

Amendment-2

Date: 01-May-2017

Ref: NIT No. RECPDCL/TECH/CED/e-Tender/2017-18/134 Dated: 13.04.2017

Sr. No.	RFP Document Reference (Clause No., Page No.)	Existing Clause	Amended Clause
1	New clause	-	Specification for 66 kV, 1 C X 1000 sq. mm XLPE Cable (Attached as Annexure-1)
2	New clause	-	Specification for 66 kV Control & Relay Panel (Attached as Annexure-2)

This is issue with the approval of Competent Authority

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Annexure-1

Specification for 66 kV, 1 C X 1000 sq. mm XLPE Cable

Applicable Standard:

The equipment covered by this specification shall unless otherwise stated, be designed, manufactured and tested in accordance with latest revisions of relevant Indian Standards /IEC and shall conform to the regulations of local statutory authorities

S. No.	STANDARDS	DESCRIPTION
IS Standards		
1.	IS 7098(Part-3)-1993	Specification for Cross-linked polyethylene insulated PVC sheathed Cables Part: 3. For working voltages from 66KV upto and including 220KV
2.	IS 8130-1984	Specification for Conductor for insulated electric Cables & flexible cords.
3.	IS 398(Part-4)-1994	Aluminum conductor for overhead transmission purposes. Part 4- Aluminum alloy stranded conductors.
4.	IS 10418-1982	Specification for Drums for Electric Cables
5.	IS 5831-1984	Specification for PVC insulation and sheath of electric Cables.
6.	IS:3975-1999	Mild steel wires, formed wires and tapes for armoring of cables
7.	IS-5216	Guide for safety procedures and practices in electric works
8.	IS- 10810:1984	Method of test of Cables
IEC Standards		
1.	IEC-60228:2004	Conductor for insulated cables.
2.	IEC-60502 (Part-2)	Power Cables with extruded insulation and their accessories rated 2005Voltages from 1KV (Um = 1,2KV) upto 30KV (Um=36KV) – Part 2: Cables for Rated voltages from6KV (Um=7,2KV) upto 30 KV (Um= 36 KV)
3.	IEC-60811:1990 and	Test methods for insulations and sheaths of electric cables and cords.
4.	IEC-60840:2004	Power cables with extruded insulation and their accessories Test methods And requirements.
5.	IS-5216	Guide for safety procedures and practices in electric works
6.	IEC-332	Flame Retardant, Characteristics of electric cables.

CLIMATIC CONDITION OF THE INSTALLATION:

Climate conditions of the installation	
Max. Ambient Temperature	50°C
Max. Daily average ambient temp.	40°C

Ref. Temperature For Design	50°C
Min Ambient Temp	0°C
Maximum Humidity	95%
Minimum Humidity	10%
Average No. of thunderstorm days per annum	50
Maximum Annual Rainfall	750 mm
Average No. of rainy days per annum	60
Rainy months	June to October
Altitude above MSL not exceeding	300 Meters
Wind Pressure	126 kg/sq m up to an elevation at 10 m
Atmosphere	Atmosphere is generally laden with mild acid and dust suspended during dry months and subjected to fog in cold Months. the design of the equipment and accessories shall be suitable to withstand seismic forces corresponding to an acceleration of 0.1 G

Guaranteed Technical Requirements

Sr. No.	Description	Units	Requirement
1.	Voltage Grade	(Uo/U) kV	38/66kV (Um=72.5 kV)
2.	Variation in Supply Voltage		+10 % -12.5 %
3.	Highest System Voltage	kV	72.5
4.	System Frequency	Hz	50
5.	Impulse withstand voltage 1.2/50 micro	kV Peak	325
6.	One minute power frequency withstand	kV rms	140
7.	Rated Short circuit current for 3 Sec	kA	26.3
8.	Type of cable		Compacted Stranded circular Aluminum conductor, Tree Retardant XLPE Extruded screen, Water Swellable tape, Corrugated Aluminum sheath, HDPE insulated covered with semiconducting Extruded.
9.	Conductor		
(a)	Material		H2/H4 Grade Aluminum conductor with water Swellable tape
(b)	No. of Cores & Size	Nos X Sq.mm	1C X 1000 sq. mm
(c)	No. of wires in each conductor (Minimum)	Nos.	53
(d)	Approx. Dia. of wires in each conductor before compaction	mm	4.9
(e)	Shape of the conductor		Compacted circular
(f)	Approx. Dia. over conductor	mm	35.7
(g)	Max. Resistance of Conductor	Ohm/Km	0.0291

(h)	Minimum Weight of Conductor	Kg/KM/Core	2600
10.	Conductor screen		
(a)	Material		Extruded semi-conducting compound layer over semi conducting water Swellable tape
(b)	Minimum thickness	mm	0.8
11.	Insulation		
(a)	Material		Tree Retardant XLPE Insulation as per IS 7098(Part-3)-1993
(b)	Nominal Thickness	mm	11.0
(c)	Eccentricity Factor (E_f)		Max 0.15
11.1.	Insulation Screening		
(a)	Non Metallic Part		Extruded semi conducting compound
(b)	Minimum thickness		0.8 mm
11.2.	Water Swellable tape		
(a)	Material		Non-Woven semi conducting tape
(b)	Nominal Thickness		0.3 mm (Each Tape)
(c)	No. of water Swellable tape/s		Two
(d)	Location of water swellable tape/s		Under Metallic Sheath
(e)	Semi Conducting Tape		Copper woven water swellable
11.3.	Metallic Screen		
(a)	Material		Ring Type Corrugated Aluminum sheath (seam weld) with bitumen compound Coating in conjunction with textile tape for Corrosion protection. Shall be able to sustain fault current of 26.3 kA for 3 Sec.
(b)	Nominal thickness(minimum)	mm	2.3 mm
12.	Protective outer sheath		
(a)	Material		HDPE with anti-termite additive black color type. Anti-termite Treatment and semi conducting layer shall be extruded on the outer sheath as an electrode for sheath test.
(b)	Type and composition	Type	ST7 as per IEC 60840
(c)	Nominal thickness	mm	3.6
(d)	Minimum thickness	mm	2.68
(e)	Colour		Black
13.	App. Nominal overall diameter of Completed single core cable	mm	70.86
14.	Pulling eye provided on one running end per drum		Yes
15.	Safe pulling force of the conductor when pulled by pulling eye on each Conductor to be indicated	KN	30
16.	Minimum radius of bend round which cable can be laid.		20 x OD of cable
17.	Standard Length with Tolerance	meter	500+/-5%
18.	Continuous current rating of cable		

(a)	Direct in ground at 30 Deg. C.	Amps	796
(b)	In Air at 40 Deg. C.	Amps	1046
19.	Short Circuit Capacity of Conductor for 1 Sec.	kA/Sec	94.5

GENERAL CONSTRUCTION

The cross linked polyethylene insulated (XLPE) Cable (Dry cured) shall be manufactured and tested strictly in accordance with the Indian Standard IS 7098(Part-3)-1993 and its latest amendments. All material used in the manufacturing of cables shall be new and shall be selected as the best available for the intended use. The rating factors for variation in ground and air temperature, depth of laying, thermal resistivity of soil and different laying configuration of cables shall be provided by the bidder.

CONDUCTOR

1. All conductors shall be Class 2 stranded, compacted circular, Pure Aluminum, Grade H2/H4 as per IS 8130:1984. A water swellable tape, capable of 90 degree Celsius continuous operation should be wrapped between the conductor strands. It should be compatible with the semi conducting and insulating compounds in the cable. The tape is required to inhibit water migration along the conductor. In addition, the tape shall have zero flow and no drip at temperature below 90 degree Celsius and it shall not harm the electrical conductivity of the conductor or joint. The Bidder shall describe the method of preparing the filled central conductor for jointing.
2. All conductors shall be of high electrical conductivity Aluminum as specified, conforming to requirement of relevant standards.
3. Before stranding, the conductor shall be circular in cross section, uniform in quality, solid, smooth and free from scale, sharp edges and other defects.
4. Conductors shall conform to the standards for permissible number of joints in any one of the single wires forming every complete length of conductor, for location of joints in same layer of conductors and for method of making such joints. No joint shall be made in any conductor after it is stranded.

