

 BHARAT HEAVY ELECTRICALS LIMITED TRANSMISSION PROJECTS ENGINEERING MANAGEMENT																																				
DOCUMENT No.	TB-434-507-014	Rev. No.	00		Prepared	Checked	Approved																													
TYPE OF DOC.	TECHNICAL SPECIFICATION			NAME	RA	AR	VK																													
TITLE	33kV XLPE Power Cable			SIGN	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>																													
				DATE	12.01.26	12.01.26	12.01.26																													
				GROUP	TBEM																															
CUSTOMER	POWERGRID Corporation of India Ltd (PGCIL)																																			
PROJECTS	(i) 765/400/ 220kV Mandsaur S/s & extension of 765kV Indore S/s (SS-43T) ii) 765/400/ 220kV Kurawar (new) S/s & extension of 765kV Mandsaur s/s, 400kV shujalpur S/s & 400kV ashtha s/s (SS-47T) iii) 765kV AIS Pkg for Establishment of 765/400/220kV Barmer-I, Sirohi Extn. and Fatehgarh-3 Extn. Substation (SS-46T)																																			
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Technical Specification - 33kV XLPE Power Cable

Doc No. – TB-434-507-014

SECTION - 1

1.1 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of 33 kV XLPE Power Cables as listed below.

This section covers the scope and quantities of 33 kV XLPE Power Cables. The Specific Technical Requirements for the above item as specified by the customer (PGCIL) are given in Section-2. The offered equipment shall also comply with the General Technical Requirements for the project as detailed under section-3 of this specification.

In case of any discrepancies between the requirements mentioned under Section-1/Section-2 and those specified in the Section-3, the specifications given under Section-1/Section-2 shall prevail and shall be treated as binding requirements.

The material is required for the following project:

Name of Customer : POWERGRID Corporation of India Ltd (PGCIL)

Projects: i) 765/400/ 220kV Mandsaur S/s & extension of 765kV Indore S/s (SS-43T)

ii) 765/400/ 220kV Kurawar (new) S/s & extension of 765kV Mandsaur s/s, 400kV shujalpur S/s & 400kV ashtha s/s (SS-47T)

iii) 765kV AIS Pkg for Establishment of 765/400/220kV Barmer-I, Sirohi Extn.and Fatehgarh-3 Extn. Substation (SS-46T)

The scope of supplies shall be as per commercial terms and conditions enclosed separately with the enquiry.

1.2 SPECIFIC TECHNICAL REQUIREMENTS

S. NO	PARTICULAR	UNIT	DATA
1.	Rated Voltage	kV	33
2.	Type of Insulation		XLPE
3.	Single core / Multi core		Single
4.	Armored /Unarmored		Armored
5.	Material of Conductor		Aluminum
6.	System		Effectively Earthed
7	Highest System Voltage	kV	36
8.	Conductor Size	mm ²	185
9.	Material		Compacted Aluminum
10.	Shape of conductor		Circular
11.	One minute power frequency dry and wet withstand voltage (rms)	kVrms	70
12	Full wave impulse withstand	kVp	170

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	voltage (1.2/50 microsec)		
13.	Continuous Withstand Temperature	°C	90
14.	Short Circuit Withstand Temp.	°C	250
15.	Oxygen Index		Min 29 (as per ASTMD 2863)

1.3 BILL OF QUANTITIES

The following items are required:

Mandsaur (SS-43T)

S no.	Description	Unit	Qty
1	33kV, 1C x 185sqmm, Aluminium, XLPE Power Cable	Meter	1800
2	33kv Outdoor Termination Kit	Nos.	6
3	Services of Installation of Cable Termination	Nos.	6

Kurawar (SS-47T)

S no.	Description	Unit	Qty
1	33kV, 1C x 185sqmm, Aluminium, XLPE Power Cable	Meter	600
2	33kv Outdoor Termination Kit	Nos.	6
3	Services of Installation of Cable Termination	Nos.	6

Barmer (SS-46T)

S no.	Description	Unit	Qty
1	33kV, 1C x 185sqmm, Aluminium, XLPE Power Cable	Meter	2000
2	33kv Outdoor Termination Kit	Nos.	6
3	Services of Installation of Cable Termination	Nos.	6

Note:

- (1.) The quantity to be used for acceptance test and type test is not included in the above quantity.
- (2.) Quantity can vary +/- 30 % based on detailed engineering.
- (3.) Exact drum length shall be informed during contract stage.

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1.4 TYPE TESTING

Bidder shall submit valid type test reports (as per relevant IEC/IS standard with latest update). the type test reports submitted shall be of the tests conducted within 10 years from the date of NoA i.e. 01-01-2025. The test should have been conducted on identical or similar equipment/components to those offered In case the test reports are of the test conducted earlier than 10 years from NoA i.e. 01-01-2025, the Bidder shall repeat these test(s) at no extra cost & and no delivery implication to BHEL/Employer.

1.5 QUALITY PLAN

Bidder to follow valid PGCIL approved Quality Plan as per PGCIL procedure. In case the bidder don't have PGCIL approved QP, it will be the bidder's responsibility to get its QP approved directly from the ultimate customer.

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SECTION 2
EQUIPMENT SPECIFICATION

Customer's (POWERGRID) standard specification is attached to this section. Kindly refer the applicable clauses for 33kV XLPE Power Cable.

SECTION: POWER AND CONTROL CABLE

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SECTION: POWER & CONTROL CABLES

1. **POWER & CONTROL CABLES[FOR WORKING VOLTAGES UP TO AND INCLUDING 1100 V]**

CRITERIA FOR SELECTION OF POWER & CONTROL CABLES

- 1.1.1. Aluminium conductor XLPE insulated armoured cables shall be used for main power supply purpose from LT Aux. Transformers to control room, between distribution boards, **supply to oil filtration units, DG supply to AC distribution board** and for supply for colony lighting from control room.
- 1.1.2. Aluminium conductor PVC insulated armoured power cables shall be used for various other applications in switchyard area/control room except for control/protection purposes.
- 1.1.3. For all control/protection purposes, PVC insulated armoured control cables of minimum 2.5 sq. mm. size with stranded Copper conductors shall be used.
- 1.1.4. POWERGRID has standardised the sizes of power cables for various feeders. 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 type
1.	Main Switch Board	LT Transformer	2-1C X 630 mm ² per phase 1-1C X 630 mm ² for neutral	XLPE
2.	Main Switch Board	AC Distribution Board	2-3½C X 300 mm ²	XLPE
3.	Main Switch Board	Oil Filtration Unit & looping to other oil filtration units.	1-3½C X 300 mm ²	XLPE
4.	Main Switch Board	Colony Lighting	1-3½C X 300 mm ²	XLPE

5.	Main Switch Board	HVV pump LCP	1-3½C X 300 mm ²	XLPE
6.	Main Switch Board	Main Lighting distribution board	1-3½C X 300 mm ²	XLPE
7.	AC Distribution Board	D.G. Set AMF Panel	2-3½C X 300 mm ²	XLPE
8.	AC Distribution Board	Emergency Lighting distribution board	1-3½C X 70 mm ²	PVC
9.	AC Distribution Board	ICT MB	1-3½C X 70 mm ²	PVC
10.	AC Distribution Board	Bay MB	1-3½C X 70 mm ²	PVC
11.	Bay MB	AC Kiosk	1- 3 ½ x 35 mm ²	PVC
12.	AC Distribution Board	Battery Charger	1-3½C X 70 mm ²	PVC
13.	DCDB	Battery	2-1C X 150 mm ²	PVC
14.	DCDB	Battery Charger	2-1C X 150 mm ²	PVC
15.	DCDB	Protection/PLCC panel	1-4C X 16 mm ²	PVC
16.	Main Lighting DB	Lighting panels(Indoor)	1-3½C X 35 mm ²	PVC
17.	Main Lighting DB	Lighting panels (outdoor)	1-3½C X 70 mm ²	PVC
18.	Main Lighting DB	Receptacles (Indoor)	1-3½C X 35 mm ²	PVC
19.	Main Lighting DB	Receptacles (Outdoor)	1-3½C X 70 mm ²	PVC
20.	Lighting Panel	Sub lighting panels	1-4C X 16 mm ²	PVC
21.	Lighting Panel	Street Lighting Poles	1-4C X 16 mm ²	PVC
22.	Lighting Panel/ Sub lighting panels	Lighting Fixtures (Outdoor)	1-2C X 6 mm ²	PVC
23.	Bay MB	Equipments	1-4C X 16 mm ² /1-4C X 6 mm ² /1-2C X 6 mm ²	PVC

- 1.1.5 Bidder may offer sizes other than the sizes specified in clause 1.1.4. 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 (***including future bays/load requirement***), voltage drop & short-circuit consideration of the system. Relevant calculations shall be submitted by bidder during detailed engineering for purchaser's approval. **The entire power and control cables & special cables (if any) required shall be executed by contractor for completion of present scope of work.**
- 1.1.6 Cables shall be laid conforming to IS : 1255.
- 1.1.7 While preparing cable schedules for control/protection purpose, following shall be ensured:
- 1.1.7.1 Separate cables shall be used for AC & DC.
- 1.1.7.2 Separate cables shall be used for DC1 & DC2.
- 1.1.8 For different cores of CT & CVT separate cable shall be used
- 1.1.9 At least 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.
- 1.1.10 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.
- 1.1.11 Standard technical data sheets for cable sizes up to and including 1100V are enclosed at Annexure. Cable sizes shall be offered/manufactured in accordance with parameters specified in standard technical data sheets. Technical data sheet for any other cores/sizes required during detailed engineering shall be separately offered for owner's approval by the contractor/supplier. ***Submission of standard technical data sheets for these cable sizes are not required for approval. Contractor/supplier shall intimate name of proposed approved cable manufacturer along with cable sizes, its quantity required during detailed engineering for purchaser's information and acceptance.***

1.2. TECHNICAL REQUIREMENTS

1.2.1. General

- 1.2.1.1. 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.
- 1.2.1.2. They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating conditions. The XLPE /PVC insulated L.T. power cables of sizes 240 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 at rated conductor temperature (70 degC for PVC insulated cables and 90 degC for XLPE insulated cables). 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.
- 1.2.1.3. 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.
- 1.2.1.4. 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 for conductors shall be of H2 grade. In case of single core cables armours shall be of H4 grade Aluminium.
- 1.2.1.5. The fillers and inner sheath 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.
- 1.2.1.6. Progressive sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of all cables.
- 1.2.1.7. 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.
- 1.2.1.8. 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.
- 1.2.1.9. All the cables shall pass fire resistance test as per IS:1554 (Part-I)

- 1.2.1.10. The normal current rating of all PVC insulated cables shall be as per IS:3961.
- 1.2.1.11. Repaired cables shall not be accepted.
- 1.2.1.12. Allowable tolerance on the overall diameter of the cables shall be plus or minus 2 mm.

1.2.2. **XLPE Power Cables**

- 1.2.2.1. The XLPE (90°C) insulated cables shall be of FR type, C1 category conforming to IS:7098 (Part-I) 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 of type ST-2 of IS:5831. **All cables shall be of armoured type.** For single core cables, the **armouring** shall consist of aluminium wires/strips. The outer sheath shall be extruded PVC of Type ST-2 of IS:5831 for all XLPE cables.

1.2.3. **PVC Power Cables**

- 1.2.3.1. The PVC (70°C) insulated power cables shall be of FR type, 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 shall be provided in all multicore cables. **All cables shall be of armoured type.** 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.

