tests & price for conducting the same are included in the offered price for individual cables. (YES)

C)

(1) S.No.	(2) Description	(3) Confirmation of Supplier
1.	Bidder to confirm that at all drawings / data sheets/QP/ valid type tests reports/ all relevant information shall be submitted to BHEL for organising approval of ultimate customer.	

Date:

Signature of the authorized representative of Bidder

Company Seal