CONDUCTOR SCREEN

The Conductor screening shall consist of a layer of extruded semi-conducting compound as per IS 7098(Part-3)-1993 with latest amendments. The semi-conducting compound shall be suitable for the operating temperature of the cable and compatible with the insulating material.

INSULATION

1. The insulating material shall be Tree retardant Cross Linked Polyethylene (XLPE) cured by Dry curing Process and applied by extrusion process as per IS 7098(Part-3)-1993 and its latest amendments. The insulation properties shall be stable under thermal conditions arising out of continuous operation at conductor temperature of 90 degree Centigrade rising momentarily to 250 Degree Centigrade under short circuit conditions.
2. The average thickness of the insulation shall be as per IS 7098(Part-3)-1993 with latest amendments or as specified in GTP, whichever is greater with tolerance as per IS

7098(Part-3)-1993. It shall fit tightly to the conductor and shall be applied concentrically about the conductor in thickness consistent with the voltage classification.

3. The insulation shall be so applied that it shall be possible to remove it without damaging the conductor.
4. The insulating material shall have excellent electrical properties with regard to resistivity, dielectric constant and loss factor and shall have high tensile strength and resistance to abrasion. This shall not deteriorate at elevated temperatures or when immersed in water. The insulation shall be resistant to chemicals like acids, alkalis, oils and ozone.

INSULATION SCREEN

The insulation screening shall consist of the following parts:

1. **Non-Metallic Part:** This shall be applied directly over the insulation of each core and shall consist of an extruded semi-conducting compound. The semi-conducting compound shall be suitable for the operating temperature of the cable and compatible with the insulating material.
2. **Water Swellable Tape:** A semi-conducting tape shall be applied under and over of metallic sheath as defined in the GTP, It shall make cable longitudinally watertight and prevent water penetration in the cable. The tape shall be of non-woven material, which has non-biodegradable characteristic with nominal thickness of 0.3mm.
3. **Metallic Part:** This shall consist of Corrugated & Seam Weld Aluminum Sheath. The sheath shall be free from pinholes, flaws and other imperfections: The metallic sheath shall be impervious to water and shall be capable of carrying the earth fault current without exceeding 250°C. The grain size of the sheath shall be uniform and the sheath shall exhibit no marked change after application, installation or in-service, particularly under extended periods of operation at elevated temperatures or under repeated cyclic variations of load.

OUTER SHEATH

The outer sheath shall be applied by extrusion process. The outer sheath shall be of polyethylene compound conforming to the requirements of Type ST₇ of IEC 60840 having anti termite additive black color type. The minimum and nominal thickness shall be as per IS 7098(Part-3)-1993 subject to tolerance as per the standard. The polyethylene outer sheath shall be ultraviolet protected for operation in direct sunlight and shall be provided with Graphite coating. The outer sheath shall be Black in color.

MARKINGS

The cable shall carry the following information stenciled on the both sides of the drum:

- a) Reference to the Standards;
- b) Manufacturer's name;
- c) Type of Cable
- d) Voltage Grade;
- e) Number of cores;
- f) Nominal Cross sectional Area of the conductor;
- g) Cable code;
- h) Length of the cable on the drum;
- i) Number of lengths on the drum (If more than one);
- j) Direction of the rotation of the drum;

- k) Gross mass;
- l) Country of manufacture;
- m) Year of manufacture.
- n) ISI Certification mark.
- o) Length Marking

TESTS

All routine, acceptance & type tests shall be carried out in accordance with the relevant IS/IEC. All routine/acceptance tests shall be witnessed by the RECPDCL/Purchaser/his authorized representative. All the components should also be type tested as per the relevant standards. Following tests shall be necessarily conducted on the 66 kV cables in additions to others specified in IS/EC standards.

TYPE TESTS

- a) Tests on conductor:
 - i) Annealing test (for copper)
 - ii) Resistance test
- b) Physical test on insulation
 - i) Test for thickness and dimensions of insulation
 - ii) Tensile strength and elongation at break
 - iii) Thermal ageing in air oven
 - iv) Hot set test
 - v) Shrinkage test
 - vi) Void and contaminants test
- c) Thickness of metallic sheath
- d) Physical tests for outer sheath
 - 1) Measurement of thickness
 - 2) PE Sheath
 - i) Carbon Black content
 - ii) Tensile strength and elongation at break before and after ageing
 - iii) Hot deformation
- e) Flammability test (for PVC outer sheath cables only)
- f) Water tightness test
- g) i) Thermal ageing on complete cable sample
 - ii) Tensile strength and elongation at break for insulation and outer sheath
- h) Bending test followed by P.O. test
 - i) Dielectric power factor and capacitance measurement at ambient temperature
- j) Dielectric power factor measurement at elevated temperature
- k) Load cycle test followed by P.O. test
- l) Impulse withstand test followed by HV test
- m) Insulation Resistance Test

ACCEPTANCE TESTS

1. Thickness of insulation
2. Eccentricity of insulation
3. Thickness of Conductor Screen (semicon)
4. Thickness of Insulation screen (semicon)
5. Thickness of Water swellable tape (Non-woven)
6. Thickness of Water swellable copper woven tape

7. Thickness of corrugated aluminum sheath
8. Thickness of outer sheath
9. Diameter over conductor
10. No. of wires in conductor
11. Overall diameter of cable
12. Hot Set test for XLPE insulation
 - a. Elongation under load
 - b. Permanent set
13. Water swellability height test for non-woven water swellable tape
14. Water swellability height test for copper woven water swellable tape
15. Voids and contamination test
16. Conductor resistance at 20 deg C
17. High voltage test at room temperature
18. Partial Discharge test at 1.5 U₀ (On full drum length)
19. Measurement of capacitance
20. Sheath voltage test
21. Insulation Resistance test

ROUTINE TESTS

- a) Conductor resistance test
- b) Partial discharge test
- c) High voltage test

TYPE TESTS CERTIFICATES

The Bidder shall furnish the type test certificates of the 66 kV cable for the tests as mentioned above as per the corresponding standards. All the tests shall be conducted at CPRI / ERDA as per the relevant standards. Type test should have been conducted in certified Test Laboratories during the period not exceeding 5 years from the date of opening the bid. In the event of any discrepancy in the test reports, i.e. any test report not acceptable or any/all type tests (including additional type tests, if any) not carried out, same shall be carried out without any cost implication to RECPDCL/CED. Bidder shall submit the Test Reports for the Tree Retardant properties of the insulation.

PRE-DISPATCH INSPECTION

The Material shall be subject to inspection by a duly authorized representative of the RECPDCL/CED. Inspection may be made at any stage of manufacture at the discretion of the Purchaser and the equipment if found unsatisfactory as to workmanship or material, the same is liable to rejection. Bidder shall grant free access to the places of manufacture to RECPDCL/CED's representatives at all times when the work is in progress. Inspection by the RECPDCL/CED or its authorized representatives shall not relieve the Bidder of his obligation of furnishing equipment in accordance with the specifications.

Material shall be dispatched after specific MDCC (Material Dispatch Clearance Certificate) is issued by RECPDCL/CED.

Following documents shall be sent along with material

- a) Test reports
- b) MDCC issued by RECPDCL/CED

- c) Invoice in duplicate
- d) Packing list
- e) Drawings & catalogue
- f) Guarantee / Warrantee card
- g) Delivery Challan
- h) Other Documents (as applicable).