1.2.4. **PVC Control Cables**

- 1.2.4.1. The PVC (70°C) insulated control cables shall be of FR type 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 shall be provided in all cables. **All cables shall be of armoured type.** The over sheath shall be extruded PVC to type ST-1 of IS: 5831 and shall be grey in colour.
- 1.2.4.2. 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).

2. **HV POWER CABLES[FOR WORKING VOLTAGES FROM 3.3 kV AND INCLUDING 33 kV]**

2.1. **HV POWER CABLE FOR AUXILIARY POWER SUPPLY**

(a) The HV cable of 1Cx185 mm² (Aluminium Conductor) or 1Cx120mm² (Copper Conductor) of voltage class as specified for 630 kVA **and 800 kVA** LT transformer for interconnecting 630kVA **and 800 kVA** LT transformer to the SEB feeder shall be, XLPE insulated, armoured cable conforming to IS 7098 (Part-II) or IEC 60502-2 1998. Terminating accessories shall conform to IS 17573-1992 or IEC 61442-1997/IEC60502-4 1998.

(b) The HV cable of 3Cx95 mm² (Aluminium Conductor) or 3Cx70mm² (Copper Conductor) of voltage class as specified for 250kVA LT transformer for interconnecting 250kVA LT transformer to the SEB feeder shall be, XLPE insulated, armoured cable conforming to IS 7098 (Part-II) or IEC 60502-2 1998. Terminating accessories shall conform to IS 17573-1992 or IEC 61442-1997/IEC60502-4 1998.

2.2. Only overhead connection has been foreseen for interconnecting **630 kVA and 800 kVA**, LT transformer to the tertiary of the ICT. However, HV cable connections in place of overhead connection, if necessary shall also be in the scope of contractor. In this case contractor shall provide 1C x 185 mm² (Aluminium Conductor) or 1Cx120mm² (Copper Conductor), 38/66kV HV cable along with necessary terminating accessories. The construction of XLPE insulated, armoured HV cable shall be generally conforming to IS 7098 (Part-III). Terminating accessories shall conform to IEC60840 1999.

2.3. Bidder may offer sizes other than the sizes specified in clause 2.1 and 2.2. In such case sizing of power cables shall be done keeping in view continuous current, voltage drop & short-circuit consideration of the system. Relevant calculations shall be submitted by bidder during detailed engineering for purchaser's approval.

2.4. **Constructional Requirements**

Cable shall have compacted circular Aluminium conductor, Conductor screened with extruded semi conducting compound , XLPE insulated, insulation screened with extruded semi conducting compound, **distinct extruded PVC inner sheath (Type ST-2) with FR properties**, armoured

with non-magnetic material **for single core cables and galvanized steel wire/strip for multicore cables** , followed by extruded PVC outer sheath(Type ST-2), with FR properties . **The armour shall be capable of withstanding rated short time current of conductor.**

- 2.5 Progressive sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of the cable.
- 2.6 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.
- 2.7 Allowable tolerance on the overall diameter of the cables shall be plus or minus 2 mm.

3. EHV XLPE POWER CABLE [FOR WORKING VOLTAGES FROM 66 KV UP TO AND INCLUDING 500 KV]

3.1 TECHNICAL REQUIREMENTS

The XLPE insulated, EHV cable shall conform to the requirements of IEC 60502-2 (applicable clauses only) for construction and IEC 60840/ IEC62067 (as applicable) for testing. The terminating accessories shall conform to IEC 60840 / IEC62067 (as applicable).

- 3.2 The cable shall be of specified EHV grade, single core, unarmoured, stranded compacted Copper conductor, core screening by a layer of semiconducting tape followed by a layer of semiconducting compound, cross linked polyethylene (XLPE) dry cured insulation, insulation screening with semiconducting compound extruded directly over the insulation, longitudinal sealing by a layer of non woven tape with water swellable absorbent over insulation screen, followed by radial sealing (Metal sheath of Lead alloy 'E'), metallic screening by concentric layer of plain copper wire followed by an open helix of copper & overall **HDPE** sheathed & graphite coated and conforming to the technical particulars of specification.
- 3.3 The construction of cable shall generally conform to the description mentioned in above mentioned clause of the specification. Bidder may offer necessary layers such as separation tape, binder tapes etc additionally as per their manufacturing practices for meeting required performance of the offered cable. The bidder shall enclose with the bid, drawing showing cross section of the cable. The conductors screen (non-metallic semi-conductive) shall be extruded in a single one-time process to ensure homogeneity and absence of voids.

- 3.4 The conductors screen (non-metallic semi-conductive) shall be extruded in a single one-time process to ensure homogeneity and absence of voids.
- 3.5 They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating conditions.
- 3.6 Progressive sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of the cable.
- 3.7 The cables shall have outer sheath of a **HDPE** material.
- 3.8 Repaired cables shall not be accepted.
- 3.9 Allowable tolerance on the overall diameter of the cables shall be plus or minus 2 mm.

4 CABLE DRUMS

- 4.1 Cables shall be supplied in 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. ***Drums offered shall conform to relevant standards. Drum drawings are not required to be submitted for approval.***
- 4.2 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 owner shall have the option of rejecting cable drums with shorter lengths. Maximum, One (1) number non standard length of cable size(s) may be supplied in drums for completion of project.
- 4.3 A layer of water proof paper shall be applied to the surface of the drums and over the outer most cable layer.
- 4.4 A clear space of at least 40 mm shall be left between the cables and the lagging.
- 4.5 Each drum shall carry the manufacturer's name, the purchaser's name, address and contract number and type, size and length of the cable, net and gross weight stencilled 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.

- 4.6 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.

5 TYPE TESTS

- 5.1 All cables shall conform to all type, routine and acceptance tests listed in the relevant IS.

5.2 ***XLPE INSULATED POWER CABLES (For working voltages up to and including 1100V):-***

- 5.2.1 Following type tests (on one size in a contract) as per IS: 7098 (Part 1) – 1988 including its amendments shall be carried out as a part of acceptance tests on XLPE insulated power cables for working voltages up to and including 1100 V:

- a) Physical tests for insulation
 - i) Hot set test
 - ii) Shrinkage test
- b) Physical tests for outer sheath
 - i) Shrinkage test
 - ii) Hot deformation
 - iii) Heat shock test
 - iv) Thermal stability

- 5.2.2 Contractor shall submit type test reports as per clause no. 9.2 of Technical Specification, Section: GTR for the following tests-

- a) Water absorption (gravimetric) test.
- b) Ageing in air oven
- c) Loss of mass in air oven
- d) Short time current test on power cables of sizes 240 sqmm and above on
 - i) Conductors.
 - ii) Armours.
- e) Test for armouring wires/strips.
- f) Oxygen and Temperature Index test.
- g) Flammability test.

5.3 ***PVC INSULATED POWER & CONTROL CABLES (For working voltages up to and including 1100V)-***

5.3.1 Following type tests (on one size in a contract) as per IS: 1554 (Part 1) - 1988 including its amendments shall be carried out as a part of acceptance tests on PVC insulated power & control cables for working voltages up to and including 1100 V:

- a) Physical tests for insulation and outer sheath
 - i) Shrinkage test
 - ii) Hot deformation
 - iii) Heat shock test
 - iv) Thermal stability
- b) High voltage test (water immersion test only a.c. test as per clause no. 16.3.1).

5.3.2 Contractor shall submit type test reports as per clause no. 9.2 of Technical Specification, Section: GTR for the following-

- a) High voltage test (water immersion d.c. test as per clause no. 16.3.2 of IS: 1554 (Part 1) - 1988).
- b) Ageing in air oven.
- c) Loss of mass in air oven.
- d) Short time current test on power cables of sizes 240 sqmm and above on
 - i) Conductors.
 - ii) Armours.
- e) Test for armouring wires/strips.
- f) Oxygen and Temperature Index test.
- g) Flammability test.

5.4 ***XLPE INSULATED HV POWER CABLES(For working voltages from 3.3 kV and including 33 kV)-***

5.4.1 Contractor shall submit type test reports as per clause no. 9.2 of Technical Specification, Section: GTR for XLPE insulated HV power cables (as per IS 7098 Part-II including its amendment or as per IEC).

5.5 ***XLPE INSULATED EHV POWER CABLES (For working voltages from 66kV up to and including 500 kV)-***

5.5.1 Contractor shall submit type test reports as per clause no. 9.2 of Technical Specification, Section: GTR for XLPE insulated EHV cables (as per IEC60840 for cables up to 150 kV & IEC 62067 for cables above 150 kV).

5.6 *TERMINATING & JOINTING ACCESSORIES-*

5.6.1 Contractor shall submit type test reports as per clause no. 9.2 of Technical Specification, Section: GTR for Terminating/jointing accessories as per IS 17573:1992/ IEC 60840:1999/ IEC62067.

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	DOCUMENT No.	TB-431-316-000			Rev. No.	00		Prepared	Checked	Approved																														
	TYPE OF DOC.	TECHNICAL SPECIFICATION			SIGN																																			
	TITLE GENERAL TECHNICAL REQUIREMENTS-SECTION 3				NAME	PC	JK	VK																																
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					GROUP	TBEM	W.O.	431																																
	CUSTOMER	Power Grid Corporation of India Limited (POWERGRID)																																						
	Station	Powergrid Sub-Stations																																						
	Project	1. 765/400/220kV Barmer-I (New), 765kV Sirohi(Extn.) and 400kV Fatehgarh-III (Extn.) 2. 765/400/220/132kV Kurawar (New), 400kV Shujalpur(Extn.), 400kV Ashtha (Extn.) 765kV Mandsaur (Extn.) 3. 765/400/220kV Mandsaur (New), 765kV Indore (Extn.)																																						
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Site Information -1

S.No.	Particular	Details
a)	Owner	Power Grid Corporation of India Limited (POWERGRID)
b)	Customer	Power Grid Corporation of India Limited (POWERGRID)
c)	Project Title	765kV AIS Pkg SS-46T for (a) Establishment of 765/400/220kV Barmer-I including 400kV, 2x125 MVAR Reactor; (b) Extn at 765kV Sirohi for termination of Barmer-I PS- Sirohi PS 765 kV D/c line; (c) Extn of 400kV Fatehgarh-III for termination of Fatehgarh-III (Section-2) PS - Barmer-I PS 400 kV D/c line
d)	Location	Barmer-I /Sirohi / Fatehgarh-III (Rajasthan)
e)	Transport Facilities	Nearest Rail Head for : 765/400/220kV Barmer – Barmer Railway Station 765/400/220kV Sirohi – Sirohi Railway Station 765/400/220kV Fatehgarh – Fatehgarh Railway Station
SITE CONDITIONS		
f)	Max. ambient air temp.	50°C
g)	Min. ambient air temp.	0°C
h)	Max. design ambient temp.	50°C
i)	Costal area consideration	No
j)	Altitude above sea level	Less than 1000 meter above mean sea level (MSL)
k)	Seismic Zone	NBC2016
l)	Wind Zone	NBC2016
m)	Snow fall	NIL
Main Electrical Parameters:		
n)	Fault Levels:	765kV: 50kA for 1 Sec 400kV: 63kA for 1 Sec 220kV: 50kA for 1 sec
o)	Creepage Distance	25mm/kV for All Equipment i.e. BPI/Bushings, CB, Isolator, CT, CVT, LA, WT, NCT etc. and for insulator string/ long rod insulators/ outdoor bushings - 31 mm/kV



Site Information - 2

S.No.	Particular	Details
a)	Owner	Power Grid Corporation of India Limited (POWERGRID)
b)	Customer	Power Grid Corporation of India Limited (POWERGRID)
c)	Project Title	765kV AIS Pkg SS-47T for (a) Establishment of 765/400/220/132kV Kurawar Substation (New) including 1x125MVA 420kV (3-Ph)Bus Reactor, (b) Extn of 400kV Shujalpur for termination of 400kV D/C Shujalpur – Kurawar TL, (c) Extn of 400kV Ashtha S/s for LILO of one circuit of Indore-Itarsi 400 kV D/c line at Ashtha & for termination of Kurawar-Ashtha 400 kV D/c line and (d) Extn of 765kV Mandsaur for termination of Mandsaur – Kurawar 765 kV D/c line.
d)	Location	Kurawar / Shujalpur / Ashtha / Mandsaur (Madhya Pradesh)
e)	Transport Facilities	Nearest Rail Head for : 765/400/220/132kV Kurawar – Sehore Railway Station 400kV Shujalpur – Shujalpur Railway Station 400kV Ashtha – Sehore Railway Station 765kV Mandsaur – Mandsaur Railway Station
SITE CONDITIONS		
f)	Max. ambient air temp.	50°C
g)	Min. ambient air temp.	0°C
h)	Max. design ambient temp.	50°C
i)	Costal area consideration	No
j)	Altitude above sea level	Less than 1000 meter above mean sea level (MSL)
k)	Seismic Zone	NBC2016
l)	Wind Zone	NBC2016
m)	Snow fall	NIL
Main Electrical Parameters:		
n)	Fault Levels:	765kV: 50kA for 1 Sec 400kV: 63kA for 1 Sec 220kV: 50kA for 1 sec 132kV: 40kA for 1 sec
o)	Creepage Distance	25mm/kV for All Equipment i.e. BPI/Bushings, CB, Isolator, CT, CVT, LA, WT, NCT etc. and for insulator string/ long rod insulators/ outdoor bushings - 31 mm/kV



Site Information - 3

S.No.	Particular	Details
a)	Owner	Power Grid Corporation of India Limited (POWERGRID)
b)	Customer	Power Grid Corporation of India Limited (POWERGRID)
c)	Project Title	Substation Package -SS-43T for (a) Establishment of 765/400/ 220kV Mandsaur S/s including 400kV, 2x125MVar (3-Ph) Reactor and (b) Extn. of 765kV Indore (PG) for termination of Mandsaur PS – Indore (PG) 765 kV D/c Line associated with “Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-2 : 5.5GW) Jaisalmer/Barmer Complex)Part-C”
d)	Location	Mandsaur & Indore, Madhya Pradesh
e)	Transport Facilities	Road/Train Nearest Rail Head For 765/400/220kV Mandsaur (New) PS - Mandsaur Nearest Rail Head For 765/400kV Indore (PG) S/S - Indore
SITE CONDITIONS		
f)	Max. ambient air temp.	50°C
g)	Min. ambient air temp.	0°C
h)	Max. design ambient temp.	50°C
i)	Costal area consideration	No
j)	Altitude above sea level	Less than 1000 meter above mean sea level (MSL)
k)	Seismic Zone	NBC2016
l)	Wind Zone	NBC2016
m)	Snow fall	NIL
Main Electrical Parameters:		
n)	Fault Levels:	765kV: 50kA for 1 Sec 400kV: 63kA for 1 Sec 220kV: 50kA for 1 sec
o)	Creepage Distance	25mm/kV for All Equipment i.e BPI/Bushings, CB, Isolator, CT, CVT, LA, WT, NCT etc. and for insulator string/ long rod insulators/ outdoor bushings - 31 mm/kV

GENERAL TECHNICAL REQUIREMENTS - SECTION 3

1.0 FOREWORD

The provisions under this section are intended to supplement requirements for the materials, equipment's and services covered under other sections of tender documents and are not exclusive.

The Supplier shall note that the standards mentioned herein are not mutually exclusive or complete in themselves, but are intended to complement each other, with minimum repetition, to define the requirements of the Specification. In the event of a conflict between requirements of any two clauses of the Specification/ documents or requirements of different codes/ standards specified, the more stringent requirement as per the interpretation of the owner shall apply, unless confirmed otherwise by the owner in writing based on a written request from the Supplier.

In case of conflicting requirements between this document (General Technical Requirement Section 3) and equipment specification (Section 1 & Section 2), equipment specification shall prevail.

When specific requirements stipulated in the Specification exceed or change those required by the applicable standards, the stipulations of the Specification shall take precedence.

Unless specifically agreed to by the Purchaser prior to Award of Contract, the Work shall be in accordance with the standards indicated and the requirements of the Specification. The Supplier shall be held responsible for any deviation.

In case of conflict between the various standards, the decision of owner shall be binding & final.

The following words and expressions shall have the meanings hereby assigned to them throughout this document

"Employer/Owner" means Power Grid Corporation of India Ltd.

"Purchaser" means Bharat Heavy Electricals Limited.

"Supplier/Manufacturer/Bidder" means the person or persons, firm or company assigned to execute the works as defined by the scope of supply, described here.

"Specification" refers to this document.

The supplier should be approved by Power Grid. If not, it is the responsibility of the vendor to be assessed and approved by Power Grid, before placement of order by BHEL. Any cost involved in vendor

assessment/approval must be borne by the vendor himself.

2.0 **GENERAL REQUIREMENT**

- 2.1 a) All equipment/materials/items, as applicable under present scope of works, shall be supplied by domestic manufacturers only with **minimum Local Content for individual items as listed annexure-K (rev.01)**

Any imported equipment/material/item/parts/component (comprising of embedded systems) to be supplied under the contract shall be tested in the certified laboratories to check for any kind of embedded malware/trojans/cyber threats and for adherence to Indian Standards as per the directions issued by Ministry of Power/Govt. of India from time to time. In case of such import from specified "prior reference" countries, the requirement of prior permission from the Govt. of India including protocol for testing in certified and designated laboratories by Ministry of Power/Govt. of India shall also be complied with by the Bidder.

The bidder/contractor shall list out the products and components producing Toxic e-waste under the contract and shall furnish to the Employer the procedure of safe disposal at the time of closing of the contract.

- 2.1 b) The Supplier/Manufacturer shall furnish catalogues, engineering data, technical information, design documents, drawings etc., fully in conformity with the technical specification during detailed engineering.

- 2.2 It is recognised that the Bidder may have standardised on the use of certain components, materials, processes or procedures different from those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to Employer.

- 2.3 Wherever a material or article is specified or defined by the name of a particular brand, Manufacturer or Vendor, the specific name mentioned shall be understood as establishing type, function and quality and not as limiting competition.

- 2.4 Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories 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 unless included in the list of exclusions. Materials and components which are minor in nature and incidental to the requirement but not specifically stated in the specification, which are necessary for commissioning and satisfactory operation of the switchyard/ 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 interchangeable with one another.

- 2.5 Deleted.

- 2.6 Deleted.

3.0 STANDARDS

- 3.1 The works covered by the specification shall be designed, engineered, manufactured, built, tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of India.
- 3.2 The equipment offered by the Bidder shall at least conform to the requirements specified under relevant IS standard. In case of discrepancy between IS and other international standard, provisions of IS shall prevail. The Bidder shall also note that the list of standards presented in Annexure-C is not complete. Whenever necessary, the list of standards shall be considered in conjunction with specific IS. If the IS standard is not available for an equipment/material, then other applicable International standard (IEC/Equivalent), as per the specification, shall be accepted.
- 3.3 The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to complement each other.
- 3.4 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.
- 3.5 Other internationally accepted standards which ensure equivalent or better performance than that specified in the standards specified under Annexure-C / individual sections for various equipments shall also, be accepted, however the salient points of difference shall be clearly brought out during detailed engineering along with English language version of such standard. The equipment conforming to standards other than specified under Annexure-C /individual sections for various equipments shall be subject to Employer's approval.

4.0 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

- 4.1 Switching surge over voltage and power frequency over voltage is specified in the system parameters below. In case of the 400kV system, the initial value of the temporary overvoltages could be 2.0 p.u. for 1-2 cycles. The equipment furnished under this specification shall perform all its functions and operate satisfactorily without showing undue strain, restrike etc under such over voltage conditions.
- 4.2 All equipments shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation.
- 4.3 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.
- 4.4 The Bidder shall design terminal connectors of the equipment taking into account various forces as above at Sl.No.4.3 that are required to withstand.
- 4.5 The equipment shall also comply to the following:
- a) To facilitate erection of equipment, all items to be assembled at site shall be "match marked".

- b) All piping, if any between equipment control cabinet/operating mechanism to marshalling box of the equipment, shall bear proper identification to facilitate the connection at site.

4.6 System Parameter

765kV, 400kV & 220kV System

SL No	Description of parameters	765kV System	400kV System	220kV System
1.	System operating voltage	765kV	400kV	220kV
2.	Maximum operating voltage of the system (rms)	800kV	420kV	245kV
3.	Rated frequency	50Hz	50Hz	50Hz
4.	No. of phase	3	3	3
5.	Rated Insulation levels			
i)	Full wave impulse withstand voltage (1.2/50 microsec.)	2100kVp	1550kVp	1050 kVp
ii)	Switching impulse withstand voltage (250/2500 micro sec.) dry and wet	1550kVp	1050kVp	-
iii)	One minute power frequency dry withstand voltage (rms)	830kV	630kV	-
iv)	One minute power frequency dry and wet withstand voltage (rms)	-	-	460kV
6.	Corona extinction voltage	508kV	320kV	-
7.	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz	2500 μ V at 508kV rms	1000 μ V at 266kV rms	1000 μ V at 156kV rms
8.	Minimum creepage distance - for Equipment other than Insulator string	20000 mm	10500 mm	6125 mm
	Minimum creepage distance - for Insulator String	24800 mm	13020 mm	7595 mm
9.	Min. clearances			
i.	Phase to phase	7600mm (for conductor-conductor configuration)	4000mm (for conductor-conductor configuration)	2100 mm
		9400mm (for rod-conductor configuration)	4200mm (for rod-conductor configuration)	
ii.	Phase to earth	4900mm (for conductor-structure)	3500 mm	2100 mm

		6400mm (for rod- structure)		
iii)	Sectional clearances	10300 mm	6500 mm	5000 mm
10.	Rated short circuit current for 1 sec. duration	50kA	63 kA	50kA
11.	System neutral earthing	Effectively earthed	Effectively earthed	Effectively earthed

66kV, 52kV and 33kV System

SL No	Description of parameters	66kV System	52 kV System	33 kV System
1.	System operating voltage	66kV	52kV	33kV
2.	Maximum operating voltage of the system(rms)	72.5kV	52kV	36kV
3.	Rated frequency	50Hz	50Hz	50Hz
4.	No. of phase	3	3	3
5.	Rated Insulation levels			
i)	Full wave impulse withstand voltage (1.2/50 microsec.)	325 kVp	250 kVp	170 kVp
ii)	One-minute power frequency dry and wet withstand voltage (rms)	140kV	95kV	70kV
6.	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz	-	-	-
7.	Minimum creepage distance	1813 mm (2248mm for coastal area)	1300mm (1612 mm for coastal area)	900 mm (1116m m for coastal area)
8.	Min. Clearance			
i.	Phase to phase	750 mm	530mm	320 mm
ii.	Phase to earth	630 mm	480mm	320 mm
iii.	Sectional clearances	3100 mm	3100mm	2800 mm
9.	Rated short circuit current	25kA for 3 Sec*	25kA for 1 Sec	25 kA for 3 sec
10.	System neutral earthing	Effectively earthed	Effectively earthed	Effectively earthed

Notes:

- The above parameters are applicable for installations up to an altitude of 1000m above mean sea level. For altitude exceeding 1000m, necessary altitude correction factor shall be applicable as per relevant IEC/IS.
- The insulation and RIV levels of the equipments shall be as per values given in the Technical Specification of respective equipment.