GUARANTEE

Bidder shall stand guarantee towards design, materials, workmanship & quality of process/ manufacturing of items under this contract for due and intended performance of the same, as an integrated product delivered under this contract. In the event any defect is found by the Purchaser up to a period of at least 12 months from the date of commissioning or 24 months from the date of last supplies made under the contract whichever is later, (the time scale of 12/24 months could be enhanced subject to mutual agreements). Bidder shall be liable to undertake to replace/rectify such defects at its own costs, within mutually agreed time frame, and to the entire satisfaction of the Purchaser, failing which the Purchaser will be at liberty to get it replaced/rectified at Bidder's risks and costs and recover all such expenses plus the Purchaser's own charges (@ 20% of expenses incurred), from the Bidder or from the Security cum Performance Deposit as the case may be. Bidder shall further be responsible for free replacement for another period of THREE years from the end of the guarantee period for any 'Latent Defects' if noticed and reported by the Purchaser.

PACKING

The cable shall be wound on strong weatherproof and non-returnable steel drums packed in coil lengths of 500 meters. The ends of the cable shall be sealed by means of non-hygroscopic sealing material. Cable drums shall be so constructed as to have required mechanical strength so that the drum flanges and other components do not break during transport, in actual use or in storage. The flanges and the outside surface of the barrel shall be free from protruding materials or projections or unevenness capable of damaging the cable or hands of operator during rotation of drums. A metal preservation shall be applied to the entire drum. All ferrous parts used shall be treated with a suitable rust free finish or coating to avoid rusting during transit or storage. The Bidder shall ensure that all the equipment covered under this specification shall be prepared for rail/road transport in a manner so as to protect the equipment from damage in transit.

QUALITY CONTROL

The Bidder shall submit with the offer Quality assurance plan indicating the various stages of inspection, the tests and checks which will be carried out on the material of construction, components during manufacture and bought out items and fully assembled component and equipment after finishing. As part of the plan, a schedule for stage and final inspection within the parameters of the delivery schedule shall be furnished. RECPDCL shall reserve the sole rights for the type test of a random sample from the lot and in case of any discrepancy or deviation from the Type test certificates submitted along with the Bid, the complete Lot shall be rejected.

The Purchaser's engineer or its nominated representative shall have free access to the Bidder's works to carry out inspections.

MINIMUM TESTING FACILITIES

Bidder shall have adequate in house testing facilities for carrying out all routine tests & acceptance tests as per relevant International/Indian standards.

MANUFACTURING ACTIVITIES

The successful Bidder will have to submit the bar chart for various manufacturing activities clearly elaborating each stage, with quantity. This bar chart should be in line with the Quality assurance plan submitted with the offer. This bar chart will have to be submitted within 15 days from the release of the order.

DRAWINGS AND DOCUMENTS

Following drawings and documents shall be prepared based on Purchaser's specifications and statutory requirements and shall be submitted with the bid:

- a) Completely filled in Technical Particulars
- b) Bill of material
- c) Fault Calculations for Corrugated Aluminum Sheath.
- d) Type Test certificates.
- e) Detailed dimensional cross-sectional drawing of the cable
- f) Experience List After the award of the contract four (4) copies of drawings, drawn to scale, describing the equipment in detail shall be forwarded for approval and shall subsequently provide four (4) complete sets of final drawings, one of which shall be auto positive suitable for reproduction, before the dispatch of the equipment. Soft copy (Compact Disk CD) of all the drawing, GTP, Test certificates shall be submitted after the final approval of the same to purchaser.

Following drawings /documents shall be submitted by the bidder for Purchaser's approval.

S. No	Description	For Approval	For Review Information	Final Submission
1.	Technical Parameters	✓		✓
2.	Manual / Catalogues / drawings for all Cables		✓	
3.	Technical Details and test If certificates of the XLPE compound.		✓	✓
4.	Fault level calculation for corrugated Aluminum Sheath	✓		✓
5.	Cross section area of the cable	✓		✓
6.	Installation Instructions		✓	✓
7.	Instruction for use		✓	✓
8.	Transport/shipping dimension drawing		✓	✓
9.	QA & QC Plan	✓	✓	✓
10.	Routine, Acceptance and Type test Certificates	✓	✓	✓

All the documents & drawings shall be in English language.

Instruction Manuals: Bidder shall furnish two softcopies (CD) and four (4) hard copies of nicely bound manuals (In English language) covering erection and maintenance instructions and all relevant information and drawings pertaining to the main equipment as well as auxiliary devices.

GUARANTEED TECHNICAL PARTICULARS:

Sr. No.	Description	Units	Requirement
1.	Voltage Grade	(Uo/U) kV	
2.	Variation in Supply Voltage		
3.	Highest System Voltage	kV	
4.	System Frequency	Hz	
5.	Impulse withstand voltage 1.2/50 micro	kV Peak	
6.	One minute power frequency withstand	kV rms	
7.	Rated Short circuit current for 3 Sec	kA	
8.	Type of cable		
9.	Conductor		
(i)	Material		
(j)	No. of Cores & Size	Sq.mm	
(k)	No. of wires in each conductor (Minimum)	Nos.	
(l)	Approx. Dia. of wires in each conductor before compaction	mm	
(m)	Shape of the conductor		
(n)	Approx. Dia. over conductor	mm	
(o)	Max. Resistance of Conductor	Ohm/Km	
(p)	Minimum Weight of Conductor	Kg/KM/Core	
10.	Conductor screen		
(c)	Material		
(d)	Minimum thickness	mm	
11.	Insulation		
(d)	Material		
(e)	Nominal Thickness	mm	
(f)	Eccentricity Factor (E_r)		
11.1.	Insulation Screening		
(c)	Non Metallic Part		
(d)	Minimum thickness		
11.2.	Water Swellable tape		
(f)	Material		
(g)	Nominal Thickness		
(h)	No. of water Swellable tape/s		
(i)	Location of water swellable tape/s		
(j)	Semi Conducting Tape		
11.3.	Metallic Screen		
(a)	Material		
(b)	Nominal thickness(minimum)	mm	
12.	Protective outer sheath		
(a)	Material		
(b)	Type and composition	Type	
(c)	Nominal thickness	mm	
(d)	Minimum thickness	mm	

(e)	Colour		
13.	App. Nominal overall diameter of Completed single core cable	mm	
14.	Cable pulling eye		
15.	Pulling eye provided on one running end per drum		
16.	Safe pulling force of the conductor when pulled by pulling eye on each Conductor to be indicated	KN	
17.	Minimum radius of bend round which cable can be laid.		
18.	Standard Length with Tolerance	meter	
19.	Dimensions of the Drum:		
(a)	With respect to Belly Diameter	mm	
(b)	With respect to Overall Diameter of the cable	mm	
20.	Equivalent effective Impedance of the Cable	Ohms/ Km	
21.	Equivalent effective Capacitance of the cable	$\mu\text{F/Km}$	
22.	Short circuit capacity of conductor for one sec.	kA	
23.	Short time overload Capacity		
(a)	For 1 hour	Amps.	
(b)	For 24 Hours	Amps.	
(c)	For 72 Hours	Amps.	
24.	Continuous current rating of cable when laid		
(a)	Direct in ground at 30 °C.	Amps.	
(b)	In Air at 40 °C.	Amps.	
(c)	In Ducts	Amps.	
(d)	In 2-Circuits	Amps.	
(e)	In 3 circuits	Amps.	
25.	Short Circuit Capacities with maximum Conductor temperature of 250 °C (Conductor Temperature of 90 °C at commencement of short circuit.		
(a)	For 0.5 Sec	kA	
(b)	For 1.0 Sec	kA	
(c)	For 2.0 Sec	kA	
(d)	For 3.0 Sec	kA	
26.	Approx. Weight of the Cable	Kq/m	
27.	Embossing details		

66 kV Control & Relay Panel Specification

The scope of this specification covers the technical requirements of design, manufacture, testing at manufacturer's works, packing, forwarding, supply and unloading of Panels, IEDs, relays and all other items & tools required for protection of 66KV power system as mentioned in the specification, at site/stores complete with all accessories including supply, installation, testing and commissioning of efficient and trouble free protection system. The specific requirements are covered in the enclosed technical data sheet.