3. Corona and radio interference voltage test and seismic withstand test procedures for equipments shall be in line with the procedure given at **Annexure-A** and **Annexure-B** respectively.
4. “*” For tertiary loading Equipment’s fault level shall be 25kA for 3 Sec.

5.0 ENGINEERING DATA AND DRAWINGS

5.1 Deleted.

5.2 Deleted.

5.3 Drawings

5.3.1 All drawings submitted by the Bidder shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, dimensions, internal & the external connections, fixing arrangement required and any other information specifically requested in the specifications.

5.3.2 Drawings submitted by the Bidder shall be clearly marked with the name of the Employer, the unit designation, the specifications title, the specification number and the name of the Project. POWERGRID has standardized a large number of drawings/documents of various make including type test reports which can be used for all projects having similar requirements and in such cases no project specific approval (except for list of applicable drawings alongwith type test reports) is required. However, distribution copies of standard drawings/documents shall be submitted as per provision of the contract. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in SI units.

5.3.3 The review of these data by the Employer will cover only general conformance of the data to the specifications and documents, interfaces with the equipment provided under the specifications, external connections and of the dimensions which might affect substation layout. This review by the Employer may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the Employer shall not be considered by the Contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

5.5 All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the Bidder’s risk. The Bidder may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Employer. Approval of Bidder’s drawing or work by the Employer shall not relieve the bidder of any of his responsibilities and liabilities under the Contract.

5.6 All engineering data submitted by the Bidder after final process including review and approval by the Employer shall form part of the Contract Document and the entire works performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the Employer in Writing.

5.7 Approval Procedure

The following schedule shall be followed generally for approval and for providing final documentation.

i)	Approval/comments/ by Employer on initial submission	15 days
ii)	Resubmission (whenever required)	Within 3 (three) weeks from date of comments
iii)	Approval or comments	Within 3 (three) weeks of receipt of resubmission
iv)	Furnishing of distribution copies (2 hard copies to each substation and one scanned copy (pdf format)	Within 3 (three) weeks of receipt of resubmission
v)	Furnishing of distribution copies of test reports	
	a) Type test reports (one scanned softcopy in pdf format to each substation plus one for corporate centre & one hardcopy per substation)	2 weeks from the date of final approval
	b) Routine Test Reports (one copy for each substation)	-do-
vi)	Furnishing of instruction/ operation manuals (2 copies per substation and one softcopy (pdf format) for corporate centre & per substation)	On completion of Engineering
vii)	As built drawings (two sets of hardcopy per substation & one softcopy (pdf format) for corporate centre & per substation)	On completion of entire works

NOTE :

- (1) The bidder may please note that all resubmissions must incorporate all comments given in the earlier submission by the Employer or adequate justification for not incorporating the same must be submitted failing which the submission of documents is likely to be returned.
 - (2) Deleted.
 - (3) The instruction Manuals shall contain full details of drawings of all equipment being supplied under this contract, their exploded diagrams with complete instructions for storage, handling, erection, commissioning, testing, operation, trouble shooting, servicing and overhauling procedures.
 - (4) If after the commissioning and initial operation of the substation, the instruction manuals require any modifications/additions/changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Employer.
 - (5) The Bidder shall furnish to the Employer catalogues of spare parts.
 - (6) All As-built drawings/documents shall be submitted after incorporating the changes before final submission.
- 5.8 Deleted.

6.0 MATERIAL/ WORKMANSHIP**6.1 General Requirement**

- 6.1.1 Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is essential 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.
- 6.1.2 In case where the equipment, materials or components are indicated in the specification as "similar" to any special standard, the Employer shall decide upon the question of similarity. When required by the specification or when required by the Employer the Contractor shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such approval shall run the risk of subsequent rejection, it is to be understood that the cost as well as the time delay associated with the rejection shall be borne by the Bidder.
- 6.1.3 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 Employer.
- 6.1.4 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.

6.1.5 Deleted.

6.1.6 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.

6.1.7 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. If such is the case, he shall declare source of oil/grease /other consumables in the GTP/Drawings, where such oil or grease is available. He shall help Employer in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

6.2 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.

6.2.1 Space Heaters

6.2.1.1 The heaters shall be suitable for continuous operation at 240V as supply voltage. On off switch and fuse shall be provided.

6.2.1.2 One or more adequately rated thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in 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.

6.2.2 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 interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

6.2.3 Ventilation opening

Wherever ventilation is provided, the compartments shall have ventilation openings with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust.

6.2.4 Degree of Protection

The enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc. to be installed shall comply with following 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/IEC60947; IS/IEC/60529. Type test report for of relevant Degree of Protection test, shall be submitted for approval.

6.3 RATING PLATES, NAME PLATES AND LABELS

6.3.1 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, Customer 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 Employer. The rating plate of each equipment shall be according to IS/ IEC requirement.

6.3.2 All such nameplates, instruction plates, rating plates of transformers, reactors, CB, CT, CVT, SA, Isolators, C & R panels and PLCC 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.

6.4 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 operation, shall be furnished by the Bidder unless specifically excluded under the exclusions in these specifications and documents.

7.0 DESIGN IMPROVEMENTS / COORDINATION

7.1 Deleted.

7.2 Deleted.

7.3 The Bidder shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic design requirements are detailed out in this Specification. The design of various components, sub-assemblies and

assemblies shall be so done that it facilitates easy field assembly and maintenance.

- 7.4 The Bidder has to coordinate designs and terminations with the agencies (if any) who are Consultants/Bidder for the Employer. The names of agencies shall be intimated to the successful bidders.
- 7.5 The Bidder will be called upon to attend design co-ordination meetings with the Engineer, other Contractor's and the Consultants of the Employer (if any) during the period of Contract. The Bidder shall attend such meetings at his own cost at POWERGRID Corporate Centre, Gurgaon (Haryana) or at mutually agreed venue as and when required and fully cooperate with such persons and agencies involved during those discussions.

8.0 QUALITY ASSURANCE PROGRAMME

8.1 To ensure that the equipment and services under the scope of this Contract, whether manufactured or performed within the Bidder's Works or at his Sub-Bidder's premises or at the Employer's site or at any other place of Work as applicable, are in accordance with the specifications, the Contractor shall ensure suitable quality assurance programme to control such activities at all points necessary. A quality assurance programme of the Contractor shall be in line with ISO requirements & shall generally cover the following:

- a) The organisation structure for the management and implementation of the proposed quality assurance programme.
- b) System for Document and Data Control.
- c) Qualification and Experience data of Bidder's key personnel.
- d) The procedure for purchases of materials, parts, components and selection of sub-Bidder's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.
- e) System for shop manufacturing and site erection controls including process controls, fabrication and assembly control.
- f) System for Control of non-conforming products including deviation dispositioning, if any and system for corrective and preventive actions based on the feedback received from the Customers and also internally documented system for Customer complaints.
- g) Inspection and test procedure both for manufacture and field activities.
- h) System for Control of calibration of testing and measuring equipment and the indication of calibration status on the instruments.
- i) System for indication and appraisal of inspection status.
- j) System of Internal Quality Audits, Management review and initiation of corrective and Preventive actions based on the above.
- k) System for authorising release of manufactured product to the Employer.

- l) System for maintenance of records.
- m) System for handling, storage and delivery.
- n) A quality plan detailing out the specific quality control measures and procedure adopted for controlling the quality characteristics relevant to each item of equipment furnished and /or service rendered.
- o) System for various field activities i.e. unloading, receipt at site, proper storage, erection, testing and commissioning of various equipment and maintenance of records. In this regard, the Employer has already prepared Standard Field Quality Plan for transmission line/substation equipments as applicable, Civil/erection Works which is required to be followed for associated works.

The Employer or his duly authorised representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the Bidder/his vendor's quality management and control activities.

8.2 **Quality Assurance Documents**

The Bidder shall ensure availability of the following Quality Assurance Documents:

- i) All Non-Destructive Examination procedures, stress relief and weld repair procedure actually used during fabrication, and reports including radiography interpretation reports.
- ii) Welder and welding operator qualification certificates.
- iii) Welder's identification list, welding operator's qualification procedure and welding identification symbols.
- iv) Raw Material test reports on components as specified by the specification and in the quality plan.
- v) The Manufacturing Quality Plan(MQP) indicating Customer Inspection Points (CIPs) at various stages of manufacturing and methods used to verify that the inspection and testing points in the quality plan were performed satisfactorily.
- vi) Factory test results for testing required as per applicable quality plan/technical specifications/GTP/Drawings etc.
- vii) Stress relief time temperature charts/oil impregnation time temperature charts, wherever applicable.

8.3 **INSPECTION, TESTING & INSPECTION CERTIFICATE**

8.3.1 The responsibility and the basis of inspection for various items & equipment is placed at **Annexure-G** along with the requirement of MQP (Manufacturing Quality Plan), ITP(Inspection & Test Plan), FAT(Factory Acceptance Test) which should be valid & POWERGRID approved and Level of inspection envisaged against each item.

Bidder shall ensure that order for items where MQP/ITP/FAT is required will be placed only on vendors having valid MQP/ITP/FAT and where the

supplier's MQP/ITP/FAT is either not valid or has not been approved by POWERGRID, MQP shall be generally submitted as per POWERGRID format before placing order.

Items not covered under MQP/ITP/FAT shall be offered for inspection as per POWERGRID LOA/technical Specifications/POWERGRID approved data sheets/ POWERGRID approved drawings and relevant Indian/International standards.

Inspection Levels: For implementation of projects in a time bound manner and to avoid any delay in deputation of POWERGRID or its authorized representative, involvement of POWERGRID for inspection of various items / equipment will be based on the level below:

Level - I: Bidder to raise all inspection calls and review the report of tests carried out by the manufacturer, on his own, as per applicable standards/ POWERGRID specification, and submit to concerned POWERGRID inspection office/Inspection Engineer. CIP/MICC will be issued by POWERGRID based on review of test reports/certificates of manufacturers.

Level - II: Bidder to raise all inspection calls and carry out the inspection on behalf of POWERGRID on the proposed date of inspection as per applicable standards/specification. However, in case POWERGRID wishes to associate itself during inspection, the same would be intimated to Bidder and CIP/MICC will be issued by POWERGRID. Else, Bidder would submit their test reports/certificates to POWERGRID. CIP/MICC will be issued by POWERGRID based on review of test reports/ certificates.

Level - III: Bidder to raise inspection calls for both, stage (as applicable) & final inspection and carry out the stage inspections (if applicable) on behalf of POWERGRID on the proposed date of inspection as per applicable standards/specification. However, in case POWERGRID wishes to associate itself during stage inspection, the same would be intimated to Bidder and CIP will be issued by POWERGRID. Else, Bidder would submit the test reports / certificates of stage inspection after their own review and CIP will be issued by POWERGRID based on review of test reports / certificates. Final inspection will be carried out by POWERGRID and CIP/MICC will be issued by POWERGRID.

Level - IV: Bidder to raise inspection calls for both, stage (as applicable) & final inspections. POWERGRID will carry out the inspection for both stage & final inspection as per applicable standards/specification and CIP/MICC will be issued by POWERGRID.

- 8.3.2 Bidder shall ensure that to implement the above inspection levels, particularly for the quality control and inspection at sub-vendor's works, they would depute sufficient qualified & experienced manpower in their Quality Control and Inspection department. Further, to assure quality of construction, Bidder shall have a separate workforce having appropriate qualification & experience and deploy suitable tools and plant for maintaining quality requirement during construction in line with applicable Field Quality Plan (FQP).

- 8.3.3 The Employer, his duly authorised representative and/or outside inspection agency acting on behalf of the Employer shall have at all reasonable times access to the Bidder's premises or Works and shall have the power at all reasonable times to ensure that proper Quality Management practices / norms are adhered to, inspect and examine the materials & workmanship of the Works, to carry out Quality/Surveillance Audit during manufacture or erection and if part of the Works is being manufactured or assembled at other premises or works. The Bidder shall obtain for the Employer and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Bidder's own premises or works. The item/equipment, if found unsatisfactory with respect to workmanship or material is liable to be rejected. The observations for improvements during product/ process inspection by POWERGRID shall be recorded in Quality Improvement Register (available & maintained at works) for review & timely compliance of observations.
- 8.3.4 Bidder shall submit inspection calls over internet through POWERGRID website. The required vendor code and password to enable raising inspection call will be furnished to the main Contractor within 30 days of award of contract on submission of documents by Contractor. After raising the inspection calls, Contractor shall then proceed as per the message of that particular call which is available on the message board.
- 8.3.5 The Employer reserves the right to witness any or all type, acceptance and routine tests specified for which the Bidder shall give the Employer/Inspector Twenty one (21) days written notice of any material being ready for testing for each stage of testing as identified in the approved quality plan as customer inspection point (CIP) for indigenous inspections. All inspection calls for overseas material shall be given at least forty five (45) days in advance. Such tests shall be to the Bidder's account except for the expenses of the Inspection Engineer. The Employer/inspector, unless witnessing of the tests is waived by Employer, will attend such tests within Twenty one (21) days of the date of which the equipment is notified as being ready for test/inspection, failing which the Bidder may proceed with the test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector three copies of tests, duly certified. Bidder shall ensure, before giving notice for type test, that all drawings and quality plans have been got approved. The equipment shall be dispatched to site only after approval of Routine and Acceptance test results and Issuance of Dispatch Clearance in writing by the Employer. CIP/Material Inspection clearance certificate (MICC) shall be issued by the Employer after inspection of the equipment or review of test reports as applicable. Employer may waive off the presence of Employer's inspecting engineer. In that case test will be carried out as per approved QP and test certificate will be furnished by the supplier for approval. CIP/MICC will be issued only after review and approval of the test reports.
- 8.3.6 Bidder shall generally offer material for inspection as per supply bar chart approved by POWERGRID and not before 30 days from schedule indicated in the bar chart. In case Bidder offers material(s) for inspection prior to 30 days from the scheduled date with necessary approval of POWERGRID, POWERGRID shall inspect the material and issue CIP only. However, in

- such an exceptional case, MICC shall be issued only as per provision of original / revised approved supply schedule.
- 8.3.7 Bidder shall minimize the number of inspection calls by offering optimum quantities in each inspection call at the respective manufacturer's works.
- 8.3.8 Bidder shall inspect the material themselves and only after they are fully convinced about the Quality, they shall offer the material for POWERGRID inspection and shall also ensure that relevant portion of LOA/NOA, approved drawing and data sheets along with applicable Quality Plans are available at the works of Contractor or their Sub-vendor before the material is offered for inspection.
- 8.3.9 Bidder shall ensure that material which has been cleared for dispatch after inspection will be dispatched within 30 days in case of domestic supplies and within 60 days in case of Off-shore supplies from the date of issuance of CIP. Material which is not dispatched within stipulated time as above will be reoffered for POWERGRID inspection or specific approval of POWERGRID QA&I shall be obtained for delayed dispatch.
- 8.3.10 The Employer or IE shall give notice in writing to the Bidder, of any objection either to conformance to any drawings or to any equipment and workmanship which in his opinion is not in accordance with the Contract. The Bidder shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objections or shall confirm in writing to the Employer/Inspection Engineer giving reasons therein, that no modifications are necessary to comply with the Contract.
- 8.3.11 All Test Reports and documents to be submitted in English during final inspection of equipment by POWERGRID or as and when required for submission.
- 8.3.12 When the factory tests have been completed at the Bidder's or Sub-Bidder's works, the Employer/Inspection Engineer(IE) shall issue a certificate to this effect within fifteen (15) days after completion of tests & submission of documents by Bidder/manufacturer but if the tests are not witnessed by the Employer/IE, the certificate shall be issued within fifteen (15) days of receipt of the Bidder's Test certificate by the Employer/IE. Bidder shall, on completion of all tests, submit test reports within Ten (10) days to POWERGRID IE. Failure of the Employer/IE to issue such a certificate shall not prevent the Contractor from proceeding with the Works. The completion of these tests or the issue of the certificate shall not bind the Employer to accept the equipment should, it, on further tests after erection, be found not to comply with the Contract.
- 8.3.13 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, except where otherwise specified, shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Employer/Inspector or his authorised representative to carry out effectively such tests of the equipment in accordance with the Contract and shall give facilities to the Employer/Inspection Engineer or to his authorised representative to accomplish testing.

- 8.3.14 The inspection and acceptance by Employer and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the Contract, or if such equipment is found to be defective at a later stage.
- 8.3.15 The Employer will have the right of having at his own expenses any other test(s) of reasonable nature carried out at Contractor's premises or at site or in any other place in addition of aforesaid type and routine tests, to satisfy that the material comply with the specification.
- 8.3.16 The Employer reserves the right for getting any additional field tests conducted on the completely assembled equipment at site to satisfy that material complies with specifications.
- 8.3.17 Rework/ Re-engineering, if any, on any item/equipment shall be carried out only after mutual discussions and in accordance with mutually agreed procedure. Bidder shall submit Joint Inspection Report of equipments under Re-Work/Re-Engineering alongwith procedure for the same to POWERGRID for approval, before taking up the Re-Work/Re-Engineering, failing which POWERGRID reserves the right to reject the equipment.
- 8.3.18 Bidder may establish a field test Laboratory to execute Civil Construction testing requirements at site with the condition that all testing equipment shall be calibrated from POWERGRID approved accredited Testing laboratories, with calibration certificates kept available at site and all testing personnel employed in the Field-Testing Laboratories to be qualified and experienced Engineers or testing to be carried out at POWERGRID approved Third Party Laboratories.
- 8.3.19 Bidder shall ensure that all possible steps are taken to avoid damages to the equipment during transport, storage and erection.
- 8.3.20 Deleted.
- 8.3.21 Bidder shall ensure commissioning of all CSDs along with Circuit Breakers wherever applicable.
- 8.3.22 **For EHV transformers/reactors:**
 Insulation oil shall be as per POWERGRID Technical specifications and same grade shall be used for impregnation of the active part & testing at the works of Transformer/Reactor Manufacturer and as well as for filling the Transformer/Reactors at site. Contractor to ensure that windings for Transformer/Reactors are made in air-conditioned environment. Core-coil assembly shall be performed in positive pressurized dust-controlled environment. Dust measurements shall be monitored regularly at Transformer / Reactor Manufacturer works. Contractor shall ensure that respective civil foundations & Fire walls for Transformer/Reactors units to be commissioned, shall be made ready at concerned sites before receipt of Transformer/Reactors units. All the requisite material for Neutral & Delta Bus formation required for charging of complete bank of 765KV class 1-ph Transformer/Reactor units shall be made available at the concerned sites before receipt of the Transformer/Reactor units at site.
- 8.3.23 The Employer reserves the right to increase or decrease their involvement in inspections at Bidder's Works or at his Sub-Bidder's premises or at the

Employer's site or at any other place of Work based on performance of Bidder/sub-bidder.

9.0 TYPE TESTING & CLEARANCE CERTIFICATE

- 9.1 All equipment being supplied shall conform to type tests as per technical specification and shall be subject to routine tests in accordance with requirements stipulated under respective sections.
- 9.2 The reports for all type tests as per technical specification shall be furnished by the Contractor along with equipment / material drawings. However, type test reports of similar equipments/ material already accepted in POWERGRID shall be applicable for all projects with similar requirement. The type tests conducted earlier 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 POWERGRID/representative authorized by POWERGRID/representative of Utility /representative of accredited test lab/ representative of The National Accreditation Board for Certification Bodies (NABCB) certified agency shall also be acceptable. Unless otherwise specified elsewhere, the type test reports submitted shall be of the tests conducted within the years specified below from the date of NOA. In case the test reports are of the test conducted earlier than the years specified below from the date of NOA, the contractor shall repeat these test(s) at no extra cost to the Employer.

S.No	Name of Equipment	Validity of type test (in years)
1	Power Transformer	5
2	LT Transformer	5
3	Shunt Reactor	5
4	OLTC	10
5	Bushing of Power Transformers/Reactors	7
6	Fittings and accessories for Power transformers & Reactors	10
7	Circuit Breaker	10
8	Isolator	10
9	Lighting Arrester	10
10	Wave Trap	10
11	Instrument transformer	7
12	GIS & Hybrid GIS	10
13	LT Switchgear	10
14	Cable and associated accessories	10
15	Relays	7
16	Capacitors	10
17	Battery & Battery Charger	7
18	Conductor & Earth wire	10
19	Insulators (Porcelain/Glass)	10
20	Composite Insulators	5
21	PLCC	5

Note :

For all other equipment's validity of type test shall be 10 years from date of NOA.

Further, 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 or any/all type tests not carried out, same shall be carried out without any additional cost implication to the Employer.

The Contractor shall intimate the Employer the detailed program about the type tests at least two (2) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies.

- 9.3 The Employer intends to repeat those type tests which are indicated in the price schedule and the same shall be payable as per provision of contract. The price of conducting type tests shall be included in Bid price and break up of these shall be given in the relevant schedule of Bid Proposal Sheets. These Type test charges would be considered in bid evaluation. In case Bidder does not indicate charges for any of the type tests or does not mention the name of any test in the price schedules, it will be presumed that the particular test has been offered free of charge. Further, in case any Bidder indicates that he shall not carry out a particular test, his offer shall be considered incomplete and shall be liable to be rejected. The Employer reserves the right to waive the repeating of type tests partly or fully and in case of waiver, test charges for the same shall not be payable.
- 9.4 The Employer reserves the right to witness any or all the type tests. The Employer shall bear all expenses for deputation of Employer's representative(s) for witnessing the type tests except in the case of re-deputation if any, necessitated due to no fault of the Employer.
- 9.5 The list of makes of various items, for which Type test reports are not required to be submitted are specified at Annexure-J.

10.0 Deleted.

11.0 PACKAGING & PROTECTION

- 11.1 All the equipments 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. On request of the Employer, the Bidder shall also submit packing details/associated drawing for any equipment/material under his scope of supply, to facilitate the Employer to repack any equipment/material at a later date, in case the need arises. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes in India should be taken into account. The Bidder shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. Employer/BHEL takes no responsibility of the availability of the wagons.
- 11.2 All coated surfaces shall be protected against abrasion, impact, discolouration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and pipings and conduit equipment

connections shall be properly sealed with suitable devices to protect them from damage.

12.0 FINISHING OF METAL SURFACES

12.1 All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. All steel conductors including those used for earthing/grounding (above ground level) shall also be galvanized according to IS: 2629.