APPLICABLE STANDARDS

The equipment covered by this specification shall unless otherwise stated, be designed, constructed and tested in accordance with latest revisions of relevant Indian/IEC/other applicable standards shall confirm to the regulations of local statutory authorities.

Standard	Description
IS 9000	Basic Environmental testing procedure for electrical and electronic items
IS 3231: Part 3: Sec 1	Specification for Electrical Relays for Power System Protection - Part 3 : Requirements for Particular Group of Relays - Section 1 : Non-specified Time or Independent Specified Time Measuring Relays
IS 3231: Part 3: Sec 2	Specification for Electrical Relays for Power System Protection - Part 3 : Requirements for Particular Group of Relays - Section 2 : Dependent Specified Time Measuring Relays
IS 3231 : Part 3 : Sec 3	Specification for Electrical Relays for Power System Protection - Part 3 : Requirements for Particular Group of Relays - Section 3 : Biased (Percentage) Differential Relays
IEC 60255	Measuring Relays and Protection Equipment
IS 694-1990	PVC Insulated cables for working voltages upto and including 1100 V
IS 2629 · 1985	Recommended practice for Hot Dip Galvanizing of iron & Steel.
IS 2633-1986	Test for uniformity of Zinc Coating
IEC 60529	Degrees of Protection provided by enclosures (IP Code)
IEC 62052 -11	Electricity metering equipment (a. c.)- General requirements, tests & test conditions
IEC 62053-22	Static meter for active energy (Class 0.2S and 0.5S)
IEC 61850	Communication networks and systems in substations

CLIMATIC CONDITION OF THE INSTALLATION:

Climate conditions of the installation	
Max. Ambient Temperature	50°C
Max. Daily average ambient temp.	40°C
Ref. Temperature For Design	50°C
Min Ambient Temp	0°C
Maximum Humidity	95%
Minimum Humidity	10%
Average No. of thunderstorm days per annum	50
Maximum Annual Rainfall	750 mm
Average No. of rainy days per annum	60
Rainy months	June to October
Altitude above MSL not exceeding	300 Meters
Wind Pressure	126 kg/sq m up to an elevation at 10 m
Atmosphere	Atmosphere is generally laden with mild acid and dust suspended during dry months and subjected to fog in cold Months. the design of the equipment and accessories shall be suitable to withstand seismic forces corresponding to an acceleration of 0.1 G

GENERAL TECHNICAL REQUIREMENTS

Sr. No	Requirement
1	For 66KV LINES:
1.1	Main Protection: It shall be both Line Differential Protection (87L) and Line Distance Protection (21) in same IED. Main Protection shall be provided with a separate dedicated PS Class CT (and PT in case of Distance protection wherever specified). The Lines, which are embedded in CED System, & those Lines interconnecting with other utilities shall be provided with 87L & 21 protection Philosophy should be such that when fiber optic connectivity is healthy between the pair then they should act in line Differential protection mode (87) and in distance (21) protection mode when Fiber optic communication between them is faulty.
1.2	B/U O/C and E/F protection: It shall be provided as backup protection. A 5P20 CT shall be provided for b/u o/c protection IED. As details mentioned at Sr no. 2.
1.3	Detailed technical specifications for main protection for 66KV & 33KV Line shall be as follows:
1.3.1	Numerical Distance Protection Scheme (21):
1.3.1.1	The numerical distance protection IED shall be the latest version meeting the in-service criteria of minimum two years.
1.3.1.2	The reaches of IED for zones 1, 2 & 3 should be able to cover line lengths associated with this contract. Application check shall be provided with the bid for owner's approval.

1.3.1.3	Shall be of the non-switched type with separate measurements for all phase-to-phase and phase-to-ground fault types.
1.3.1.4	Shall have two, independent, continuously variable, time settings each with a range of 0 to 5s for zone-2 and zone-3.
1.3.1.5	The characteristics shall have adjustable characteristic angle setting ranges of 30° to 85°.
1.3.1.6	Tripping characteristics shall be polygonal and/or mho circle with adjustable offset and with independently adjustable reactive and resistive reaches (for polygonal characteristics) separately settable for each zone. Since the lines being protected are short lines, high resistive reach for high resistance faults shall be provided. Same shall be proved in the application check along with the Bid. The type of tripping characteristics shall be user selectable
1.3.1.7	The protection shall operate correctly for close-up three-phase faults and other adverse conditions. It shall operate instantaneously when the circuit-breaker is closed onto a zero-volt 3-phase fault.
1.3.1.8	The protection shall provide three-phase tripping
1.3.1.9	The protection shall have a maximum resetting time of 60 Milli seconds.
1.3.1.10	Zone 3 shall have a reverse offset capability adjustable to 10 to 20% of zone-1 setting, or alternatively, an independent reverse zone 4 shall be provided.
1.3.1.11	The earth fault measurements shall have zero sequence compensation variables from 0.5 to 5 (scalar Z0/Z1)
1.3.1.12	The setting I reach should not be affected by mutual coupling effects
1.3.1.13	It shall have a continuous current rating of 2 times rated current. The IED shall also be capable of carrying a high short time current of 100 times the rated current without damage for a period of 1.0 s. The voltage circuit shall be capable of continuously withstanding 1.2 times the rated voltage and 1.7 times for 3 s.
1.3.1.14	The protection shall include Power Swing Blocking protection. The power swing blocking feature shall: <ul style="list-style-type: none"> a) Be of three pole type b) Block/unblock tripping during power swing conditions, separately for each zone. c) Have a continuously adjustable time delay on pick up of 0 to 5s. d) Be in service during the dead time of a single pole reclosing cycle. e) Have user configurable unblocking criteria in the case of fault detection during a power swing.
1.3.1.15	Shall include Fuse Failure Protection, which shall: <ul style="list-style-type: none"> a) Monitor all the three fuses of the CVT and associated cabling against open circuit b) Inhibit trip circuits on operation and initiate annunciation c) Have an operating time of less than 7.0 ms d) Remain inoperative for system earth faults
1.3.1.16	It shall have user configurable scheme logic such as permissive under-reach (PUTT), Permissive over-reach (POTT), Direct Transfer Trip, Blocking scheme etc. using communication channels. The scheme shall be complete so that the user can select any option on site without any modification. Non-carrier aided schemes such as Zone -1 extension, Loss of Load etc. shall be provided to ensure high-speed clearance during channel failure.
1.3.1.17	The protection shall be able to distinguish between short circuit and heavy load conditions.
1.3.1.18	It shall have supplementary over current and earth fault protection functions
1.3.1.19	The dead line charging feature shall have adjustable minimum and maximum voltages.

1.3.1.20	The protection shall have a multiple settings group feature. It shall be possible to switch between the various available setting groups when the IED is in service without compromising the protection during the switch-over.
1.3.1.21	<p>The protection shall include the following additional functions:</p> <ul style="list-style-type: none"> a) Weak-in feed tripping b) Echo function c) Current reversal guard d) Switch onto fault logic
1.3.1.22	<p>Auto-Reclose and Synchronizing Check : Auto-reclose (AR) and Synchronizing Check (SC) functionality shall be provided in-built in the Distance/ Line differential Protection IED. Interfacing between BCUs and Protection IED for achieving the AR function logic shall be achieved at Bay Level using communication LAN as well as standby hard-wired logic between BCU and Bay Protection Units. The intent of providing the hard- wired logic as a back up to the software logic is to ensure that in the event of failure of Substation LAN, the bay level functionality is not hampered. The AR function shall meet the following criteria:</p> <ul style="list-style-type: none"> a) Be of single shot type b) Have three phase reclosing facilities. It shall have a user-selectable option of reclosing or non-auto recloser mode. c) Incorporate a normal/delayed auto recloser option with a time range of 1 to 60 s. d) Have a continuously variable three-phase dead time of 0.1to5s. e) Have a continuously variable reclaim time of 5 to 300 s. f) Incorporate the necessary auxiliary IEDs and timers to provide a comprehensive reclosing and synchronizing scheme. g) Have facilities for selecting check synchronizing or dead line charging features. The user shall have an option to change the required feature. h) The built-in Synchronization Check feature shall determine the difference between the amplitudes, phase angles and frequencies of two voltage vectors. Checks shall be provided to detect a dead line or bus bar. The voltage difference, phase angle difference and slip frequency settings shall be adjustable.
1.3.2	<p>Numerical Line Differential Protection Scheme: (87 L):</p> <ul style="list-style-type: none"> a) Shall be phase segregated current line differential protection scheme b) Communication between the differential IEDs at the feeder ends shall be through the Owners OPGW or Optical cable network. c) Shall have high sensitivity for differential current below the minimum line loading of 20%. d) Shall be suitable for different CT ratios of the CTs provided at the terminals of the Line. Shall be suitable for transmission line with two line ends only. However, where ever TEED lines with 3 or 4 terminal ends are specified by Owner, suitable line differential protection shall be provided by the bidder. e) Shall have high set differential stage for fast tripping on heavy internal faults. f) Shall be non-operative for transient cable/line charging current without affecting the sensitivity of the IED. g) In-built b/u o/c protection shall be provided in case of Communication failure between the Line ends. h) Shall have high stability for high through fault currents. i) shall have measurement of delay time to remote line terminals for dynamic compensation of delay in differential measurement.

	j) The IED should have broken conductor application along with fault locator facility.
2.0	Detailed Technical Specifications for Back- Up Protection of 66KV Lines and Bus Sections:
	<p>A numerical three phase O/C and E/F & directional IED shall be used as a backup of main protection of line.</p> <p>Backup protection IEDs supplied shall have the following features:</p> <ul style="list-style-type: none"> a) Both Non Directional (50/51 & 50N/51N) & Directional O/C and E/F (each element shall b) have one IDMTL and three high set definite time relay) (67 R, Y, B and 67N) features c) shall be available. d) Negative sequence current (unbalance current) (46) e) Overload relay (49). f) VT supervision relay and Trip circuit supervision relay. g) Integrated CB failure protection. h) Configurable LEDs shall also be provided to indicate the IED operation and the alarm / status change of a bay equipment e.g. Phase Fault operated/ Earth Fault operated /CB open / CB close / spring charge etc. i) Auto reclose (79) Protection element feature to be incorporated in the Back up IED j) IEDs should have Circuit Breaker monitoring Σ KA square online monitoring of breaker k) The IEDs shall have synch-check facility. l) Electrically reset type high speed, heavy duty relay (master trip 86) shall be used for tripping on operation of main and BCPD IEDs. The two trip coils wherever provided shall be provided with independent potential free contacts from different fused DC supplies. The trip relay shall be supervised. Master trip relay should be such that on resetting its flag should be automatically reset. m) Breaker counter logic shall be there on fault opening. n) The IED must have broken conductor and fault locator facility.
3.0.	Detailed Requirements (Software & Hardware) of Numerical Protection IED:
	<ol style="list-style-type: none"> 1. All numerical IEDs, auxiliary IEDs and devices comprising the Bay Protection Units shall be of types proven for the application, satisfying the requirements specified in technical specifications and shall be subject to the RECPDCL/CED's approval. Numerical IEDs shall have appropriate setting ranges, accuracy, resetting ratio, transient overreach and other characteristics to provide the required sensitivity to the satisfaction of the Owner. 2. All IEDs must have conformal coating for protection against harsh environments. 3. The Protection IED offered shall be suitable for both 1A and 5A analogue inputs, also the offered IEDs should be based on IEC : 61850 standard edition 2 series preferably. If the station already had 61850 edition 1 kind of relay then bidder has to provide 61850 edition 1 kind of IEDs only. Bidder shall provide necessary certificates to ascertain the communication capability (Interoperability) with other make IED in 61850 standard for interlocks /logic through GOOSE messaging. The relays provided for any project must have self-diagnostic feature to enable

us to know about component failure. If not possible then necessary software to detect the same must be provided.

4. Equipment shall be designed for a working life of at least fifteen years in the specified environment and application. Components, component ratings and all other factors determining equipment life shall take this into account. Normal routine and breakdown maintenance shall be assumed and it is accepted that certain consumable components and modules may need periodic replacement adjustment. However, the Bidder shall state in his bid, the expected frequency of such replacement or adjustment and life expectancy. Bidder need to furnish the expected life of IEDs While submitting the performance reports of the concerned IEDs. Bidders need to provide life cycle support and supplies to ensure Necessary support in terms of services and spares for next 15 years Regarding discontinuation OEM must need to follow clauses 3.15 & 6 of IEC 61850-4. The example cases should be taken as reference.
5. Numerical IEDs shall be suitable for efficient and reliable operation of the protection scheme. The necessary auxiliary relays, trip relays, etc. required for complete scheme, interlocking, alarm, logging, etc. shall be provided. No control IED, which shall trip the circuit breaker when the IED is de-energized, shall be employed in the circuits. Any connectors, terminals, switches Required to extend or isolate the wiring to IEDs to be provided by bidder.
6. IEDs shall be provided with self-reset contacts except for the trip lockout, which shall have contacts with an electrical reset feature.
7. Suitable measures shall be provided to ensure that transients present in CT & VT connections due to extraneous sources in the HV system do not cause damage to the numerical and other IEDs. CT saturation shall not cause mal-operation of numerical IEDs.
8. Hardware selection should be done in such a manner that all power supply requirements could be met with the available grid voltages (220 V DC for 66 KV station).DC batteries in protective IEDs necessary for IED operation shall not be acceptable.
9. Equipment shall be protected against voltage spikes in the auxiliary DC supply. Auxiliary supply supervision and necessary alarm generation to SCADA be possible.
10. The numerical IEDs shall have continuous self-monitoring & cyclical test facilities. The internal clock of the system shall be synchronized through the GPS Time Synchronizing System to be provided by the owner at later date.
11. Each numerical IED shall have a serial interface on the front for local communication to a Personal Computer and Printer. Facilities shall be provided to access each discrete protection function including modification in IED settings and monitoring of the IED from a HMI. A print out of all settings, scheme logic, event records etc. shall be accessible through the HMI. The display of various measured parameters during normal as well as fault conditions on a segregated phase basis shall be provided. LEDs and a backlit LCD screen shall be provided

for visual indication and display of messages related to major trips / alarms. Necessary multilevel password protection shall be provided.

12. The sampling rate of analog inputs: the processing speed and processing cycle of digital values shall be selected so as to achieve the operating times of various protection functions specified. In case the Bidder does not have all the protection functions specified as a part of the standard numerical IED, separate discrete numerical IEDs can be provided for such protection. The reasons for providing such discrete IEDs shall be clearly outlined in the bid.
13. The numerical IEDs shall be provided with built-in disturbance recording functionality. The data from DR function shall be available in IEEE/COMTRADE format and shall be compatible with the dynamic IED test system being supplied under this contract.
14. The manufacturer of the numerical protection system offered shall carry out the complete engineering, testing and commissioning on site of the offered protection equipment including the associated IEDs and protection panels. The testing and commissioning protocols for the numerical protection systems offered shall be approved by the RECPDCL/CED before commissioning on site.
15. The numerical IEDs offered shall have self-diagnostic features to reduce the down time of the IED and to provide useful diagnostic information upon detection of an internal fault so as to speed up the maintenance. The necessary support documentation explaining in detail the self-diagnostic features of the numerical IEDs shall be furnished for the Owner's use. Self-diagnostic feature to meet clause 7.1.2.4 of IEC 61850-4.
16. There should also be separate logic in IED to cater breaker operation counter on faults only.
17. RSTP to be made available by default in relay with dual RJ45 or dual FO.
18. Fault currents sensed by relay to be mapped to SCADA (in future). Proper programming to be done for the same.
19. All the protection signals along with corresponding IEDs to be latched at SCADA, so suitable logic to be built in the relay.
20. On resetting the BCPUs from SCADA or Locally from relay, all the protection signals must be get reset both at SCADA and at relay with relay outputs in one go. If separate logics required to meet the same, then same can be formulized.
21. 66KV BCPUs must have same order code for better IEC 61850 project management and one to one replacement.
22. The bidder shall provide all software licenses for all the software being used in Protection.
23. IED offered for engineering, IED setting uploading and FDR down loading etc. The license shall be provided on a site license basis and shall be valid for the plant/ Equipment life cycle. In the case of anti-virus software, the license shall