12.2 HOT DIP GALVANISING

12.2.1 The minimum weight of the zinc coating shall be 610 gm/sq.m and minimum average thickness of coating shall be 86 microns for all items having thickness 6mm and above. For items lower than 6mm thickness requirement of coating thickness shall be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sq.m minimum.

12.2.2 The galvanized surfaces shall consist of 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.

12.2.3 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 or alternate approved treatment shall be provided to avoid formation of white rust after hot dip galvanization.

12.2.4 The galvanized steel shall be subjected to four numbers of one minute dips in copper sulphate solution as per IS-2633.

12.2.5 Sharp edges with radii less than 2.5 mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.

- Coating thickness
- Uniformity of zinc
- Adhesion test
- Mass of zinc coating

12.2.6 Galvanised material must be transported properly to ensure that galvanised surfaces are not damaged during transit. Application of touch-up zinc rich paint at site shall be allowed with approval of Engineer Incharge.

12.3 PAINTING

- 12.3.1 All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS6005 "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.
- 12.3.2 Hot Phosphating shall be done for phosphating process under pretreatment of sheets 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.
- 12.3.3 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.
- 12.3.4 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 be matching with the existing panels in case of extension of a substation. Each coat of 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.
- 12.3.5 In case the contractor 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 during detailed engineering for Employer's review & approval.
- 12.3.6 The colour scheme as given below shall be followed for Fire Protection and Air Conditioning systems

S.No.	PIPE LINE	Base colour	Band colour
<u>Fire Protection System</u>			
1	Hydrant and Emulsifier system pipeline/NIFPS	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 Plant			
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

The direction of flow shall be marked by → (arrow) in black colour.



Base Colour Direction of flow Band Colour

12.3.7 For aluminium casted surfaces, the surface shall be with smooth finish. Further, in case of aluminium enclosures, the surface shall be coated with powder (coating thickness of 60 microns) after surface preparation for painting. For stainless steel surfaces, no painting is envisaged.

12.3.8 Band colour is required for Emulsifier system detection line only if both water and air detection lines are present at the same substation. Further, band colour shall be applied at an interval of 2 meters approx. along the length and minimum width of band shall be 25mm.

13.0 Deleted.

14.0 TOOLS

14.1 Deleted.

14.2 SPECIAL TOOLS AND TACKLES

The bidder shall supply all special tools and tackles required for Operation and maintenance of equipment. The special tools and tackles shall only cover items which are specifically required for the equipment offered and are proprietary in nature. The list of special tools and tackles, if any, shall be finalized during detail engineering and the same shall be supplied without any additional cost implication to the Employer.

14.3 Deleted.

15.0 AUXILIARY SUPPLY

15.1 The auxiliary power for station supply, including the equipment drive, cooling system of any equipment, air-conditioning, lighting etc shall be designed for the specified Parameters as under. The DC supply for the instrumentation and PLCC system shall also conform the parameters as indicated in the following table:

Normal Voltage	Variation in Voltage	Frequency in HZ	Phase/Wire	Neutral connection
415V	± 10%	50 ± 5%	3/4 Wire	Solidly Earthed.

240V	$\pm 10\%$	$50 \pm 5\%$	1/2 Wire	Solidly Earthed.
220V	190V to 240V	DC	Isolated 2 wire System	-
110V	95V to 120V	DC	Isolated 2 wire System	-
48V	--	DC	2 wire system (+) earthed	-

Combined variation of voltage and frequency shall be limited to $\pm 10\%$.

- 15.2 Pickup value of binary input modules of Intelligent Electronic Devices, Digital protection couplers, Analog protection couplers shall not be less than 50% of the specified rated station auxiliary DC supply voltage level.

16.0 SUPPORT STRUCTURE (ONLY OF CIRCUIT BREAKER)

- 16.1 The equipment support structures shall be suitable for equipment connections at the first level i.e 14.0-meter, 8.0-meter, 5.9 meter and 4.6 meter from plinth level for 765kV, 400kV, 220kV and 132kV substations respectively. All equipment support structures shall be supplied alongwith brackets, angles, stools etc. for attaching the operating mechanism, control cabinets & marshalling box (wherever applicable) etc.
- 16.2 The minimum vertical distance from the bottom of the lowest porcelain/polymer part of the bushing, porcelain/polymer enclosures or supporting insulators to the bottom of the equipment base, where it rests on the foundation pad shall be 2.55 metres.

17.0 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS (For Lightning Arrester & Wave Trap only)

- 17.1 All power clamps and connectors shall conform to IS:5561 or other equivalent international standard and shall be made of materials listed below :

Sl. No.	Description	Materials
a)	For connecting ACSR conductors/AAC conductors/ Aluminium tube	Aluminum alloy casting, conforming to designation 4600 of IS:617 and all test shall conform to IS:617
b)	For connecting equipment terminals mad of copper with ACSR conductors/AAC conductors/ Aluminium tube	Bimetallic connectors made from aluminum alloy casting, conforming to designation 4600 of IS:617 with 2mm thick bimetallic liner/strip and all test shall conform to IS:617
c)	For connecting G.I	Galvanised mild steel shield wire

d)	Bolts, nuts & plain washers	Electro-galvanised for sizes below M12, for others hot dip galvanised.
e)	Spring washers	Electro-galvanised mild steel suitable for atleast service condition-3 as per IS:1573

- 17.2 Necessary clamps and connectors shall be supplied for all equipment and connections. 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.
- 17.3 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.
- 17.4 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.
- 17.5 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/strip of minimum 2 mm thickness shall be cast integral with aluminum body or 2 mm thick bi-metallic liner/strips shall be provided for Bi-metallic clamps.
- 17.6 All casting shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.
- 17.7 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 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.
- 17.8 Current carrying parts (500A and above) of the clamp/connector shall be provided with minimum four numbers of bolts preferably for 132kV and above.
- 17.9 All current carrying parts shall be designed and manufactured to have minimum contact resistance.
- 17.10 Power Clamps and connectors shall be designed to control corona as per requirement.

17.11 Tests

Clamps and connectors should be type tested on minimum three samples 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. Type test once conducted shall hold good. 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 132kV and above voltage level clamps]
- iv) Resistance test and Pullout strength test
- v) Cantilever Strength test on bus support clamps & connectors

18.0 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES MARSHALLING BOXES FOR OUTDOOR EQUIPMENT

18.1 All types of boxes, cabinets etc. shall generally conform to & be tested in accordance with IS/IEC 61439-0, as applicable, and the clauses given below:

18.2 Control cabinets, junction boxes, Marshalling boxes & terminal boxes, Out door ACDB cum DCDB panels shall be made of stainless steel of atleast 1.5 mm thick or aluminium enclosure of atleast 1.6 mm thick and shall be dust, water and vermin proof. Stainless steel used shall be of grade SS304 (SS316 for coastal area) or better. The box shall be properly braced 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.

Control cabinets, junction boxes, marshalling boxes & terminal boxes, outdoor ACDB cum DCDB panels shall have adequate space/clearance as per guidelines/technical specifications to access/replace any component. Necessary component labelling to be also done on non-conducting sheet.

For CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES MARSHALLING BOXES

FOR OUTDOOR EQUIPMENT Junction Box, wire should be as per IS or equivalent IEC with FRLS grade.

Machine laid PU Foam gasket may be permitted for use in Control Cabinets etc.

18.3 A canopy and sealing arrangements for operating rods shall be provided in marshalling boxes / Control cabinets to prevent ingress of rain water.

18.4 Cabinet/boxes with width more than 700 mm 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.

18.5 All doors, removable covers and plates shall be gasketed all around with suitably profiled EPDM/Neoprene/PU gaskets. The gasket shall be tested in accordance with approved quality plan, IS:11149 and IS:3400. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

Further, the gasketing arrangement shall be such that gaskets are pasted in slots (in door fabrication/gasket itself) in order to prevent ingress of dust and moisture inside the panels so that no internal rusting occurs in panels during the operation of the equipment.

- 18.6 All boxes/cabinets shall be designed for the entry of cables 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 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. The Nickel plated glands shall be dust proof, screw on & double compression type and made of brass. The gland shall have provision for securing armour of the cable separately and shall be provided with earthing tag. The glands shall conform to BS:6121.
- 18.7 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.
- 18.8 LED based illumination of minimum 9 watts 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.
- 18.9 All control switches shall be of MCB/rotary switch type and Toggle/piano switches shall not be accepted.
- 18.10 Earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire 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.
- 18.11 The bay marshalling kiosks shall be provided with danger plate and a diagram showing the numbering/connection/feruling by pasting the same on the inside of the door.
- 18.12 The following routine tests alongwith the routine tests as per IS:5039 shall also be conducted:
- i) Check for wiring
 - ii) Visual and dimension check
- 18.13 The enclosure of bay marshalling kiosk, junction box, terminal box and control cabinets shall conform to IP-55 as per IS/IEC60947 including application of 1kV rms for 1 (one) minute, after IP-55 test.
- 19.0 Deleted.**
- 20.0 TERMINAL BLOCKS AND WIRING**
- 20.1 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.
- 20.2 Terminal blocks shall be 650V grade and have continuous rating to carry the maximum expected current on the terminals and non-breakable type.

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. But the terminal blocks shall be non-disconnecting stud type except for the secondary junction boxes of Current Transformer and Voltage Transformer.

- 20.3 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.
- 20.4 The terminal 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.
- 20.5 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.
- 20.6 The terminal blocks shall be of extensible design, multilayer terminal arrangement is not allowed in any junction box (Common MB, Individual MB, JB etc.). There should be sufficient space at both sides of terminals so that ferrule number of wires / TB numbers are clearly visible during wire removal or insertion.
- 20.7 The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.
- 20.8 The terminal blocks shall be fully enclosed with removable covers of transparent, nondeteriorating 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.
- 20.9 Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.
- | | | |
|----|------------------------------------|---|
| a) | All circuits except CT/PT circuits | Minimum of two of
2.5 sq mm copper
flexible. |
| b) | All CT/PT circuits | Minimum of 4 nos. of
2.5 sq mm copper
flexible. |
- 20.10 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.
- 20.11 At least 20 % spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.
- 20.12 There shall be a minimum clearance of 250 mm between the First/bottom row of terminal block and the associated cable gland plate for outdoor

ground mounted marshalling box and the clearance between two rows of terminal blocks shall be a minimum of 150 mm.

- 20.13 The Contractor 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

21.0 LAMPS & SOCKETS

21.1 Lamps & Sockets

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

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.

21.2 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.

21.3 Switches and Fuses:

- 21.3.1 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 / switch fuse 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.

- 21.3.2 All fuses shall be of HRC cartridge type conforming to relevant IS 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 of the fuse rating and voltage.

22.0 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS:

- 22.1 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.

- 22.2 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.

- 22.3 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.

- 22.4 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.
- 22.5 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.
- 22.6 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.
- 22.7 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.
- 22.8 Void
- 22.9 Deleted.

23.0 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.

23.1 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.

23.2 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.

23.3 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.

23.4 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.

23.5 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 Employer without any extra cost to the Employer. The Contractor shall arrange all instruments

required for conducting these tests alongwith calibration certificates and shall furnish the list of instruments to the Employer 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

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ANNEXURE-A

CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1. General

Unless otherwise stipulated, all equipment together with its associated connectors, where applicable, shall be tested for external corona (for 400kV & 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 132kV and above.

2. 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. 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 carried out in accordance with relevant IEC of respective equipment or NEMA standard Publication No. 107-1964.