	<p>include regular updates. The Bidder Shall guarantee that all software are defect free and meet the System specifications, and undertake to fix any defects Which may arise during the life of the system at no cost to the Owner.</p> <p>24. In case offered IEDs require any additional software for its integration to RTU then the bidder shall provide the same.</p> <p>25. All software versions in components shall be the latest official releases as on the date of shipment from works and shall include all software updates etc. released till that date. A certificate to this effect shall be furnished by the bidder at the time of pre-dispatch inspection for each software package. All new software revisions and/or patch updates that are released before the end of the warranty period which addresses system defects shall be implemented on site and the system re-tested to validate system integrity by the bidder at no cost to the owner (This excludes new revisions which provides additional Functionality). The bidder shall periodically inform the designated officer of the RECPDCL/Owner about software updates / new releases that would be taking place after the system is commissioned. Bidder shall train owner engineers to guide the upgrading procedures of project files with respect to a test releases.</p> <p>26. Two nos. of communication cords for each type of relay uploading and down loading data from front and rear port of Protection JED shall be supplied by the bidder. One no. of Serial to USB Converter to be supplied by bidder.</p> <p>27. Station Project Files shall be ready before raising inspection call & submission of the internal test report by the vendor.</p> <p>28. Vendor shall submit 2 copies of as built drawings & station project files in sot format.</p>
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GENERAL CONSTRUCTION FOR CRP	
S. No	Description
4	<p>GENERAL CONSTRUCTION FOR CRP:</p> <p>Switchgear panel construction is governed by individual specification in minimum. Additionally following protection related construction features to be provided/ ensured for 66KV control and relay panel.</p>
4.1	<p>Simplex Panel:</p> <p>Simplex panel shall consist of a vertical front panel with equipment mounted thereon and having wiring access from rear for control panels & either front or rear for relay panels. In case of panel having width equal to or more than 800mm, double leaf-doors shall be provided. Doors shall have handles with either built-in locking facility or will be provided with pad-lock.</p>
4.2	<p>Constructional Features:</p> <p>Control and Relay Board shall be of panels of simplex type design as indicated in bill of quantity. It is the responsibility of the BA to ensure that the equipment specified and such</p>

	<p>unspecified complementary equipment required for completeness of the protective / control schemes is properly accommodated in the panels without congestion and if necessary, provide panels with larger dimensions. No price increase at a later date on this account shall be allowed. However, the width of panels that are being offered to be placed in existing switchyard control rooms, should be in conformity with the space availability in the Control room. Panels shall be completely metal enclosed and shall be dust, moisture and vermin proof. The enclosure shall provide a degree of protection not less than IP-54 in accordance with IS: 2147. Panels shall be free standing, floor mounting type and shall comprise structural frames completely enclosed with specially selected smooth finished, cold rolled sheet steel of thickness not less than 3 mm for weight bearing members of the panels such as base frame, front sheet and door frames, and 2.0mm for sides, door, top and bottom portions. There shall be sufficient reinforcement to provide level transportation and installation. All doors, removable covers and panels shall be gasketed all around with synthetic rubber gaskets Neoprene/EPDM generally conforming to provision of IS 11149. However, XLPE gaskets can also be used for fixing protective glass doors. Ventilating louvers, if provided shall have screens and filters. The screens shall be made of either brass or GI wire mesh.</p> <p>Design, materials selection and workmanship shall be such as to result in neat appearance, inside and outside with no welds, rivets or bolt head apparent from outside, with all exterior surfaces true and smooth.</p> <p>Panels shall have base frame with smooth bearing surface, which shall be fixed on the embedded foundation channels/insert plates. Anti-vibration strips made of shock absorbing materials that shall be supplied by the contractor, shall be placed between panel & base frame. Cable entries to the panels shall be from the bottom. Cable gland plate fitted on the bottom of the panel shall be connected to earthing of the panel/station through a flexible braided copper conductor rigidly.</p> <p>Relay panels of modern modular construction would also be acceptable</p>
4.3	<p>Mounting:</p> <p>All equipment on and in panels shall be mounted and completely wired to the terminal blocks ready for external connections. The equipment on front of panel shall be mounted flush. Equipment shall be mounted such that removal and replacement can be accomplished individually without interruption of service to adjacent devices and are readily accessible without use of special tools. Terminal marking on the equipment shall be clearly visible.</p> <p>The BA/Vendor shall carry out cut out, mounting and wiring of the free issue items supplied by others (if any) which are to be mounted in his panel in accordance with the corresponding equipment manufacturers drawings. Cutouts if any, provided for future mounting of equipment shall be properly blanked off with blanking plate.</p> <p>The Centre lines of switches, push buttons and indicating lamps shall be not less than 750mm from the bottom of the panel. The Centre lines of relays, meters and recorders shall be not less than 450mm from the bottom of the panel.</p> <p>The Centre lines of switches, push buttons and indicating lamps shall be matched to give a neat and uniform appearance. Likewise, the top lines of all meters, relays and recorders etc. shall be matched. No equipment shall be mounted on the doors. At existing station, panels shall be matched with other panels in the control room in respect of dimensions,</p>

	colour, appearance and arrangement of equipment (Centre lines of switches, push buttons and other equipment) on the front of the panel.
4.4	<p>Panel Internal Wiring:</p> <p>Panels shall be supplied complete with interconnecting wiring provided between all electrical devices mounted and wired in the panels and between the devices and terminal blocks for the devices to be connected to equipment outside the panels. When panels are arranged to be located adjacent to each other, all inter panel wiring and connections between the panels shall be furnished and the wiring shall be carried out internally, this is in the BA's scope.</p> <p>All wiring shall be carried out with 1100 V grade, single core, stranded copper conductor wire's with PVC insulation. The minimum size of the multi-stranded copper conductor used for internal wiring shall be as follows:</p> <p>Internal wiring to be connected to external equipment shall terminate on terminal blocks.</p> <p>The terminal blocks for CTs VTs shall be provided with test links and isolating facilities. The CT terminal blocks shall be provided with short-circuiting and earthing facilities.</p> <p>Shall have 20% terminals as spare, terminals in each panel.</p> <p>All equipment mounted on front of the panels shall have individual nameplates with equipment designation engraved. Each panel shall also have circuit/feeder designation name plate. All wiring shall be with 660/1100 V grade, single core, PVC insulated stranded copper conductor.</p> <p>Wires shall be vermin proof. Minimum size of conductor shall be 2.5 sq. mm in general, but for CT & VI circuits it shall be 4 sq.mm.</p> <p>Contractor shall be solely responsible for completeness and correctness of all the wiring, and for proper functioning of the connected equipment.</p> <p>Specification for Auxiliary relays/ MCB's:</p> <ol style="list-style-type: none"> 1. Fuse Failure relay and trip Circuit Supervision relay shall be suitably selected, considering, burden and auxiliary voltage. External circuitry like compensating resistances will not be accepted. 2. Auxiliary contact multiplier relays should be of reputed make, and Selected on the basis of continuous current carrying capacity and Rated voltage. The fluctuation in voltage level must be accounted For(+/-) 10% continuously. 3. DC MCB's should not be substituted by AC MCB's for DC Distribution, irrespective of manufacturer's individual multi usage Recommendations. 4. DC Fail Supervision relay (80) shall be provided on all control and IED panels. <p>Spare I/Os wiring shall be brought upto terminal block for future use.</p> <p>All internal wiring shall be securely supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks. Wiring gutters & troughs shall be used for this purpose.</p>

	<p>Auxiliary bus wiring for AC and DC supplies, voltage transformer circuits, annunciation circuits and other common services shall be provided near the top of the panels running throughout the entire length of the panels.</p> <p>Wire termination shall be made with solder less crimping type and tinned copper lugs, which firmly grip the conductor. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected from terminal blocks. All wires directly connected to trip circuit breaker or device shall be distinguished by the addition of red colored unlettered ferrule.</p> <p>Longitudinal troughs extending throughout the run length of the panel shall be preferred for inter panel wiring. Inter-connections to adjacent panel shall be brought out to a separate set of terminal blocks located rear the slots of holes meant for taking the inter-connecting wires.</p> <p>BA/Vendor shall be solely responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipments.</p>
4.5	<p>Terminal Blocks:</p> <p>All internal wiring to be connected to external equipment shall terminate on terminal blocks. Terminal blocks shall be 1100 V grade and have 10 Amps. Continuous rating, moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Markings on the terminal blocks shall correspond to wire number and terminal numbers on the wiring diagrams. All terminal blocks shall have shrouding with transparent unbreakable material.</p> <p>Disconnecting type terminal blocks for AC/DC, current transformer and voltage transformer secondary leads shall be provided. Also current transformer secondary leads shall be provided with short circuiting and earthing facilities.</p> <p>At least 20% spare terminals shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks.</p> <p>Unless otherwise specified, terminal blocks shall be suitable for connecting the following conductors of external cable on each side.</p> <ul style="list-style-type: none"> • All CT & PT circuits: minimum of two of 4 sq. mm copper. • AC/DC Power Supply Circuits: One of 6 sq. mm Copper. • All other circuits: minimum of one of 2.5 sq. mm Copper. <p>There shall be a minimum clearance of 250 mm between the first row of terminal blocks and the associated cable gland plate or panel side wall. Also the clearance between two rows of terminal blocks edges shall be minimum of 150mm.</p> <p>Arrangement of the terminal block assemblies and the wiring channel within the enclosure shall be such that a row of terminal blocks is run in parallel and close proximity along each side of the wiring-duct to provide for convenient attachment of internal panel wiring. The side of the terminal block opposite the wiring duct shall be reserved for the Owner's external cable connections. All adjacent terminal blocks shall also share this field-wiring corridor. All wiring shall be provided with adequate support inside the panels to hold them firmly and to enable free and flexible termination without causing strain on terminals.</p>

	<p>The number and sizes of the CED's multi core incoming external cables will be furnished to the BA after placement of the order. All necessary cable terminating accessories such as gland plates, supporting clamps & brackets, wiring troughs and gutters etc. (except glands & lugs) for external cables shall be included the scope of supply.</p>
4.6	<p>Painting: All sheet steel work shall be phosphated in accordance with the IS: 6005 "Code of practice for phosphating iron and steel". It should follow the seven-tank process. Oil, grease, dirt and swarf 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 a slightly alkaline hot water and drying. 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, stoved type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be stoved. Thereafter an established painting procedure like electrostatic painting followed for powder coating the panel. The color shade shall be Siemens grey RAL 7032.</p>
4.7	<p>Miscellaneous Accessories:</p> <p>Plug Point: 24011, Single phase 50Hz, AC socket with switch suitable to accept 5 Amps and 15 Amps pin round standard Iridian plug, shall be provided in the interior of each cubicle with ON-OFF switch.</p> <p>Interior Lighting: Each panel shall be provided with an LED lighting fixture rated for 240 Volts, single phase, 50 Hz supply for the interior illumination of the panel controlled by the respective panel door switch.</p> <p>Switches and Fuses: Each panel shall be provided with necessary arrangements for receiving, distributing and isolating of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breakers (MCB). Selection of the main and sub-circuit MCB rating shall be such as to ensure selective clearance of sub-circuit faults. MCBs shall confirm to IS: 13947. Each MCB shall be provided with one potential free contact and the same shall be wired for annunciation purpose. However, voltage transformer circuits for relaying and metering shall be protected by fuses. All fuses shall be HRC cartridge type conforming to IS: 13703 mounted on plug-in type fuse bases. Fuse carrier base as well as MCBs shall have imprints of the fuse 'rating' and 'voltage'.</p> <p>Space Heater: Each panel shall be provided with a space heater rated for 240V, single phase, 50 Hz Ac supply for the internal heating of the panel to prevent condensation of moisture. The fittings shall be complete with switch unit.</p>
4.8	<p>Earthing: All panels shall be equipped with an earth bus securely fixed. Location of earth bus shall ensure no radiation interference for earth systems under various switching conditions of isolators and breakers. The material and the sizes of the bus bar shall be at least 25 X 6 sq. mm perforated copper with threaded holes at a gap of 50mm with a provision of bolts and nuts for connection with cable armors and mounted equipment etc. for effective earthing. When several panels are Mounted adjoining each other, the earth bus shall be</p>

	<p>made continuous and necessary connectors and clamps for this purpose shall be included in the Scope of supply of the Contractor. Provision shall be made for extending the earth bus bars to future adjoining panels on either side.</p> <p>Provision shall be made on each bus bar of the end panels for connecting Substation earthing grid. Necessary terminal clamps and connectors for this purpose shall be included in the scope of supply of BA. All metallic cases of relays, instruments and other panel mounted equipment including gland plate, shall be connected to the earth bus by copper wires of size not less than 2.5 sq. mm. The color code of earthing wires shall be green.</p> <p>Looping of earth connections, which would result in loss of earth connection to other devices when the loop is broken, shall not be permitted. However, looping of earth connections between equipment to provide alternative paths to earth bus shall be provided.</p> <p>VT and CT secondary neutral or common lead shall be earthed at one place only at the terminal blocks where they enter the panel. Such earthing shall be made through links so that earthing may be removed from one group without disturbing continuity of earthing system for other groups.</p>										
4.9	<p>Switches:</p> <p>Control and instrument switches shall be rotary operated type with escutcheon plates clearly marked to show operating position and circuit designation plates and suitable for flush mounting with only switch front plate and operating handle projecting out.</p> <p>The selection of operating handles for the different types of switches shall be as follows:</p> <ul style="list-style-type: none"> • Breaker, Isolator: Pistol grip, black control switches • Selector switches: Oval or knob, black • Instrument switches: Round, knurled, black <p>The control switch of breaker and isolator shall be of spring return to neutral type. The switch shall have spring return from close and trip positions to "after close" and "after trip" positions respectively. Instrument selection switches shall be of maintained contact (stay put) type. Ammeter selection switches shall have make-before-break type contacts so as to prevent open circuiting of CT secondary when changing the position of the switch. Voltmeter transfer switches for AC shall be suitable for reading all line- to-line and line-to-neutral voltages for non-effectively earthed systems and for reading all line to line voltages for effectively earthed systems. Lockable type of switches which can be locked in particular positions shall be provided when specified.</p> <p>The key locks shall be fitted on the operating handles.</p> <p>The contacts of all switches shall preferably open and close with snap action to minimize arcing. Contacts of switches shall be spring assisted and contact faces shall be with rivets of pure silver or silver alloy.</p> <p>Springs shall not be used as current carrying parts.</p> <p>The contact combination and their operation shall be such as to give completeness to the interlock and function of the scheme.</p> <p>The contact rating of the switches shall be as follows:</p> <table> <tr> <th>Description</th><th>220VDC</th><th>50VDC</th><th>240V AC</th></tr> <tr> <td>Contact rating in Amps</td><td></td><td></td><td></td></tr> </table>			Description	220VDC	50VDC	240V AC	Contact rating in Amps			
Description	220VDC	50VDC	240V AC								
Contact rating in Amps											