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 765kV, 400 kV, 220 KV 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. 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,

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

ANNEXURE-A

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 3 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 three values at which visible corona (negative or positive polarity) disappears.

The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.

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 Employer's inspector if, in his opinion, it will not prejudice other test

5. 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.

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)ANNEXURE-B**SEISMIC WITHSTAND TEST PROCEDURE**

The seismic withstanding test on the complete equipment (for 400kV and above) shall be carried out along with supporting structure. Seismic Withstand Test carried out using either lattice or pipe structure is acceptable.” **Seismic Calculations certified by NABL Labs shall also be acceptable**

The Bidder shall arrange to transport the structure from his Contractor’s premises/ POWERGRID 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 Employer. 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 Employer.

The frequency range for the earthquake spectra shall be as per IEC-62271-300.

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)ANNEXURE-C**LIST OF GENERAL STANDARDS AND CODES**

CODES	TITLE
--	India Electricity Rules
--	Indian Electricity Act
--	Indian Electricity (Supply) Act
--	Indian Factories Act
IS-5	Colors for Ready Mixed Paints and Enamels
IS-335	New Insulating Oils
IS-617	Aluminium and Aluminium Alloy Ingots and Castings for General Engineering Purposes
IS-1448 (P1 to P 145)	Methods of Test for Petroleum and its Products
IS-2071 (P1 to P3)	Methods of High Voltage Testing
IS-12063	Classification of degrees of protection provided by enclosures of electrical equipment
IS-2165 ; P1:1997, P2:1983	Insulation Coordination
IS-3043	Code of Practice for Earthing
IS-6103	Method of Test for Specific Resistance (Resistivity) of Electrical Insulating Liquids
IS-6104	Method of Test for Interfacial Tension of Oil against Water by the Ring Method
IS-6262	Method of test for Power factor & Dielectric Constant of Electrical Insulating Liquids
IS-6792	Method for determination of electric strength of insulating oils
IS-5578	Guide for marking of insulated conductors
IS-11353	Guide for uniform system of marking & identification of conductors & apparatus terminals.
IS-8263	Methods for Radio Interference Test on High voltage Insulators
IS-9224 (Part 1,2&4)	Low Voltage Fuses
IEC-60060 (Part 1 to P4)	High Voltage Test Techniques
IEC 60068	Environmental Test
IEC-60117	Graphical Symbols
IEC-60156	Method for the Determination of the Electrical Strength of Insulation Oils
IEC-60270	Partial Discharge Measurements
IEC-60376	Specification and Acceptance of New Sulphur Hexafluoride
IEC-60437	Radio Interference Test on High Voltage Insulators
IEC-60507	Artificial Pollution Tests on High Voltage Insulators to be used on AC Systems
IEC-62271-1	Common Specification for High Voltage Switchgear & Control gear Standards
IEC-60815	Guide for the Selection of Insulators in respect of Polluted Conditions

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CODES	TITLE
IEC-60865 (P1 & P2)	Short Circuit Current - Calculation of effects
ANSI-C.1/NFPA.70	National Electrical Code
ANSI-C37.90A	Guide for Surge Withstand Capability (SWC) Tests
ANSI-C63.21, C63.3	Specification for Electromagnetic Noise and Field Strength Instrumentation 10 KHz to 1 GHZ
C36.4ANSI-C68.1	Techniquet for Dielectric Tests
ANSI-C76.1/EEE21	Standard General Requirements and Test Procedure for Outdoor Apparatus Bushings
ANSI-SI-4	Specification for Sound Level Meters
ANSI-Y32-2/C337.2	Drawing Symbols
ANSI-Z55.11	Gray Finishes for Industrial Apparatus and Equipment No. 61 Light Gray
NEMA-107T	Methods of Measurements of RIV of High Voltage Apparatus
NEMA-ICS-II	General Standards for Industrial Control and Systems Part ICSI-109
CISPR-1	Specification for CISPR Radio Interference Measuring Apparatus for the frequency range 0.15 MHz to 30 MHz
CSA-Z299.1-1978h	Quality Assurance Program Requirements
CSA-Z299.2-1979h	Quality Control Program Requirements
CSA-Z299.3-1979h	Quality Verification Program Requirements
CSA-Z299.4-1979h	Inspection Program Requirements
TRANSFORMERS AND REACTORS	
IS:10028 (Part 2 & 3)	Code of practice for selection, installation & maintenance of Transformers (P1:1993), (P2:1991), (P3:1991)
IS-2026 (P1 to P4)	Power Transformers
IS-3347 (part 1 to Part 8)	Dimensions for Porcelain transformer Bushings for use in lightly polluted atmospheres
IS-3639	Fittings and Accessories for Power Transformers
IS-6600	Guide for Loading of oil immersed Transformers
IEC-60076 (Part 1 to 5)	Power Transformers
IEC-60214	On-Load Tap-Changers
IEC-60289	Reactors
IEC- 60354	Loading Guide for Oil - Immersed power transformers
IEC-60076-10	Determination of Transformer and Reactor Sound Levels
ANSI-C571280	General requirements for Distribution, Power and Regulating Transformers
ANSI-C571290	Test Code for Distribution, Power and Regulation Transformers
ANSI-C5716	Terminology & Test Code for Current Limiting Reactors
ANSI-C5721	Requirements, Terminology and Test Code for Shunt Reactors Rated Over 500 KVA
ANSI-C5792	Guide for Loading Oil-Immersed Power Transformers upto and including 100 MVA with 55 deg C or 65 deg C Winding Rise

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CODES	TITLE
ANSI-CG,1EEE-4	Standard Techniques for High Voltage Testing
IEC 60076	Power transformers
IEC 60076-1	Part 1: General
IEC 60076-2	Part 2: Temperature rise
IEC 60076-3	Part 3: Insulation levels, dielectric tests and external clearances in air
IEC 60076-4	Part 4: Guide to the lightning impulse and switching impulse testing - Power transformers and reactors
IEC 60076-3-1	Part 3-1: Insulation Levels and Dielectric Tests –External Clearances in Air
IEC 60076-5	Part 5: Ability to withstand short circuit
IEC 60076-6	Part 6: Reactors
IEC 60076-7	Part 7: Loading guide for oil-immersed power transformers
IEC 60076-8	Part 8: Application guide
IEC 60076-10	Part 10: Determination of sound levels
IEC 60076-10-1	Part 10-1: Determination of sound levels - Application guide
IEC 60076-11	Part 11: Dry-type transformers
IEC 60076-12	Part 12: Loading guide for dry-type power transformers
IEC 60076-13	Part 13: Self-protected liquid-filled transformers
IEC 60076-14	Part 14: Design and application of liquid-immersed power transformers using high-temperature insulation materials
IEC 60076-15	Part 15: Gas-filled power transformers
IEC 60076-16	Part 16: Transformers for wind turbine applications
IEC 60076-18	Part 18: Measurement of frequency response
IEC 60076-19	Part 19: Rules for the determination of uncertainties in the measurement of losses in power transformers and reactors
IEC 60076-21	Part 21: Standard requirements, terminology, and test code for step-voltage regulators
IEC 60044, BS 3938	Current transformers
IEC 60050	International Electrotechnical Vocabulary
IEC 60050(421)	International Electrotechnical vocabulary- Chapter 421 : Power Transformers and Reactors
IEC 60060	High Voltage test techniques
IEC 60060-1	General definitions and test requirements
IEC 60060-2	Measuring systems
IEC 60071	Insulation co-ordination
IEC 60071-1	Part 1: Definitions, principles and rules
IEC 60071-2	Part 2 : Application guide
IEC 60137	Bushing for alternating voltage above 1000V
IEC 60214	On-Load Tap changers
IEC 255-21-3	Relays vibration

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CODES	TITLE
IEC 60270	Partial discharge measurements
IEC 60296	Specification for Unused Mineral Oil for Transformers and Switchgear
IEC 60422	Supervision and Maintenance guide for Mineral Insulating Oil in Electrical Equipment
IEC 60475	Method of Sampling Liquid dielectrics
IEC 60529	Classification of Degrees of Protection provided by Enclosures
IEC 60542	Application Guide for On-Load Tap-Changers
IEC 60567	Guide for the Sampling of Gases and of Oil from Oil-filled Electrical Equipment for the Analysis of Free and Dissolved Gases
IEC 60651	Sound Level Meters
IEC 61083	Digital Recorders and Software for High Voltage Impulse testing
IEC 61083-1	Part 1: Requirements for digital recorders in high voltage impulse tests
IEC 61083-2	Part 2: Evaluation of software used for the determination of the parameters of impulse waveforms
CISPR 16	Specification for radio disturbance and immunity measuring apparatus
CISPR 16-1	Radio disturbance and immunity measuring apparatus
CISPR-18	Radio Interference Characteristics of Power Lines and High Voltage Equipment
ISO 9001	Quality system-Model for Quality Assurance in Design /development
Cigre Publication 202	Guidelines for conducting design reviews for transformers 100 MVA and 123 kV and above. August 2002-Cigre Working Group 12.22
WG 12-15	Guide for Customers Specifications for Transformers 100 MVA and 123 kV and above
WG 12 19	Short Circuit Performance of Transformers.
BS-4360	Specification for weldable structural steel
BS-5135	Specification for arc welding of carbon and carbon manganese steels
BS-5500	Specification for unfired fusion welded pressure vessels
IS-3618	Specification for phosphate treatment of iron & steel for protection against corrosion
IS-6005	Code of practice for phosphating of Iron and Steel
ISO-8501	Preparation of steel surface before application of Paints and related product
IEC-60599	Mineral oil impregnated electrical equipment in service – guide to the interpretation of dissolved and free gases analysis
IS-10593	Method of evaluating the analysis of gases in oil filled electrical equipment in service
IS-2099	Bushings for alternating voltages above 1000 volts

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)ANNEXURE-C

CODES	TITLE
IS-3347 Part I to 8	Dimension for porcelain transformer bushing
DIN-42530	Bushing up to 1000kV from 250A-5000A for liquid filled Transformer
IS-2026 Part 1 to 5	Power transformer
IS-4691	Degrees of protection provided by enclosure for rotating electrical machinery
IEC-60034-5	Degrees of protection provided by integral design of rotating electrical machines(IP Code) classification
IS:325 / IEC -60034	Performance of cooling fan / oil pump motor
IS-13947 part 1 to 5	Specification for low voltage switchgear and control gear
IS:3400	Methods of test for vulcanised rubber
IS:7016 part 1 to 14	Methods of test for coated and treated fabrics
IS:803	Code of practice for design, fabrication and erection of vertical mild steel cylindrical welded oil storage tanks.
IS:3637	Gas operated Relays
IS:335	New Insulating oils – Specification
IEC-62271-203	Gas insulated metal enclosed switchgear for rated voltage above 52kV
IEC-61639	Direct connection between power transformers and gas-insulated metal enclosed switchgear for rated voltages of 52.5 kV and above.
IS:3400 / BS 903 / IS:7016	Air cell (Flexible Air Separator)
IEC 60529 / IP : 55	Degree of protection for cooler control cabinet , MOLG, Cooling fan , oil pump, Buchholz Relay
IEC 60529 / IP : 56	Degree of protection for Pressure Relief Device
IEC 60529 / IP : 43	Degree of protection for Remote tap Changer cubicle (RTCC)
CIRCUIT BREAKERS	
IEC-62271-100	High-voltage switchgear and control gear - Part 100: Alternating current circuit-breakers
IEC-62271-101	High-voltage switchgear and control gear - Part 101: Synthetic testing
IEC-62155	Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1000 V
IEC-62271-110	High-voltage switchgear and control gear - Part 110: Inductive load switching
IEC-62271-109	High-voltage switchgear and control gear - Part 110: Inductive load switching
CURRENT TRANSFORMERS, VOLTAGE TRANSFORMERS AND COUPLING CAPACITOR VOLTAGE TRANSFORMERS	
IS-2705- (P1 to P4)	Current Transformers