	Make and carry	10 Amp	10 AMP	10 AMP
	Continuously Make and carry for 0.5 sec.	30 Amp	30 Amp	30 Amp
	Break for: Resistive load	3 Amp	20 Amp	7 Amp
	Inductive load with L/R = 40m sec.	0.2		
4.10	<p>Indicating Lamps: Indicating lamps shall be of cluster LED type suitable for panel mounting with rear terminal connections. Lamps shall be provided with series connected resistors preferably built in the lamp assembly. Lamps shall have translucent lamp covers to diffuse lights colored red, green, amber, dear white or blue as specified The lamp cover shall be preferably of screwed type, unbreakable and moulded from heat resisting material.</p> <p>The lamps shall be provided with suitable resistors. Lamps and lenses shall be interchangeable and easily replaceable from the front of the panel. Tools, if required for replacing the bulbs and lenses shall also be included in the scope of the supply.</p> <p>The indicating lamps with resistors shall withstand 120% of rated voltage on a continuous basis</p>			
4.11	<p>Dust Proof Environment: All the panels in the control room and switchgear room have to be in a dust proof environment. Civil works have to be taken care in the same directions.</p>			
4.12	<p>NAME PLATE & MARKING:</p> <p>All equipment mounted on front and rear side as well as equipment mounted inside the panels shall be provided with individual name plates with equipment designation engraved. Also on the top of each panel on front as well as rear side, large and bold nameplates shall be provided for circuit/feeder designation.</p> <p>All front mounted equipment shall also be provided at the rear with individual nameplates engraved with tag numbers corresponding to the one shown in the panel internal wiring to facilitate easy tracing of the wiring.</p> <p>Each IED and meter shall be prominently marked. All relays and other devices shall be clearly marked with manufacturer's name, manufacturer's type, serial number and electrical rating data. Name Plates shall be made of anodized aluminum. Nameplates shall be black with white engraving lettering.</p> <p>Each switch shall bear clear inscription identifying its function e.g. 'BREAKER " 52 / "SYNCHRONISING" etc. Similar inscription shall also be provided on each device whose function is no otherwise identified. if any switch device does not bear this inscription, separate name plate giving its function shall be provided for it. Switch shall also have clear inscription for each position Indication e.g. "Trip- Neutral-Close", "ON-OFF", "R-Y-B-OFF" etc.</p>			

	All the panels shall be provided with nameplate mounted inside the panel bearing PO No & Date, Name of the Substation & feeder and reference drawing number.
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TESTS

Type Test Requirements:

Test reports for following type tests shall be submitted for the Protection IED along with the Bid:

Sr. No	Description	Standard
Insulation Tests:		
1.	Dielectric Withstand Tests	(a) IEC 60255-5 (b) 2kV rms for 1 minute between all case terminals connected together and the case earth. (c) 2k V rms for 1 minute between all terminals of independent circuits with terminals on each independent circuit connected together (d) ANSI/IEEE C37.90-1989 (e) 1 kV rms for 1 minute across open contacts of changeover output IEDs (f) 1.5 kV rms for 1 minute across open contacts of normally open output IEDs.
2.	High Voltage Impulse Test, Class-III	IEC 60255-5 5 kV peak; 1.2/50 μ sec; 0.5 J; 3 positive and 3 negative shots at intervals of 5 sec
Electrical Environment Tests		
1.	DC Supply Interruption	IEC 60255-11 The unit will withstand a 20ms interruption in the auxiliary supply, in its quiescent state without de-energizing.
2.	AC Ripple on DC Supply	IEC 6025 5-11 The unit will withstand a 12% ac ripple on the de supply.
3.	AC voltage dips and short Interruptions	IEC 61000-4-11 20ms interruptions/dips
4.	High Frequency Disturbance	IEC 60255-22-1, Class III At 1MHz, for 2s with 200 ohms , Source impedance: 2.5 kV peak; 1 MHz; T = 15 μ Sec; 400 shots/sec; duration 2 sec between independent circuits and independent circuit and case earth. 1.0 kV peak across terminals of the same circuit.
5.	Fast Transient Disturbance	IEC 60255-22-4, Class IV 4kV, 2.5kHz applied directly to auxiliary supply 4kV, 2.5kHz applied to all inputs
6.	Surge Withstand Capability	IEEE/ ANSI C37.90.1 (1989) 4kV fast transient and 2.5kV oscillatory applied directly across each output contact, optically isolated input and power supply circuit.
7.	Radiated Immunity	C37.90.2: 1995

		25MHz to 1000 MHz, zero and 100% square wave modulated. Field strength of 35V/m.
8.	Electrostatic Discharge	IEC 60255-22-2 Class 4 15k V discharge in air to user interface, display and exposed metalwork. IEC 60255-22-2 Class 3 8kV discharge in air to all communication ports. 6kV point contact discharge to any part of the front of the product.
9.	Surge Immunity	IEC 61000-4-5: 1995 Level4 4kV peak, 1.2/50ms between all groups and case earth. 2kV peak, 1.2/50ms between terminals of each group.
10.	Capacitor Discharge	No change of state or any operation shall occur when a capacitor of capacitance shown below, charged to 1.5 x Vn volts, is connected between any combination of terminals and any combination of terminals and ground. Master trip circuits – 10 µF Other protection & control circuits - 2 µF Carrier/channel interface – 0.2 µF
EMC Tests:		
1.	Radio-Frequency Electromagnetic Field Non- Modulated	IEC 60255-22-2, Class III 10 V/m; 27 MHz to 500 MHz
2.	Radio- Frequency Electromagnetic Field Amplitude Modulated	ENV 50140, Class III 10 V/m; 80 MHz to 1000 MHz; 80% AM;1kHz
3.	Radio-Frequency Electromagnetic Field Pulse Modulated	ENV 50140/ENV 50204 10 V/m; 900 MHz; repetition frequency 200Hz; duty cycle 50%
4.	Disturbances Induced by Radio Frequency fields, Amplitude Modulated	ENV 50141, Class III 30 Aim continuous; 300 Aim for 3 sec; 50 Hz
5.	Power Frequency Magnetic Field	EN 61 000-4-8, Class IV 30 Aim continuous; 300 Aim for 3 sec; 50 Hz
6.	Interference Voltage Aux. Voltage	EN 50081 150kHz to 30 MHz
7.	Interference Field Strength	EN 50081 30 MHz to 1000 MHz
Atmospheric Environment Tests:		
1.	Temperature	IEC 60255-6 Operating -25 °C to +55 °C Storage and transit -25 °C to + 70°C IEC 60068-2-1 for Cold IEC 60068-2-2 for Dry heat
2.	Humidity	IEC 60068-2-3 56 days at 93% RH and +40 °C
Mechanical Stress Tests:		
1.	Vibration (during Operation and Transportation)	IEC 255-21-1; IEC 68-2-6 Response Class 2 Endurance Class 2

2.	Shock (during Operation and Transportation)	IEC 255-21-2, Class 1, IEC 68-2-27 Shock response Class 2 Shock withstand Class 1 Bump Class 1
3.	Seismic Vibration (during Operation)	IEC 60255-21-3 Class 2
4.	Continuous Shock (during Transportation)	IEC 255-21-2, Class 1, IEC 68-2-27

Services to be included during guarantee period (SLA)

1. Guarantee shall be for 48 months from the date of commissioning or 60 months from the date of supply, whichever is later.
2. Vendor shall conform to the following guideline to mitigate failure. To provide immediate support in case of failure of IED. The vendor shall always maintain 2 no.s of IEDs as spare at their India office/ Support Centre .
 - a. Vendor shall report to site within 48 hours of receipt of reporting of the failure occurrence.
 - b. Vendor shall provide replacement of the faulty IEDs within 7 days after confirmation of the fact that the IED can't be repaired at site.
 - c. Vendor shall provide detailed root cause analysis report of the faulty IEDs within 30 days from the date of the IED receipt.
 - d. Any spare IED replacement, testing and its commissioning to be done by vendor only without any cost implications. Any equipment, any software or any hardware to test the IEDs to be borne by vendor only.