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)ANNEXURE-C

CODES	TITLE
IS:3156- (P1 to P4)	Voltage Transformers
IS-4379	Identification of the Contents of Industrial Gas Cylinders
IEC-61869 (Part-1)	Instrument transformers - Part 1: General requirements
IEC-61869 (Part-2)	Instrument transformers - Part 2: Additional requirements for current transformers
IEC-61869 (Part-3)	Instrument transformers - Part 3: Additional requirements for inductive voltage transformers
IEC-61869 (Part-4)	Instrument transformers - Part 4: Additional requirements for combined transformers
IEC-61869 (Part-5)	Instrument transformers - Part 5: Additional requirements for capacitor voltage transformers
IEC-61869 (Part-6)	Instrument transformers - Part 6: Additional general requirements for low-power instrument transformers
IEC-61869 (Part-9)	Instrument transformers - Part 9: Digital interface for instrument transformers
IEC-61869 (Part-102)	Instrument transformers - Part 102: Ferroresonance oscillations in substations with inductive voltage transformers
IEC-61869 (Part-103)	Instrument transformers - The use of instrument transformers for power quality measurement
BUSHING	
IS-2099	Bushings for Alternating Voltages above 1000V
IEC-60137	Insulated Bushings for Alternating Voltages above 1000V
SURGE ARRESTERS	
IS-3070 (PART2)	Lightning arresters for alternating current systems : Metal oxide lightning arrestors without gaps
IEC-60099-4	Metal oxide surge arrestors without gaps
IEC-60099-5	Selection and application recommendation
ANSI-C62.1	IEE Standards for S A for AC Power Circuits
NEMA-LA 1	Surge Arresters
CUBICLES AND PANELS & OTHER RELATED EQUIPMENTS	
IS-722, IS-1248	Electrical relays for power system
IS-3231, 3231 (P-3)	Protection
IS:5039	Distributed pillars for Voltages not Exceeding 1000 Volts
IEC-60068.2.2	Basic environmental testing procedures Part 2: Test B: Dry heat
IEC-60529	Degree of Protection provided by enclosures
IEC-60947-4-1	Low voltage switchgear and control gear
IEC-61095	Electromechanical Contactors for household and similar purposes
IEC-60439 (P1 & 2)	Low Voltage Switchgear and control gear assemblies
ANSI-C37.20	Switchgear Assemblies, including metal enclosed bus
ANSI-C37.50	Test Procedures for Low Voltage Alternating Current Power

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)ANNEXURE-C

CODES	TITLE
	Circuit Breakers
ANSI-C39	Electric Measuring instrument
ANSI-C83	Components for Electric Equipment
IS: 8623: (Part I to 3)	Specification for Switchgear & Control Assemblies
NEMA-AB	Moulded Case Circuit and Systems
NEMA-CS	Industrial Controls and Systems
NEMA-PB-1	Panel Boards
NEMA-SG-5	Low voltage Power Circuit breakers
NEMA-SG-3	Power Switchgear Assemblies
NEMA-SG-6	Power switching Equipment
NEMA-5E-3	Motor Control Centers
1248 (P1 to P9)	Direct acting indicating analogue electrical measuring instruments & their accessories
Disconnecting switches	
IEC-62271-102	High-voltage switchgear and control gear - Part 102: Alternating current disconnectors and earthing switches
IEC-60265 (Part 1 & 2)	High Voltage switches
ANSI-C37.32	Schedule of preferred Ratings, Manufacturing Specifications and Application Guide for high voltage Air Switches, Bus supports and switch accessories
ANSI-C37.34	Test Code for high voltage air switches
NEMA-SG6	Power switching equipment
PLCC and line traps	
IS-8792	Line traps for AC power system
IS-8793	Methods of tests for line traps
IS-8997	Coupling devices for PLC systems
IS-8998	Methods of test for coupling devices for PLC systems
IEC-60353	Line traps for A.C. power systems
IEC-60481	Coupling Devices for power line carrier systems
IEC-60495	Single sideboard power line carrier terminals
IEC-60683	Planning of (single Side-Band) power line carrier systems
CIGRE	Teleprotection report by Committee 34 & 35
CIGRE	Guide on power line carrier 1979
CCIR	International Radio Consultative Committee
CCITT	International Telegraph & Telephone Consultative Committee
EIA	Electric Industries Association
Protection and control equipment	
IEC-60051: (P1 to P9)	Recommendations for Direct Acting indicating analogue electrical measuring instruments and their accessories
IEC-60255 (Part 1 to 23)	Electrical relays
IEC-60297 (P1 to P4)	Dimensions of mechanical structures of the 482.6mm (19 inches)

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)ANNEXURE-C

CODES	TITLE
	series
IEC-60359	Expression of the performance of electrical & electronic measuring equipment
IEC-60387	Symbols for Alternating-Current Electricity meters
IEC-60447	Man machine interface (MMI) - Actuating principles
IEC-60521	Class 0.5, 1 and 2 alternating current watt hour metres
IEC-60547	Modular plug-in Unit and standard 19-inch rack mounting unit based on NIM Standard (for electronic nuclear instruments)
ANSI-81	Screw threads
ANSI-B18	Bolts and Nuts
ANSI-C37.1	Relays, Station Controls etc
ANSI-C37.2	Manual and automatic station control, supervisory and associated telemetering equipment
ANSI-C37.2	Relays and relay systems associated with electric power apparatus
ANSI-C39.1	Requirements for electrical analog indicating instruments
MOTORS	
IS-325	Three phase induction motors
IS-4691	Degree of protection provided by enclosure for rotating electrical machinery
IEC-60034 (P1 to P19:)	Rotating electrical machines
IEC-Document 2 (Central Office)	Three phase induction motors Motors and Generators
NEMA-MGI	
Electronic equipment and components	
MIL-21B, MIL-833 & MIL-2750	Environmental testing
EC-60068 (P1 to P5)	Printed boards
IEC-60326 (P1 to P2)	Material and workmanship standards
IS-1363 (P1 to P3)	Hexagon head bolts, screws and nuts of product grade C
IS-1364 (P1 to P5)	Hexagon head bolts, screws and nuts of products grades A and B
IS-3138	Hexagonal Bolts and Nuts (M42 to M150)
ISO-898	Fasteners: Bolts, screws and studs
ASTM	Specification and tests for materials
Clamps & connectors	
IS-5561	Electric power connectors
NEMA-CC1	Electric Power connectors for sub station
NEMA-CC 3	Connectors for Use between aluminium or aluminum-Copper Overhead Conductors
Bus hardware and insulators	
IS: 2121	Fittings for Aluminum and steel cored Al conductors for overhead

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**ANNEXURE-C**

CODES	TITLE
	power lines
IS-731	Porcelain insulators for overhead power lines with a nominal voltage greater than 1000 V
IS-2486 (P1 to P4)	Insulator fittings for overhead power lines with a nominal voltage greater than 1000 V
IEC-60120	Dimensions of Ball and Socket Couplings of string insulator units
IEC-60137	Insulated bushings for alternating voltages above 1000 V
IEC-60168	Tests on indoor and outdoor post insulators of ceramic material or glass for Systems with Nominal Voltages Greater than 1000 V
IEC-62155	Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1 000 V
IEC-60273	Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000V
IEC-61462	Pressurized and un-pressurized insulator for use in electrical equipment with rated voltage greater than 1000V – Definitions, Test methods, acceptance criteria and design recommendations
IEC-60305	Insulators for overhead lines with nominal voltage above 1000V-ceramic or glass insulator units for ac systems Characteristics of String Insulator Units of the cap and pin type
IEC-60372 (1984)	Locking devices for ball and socket couplings of string insulator units : dimensions and tests
IEC-60383 (P1 and P2)	Insulators for overhead lines with a nominal voltage above 1000 V
IEC-60433	Characteristics of string insulator units of the long rod type
IEC-60471	Dimensions of Clevis and tongue couplings of string insulator units
ANSI-C29	Wet process porcelain insulators
ANSI-C29.1	Test methods for electrical power insulators
ANSI-C92.2	For insulators, wet-process porcelain and toughened glass suspension type
ANSI-C29.8	For wet-process porcelain insulators apparatus, post-type
ANSI-G.8	Iron and steel hardware
CISPR-7B	Recommendations of the CISPR, tolerances of form and of Position, Part 1
ASTM A-153	Zinc Coating (Hot-Dip) on iron and steel hardware
Strain and rigid bus-conductor	
IS-2678	Dimensions & tolerances for Wrought Aluminum and Aluminum Alloys drawn round tube
IS-5082	Wrought Aluminum and Aluminum Alloy Bars. Rods, Tubes and Sections for Electrical purposes
ASTM-B 230-82	Aluminum 1350 H19 Wire for electrical purposes

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)ANNEXURE-C

CODES	TITLE
ASTM-B 231-81	Concentric - lay - stranded, aluminum 1350 conductors
ASTM-B 221	Aluminum - Alloy extruded bar, rod, wire, shape
ASTM-B 236-83	Aluminum bars for electrical purpose (Bus-bars)
ASTM-B 317-83	Aluminum-Alloy extruded bar, rod, pipe and structural shapes for electrical purposes (Bus Conductors)
Batteries	
IS:1651	Stationary Cells and Batteries, Lead-Acid Type (with Tubular Positive Plates)
IS:1652	Stationary Cells and Batteries, Lead-Acid Type (with Plante Positive Plates)
IS:1146	Rubber and Plastic Containers for Lead-Acid Storage Batteries
IS:6071	Synthetic Separators for Lead-Acid Batteries
IS:266	Specification for Sulphuric Acid
IS:1069	Specification for Water for Storage Batteries
IS:3116	Specification for Sealing Compound for Lead-Acid Batteries
IS:1248	Indicating Instruments
IS:10918	Vented type nickel Cadmium Batteries
IEC:60896-21&22	Lead Acid Batteries Valve Regulated types – Methods of Tests & Requirements
IEC: 60623	Vented type nickel Cadmium Batteries
IEC:60622	Secondary Cells & Batteries – Sealed Ni-Cd rechargeable single cell
IEC:60623	Secondary Cells & Batteries – Vented Ni-Cd rechargeable single cell
IEC:60896-11	Stationary Lead Acid Batteries – Vented Type – General requirements & method of tests
IEEE-485	Recommended practices for sizing of Lead Acid Batteries
IEEE-1115	Sizing of Ni-Cd Batteries
IEEE-1187	Recommended practices for design & installation of VRLA Batteries
IEEE-1188	Recommended practices for design & installation of VRLA Batteries
IEEE-1189	Guide for selection of VRLA Batteries
Battery Charger	
IS:3895	Mono-crystalline Semiconductor Rectifier Cells and Stacks
IS:4540	Mono-crystalline Semiconductor Rectifier Assemblies and Equipment
IS:6619	Safety Code for Semiconductor Rectifier Equipment
IS:2026	Power Transformers

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)ANNEXURE-C

CODES	TITLE
IS:2959	AC Contactors for Voltages not Exceeding 1000 Volts
IS:1248	Indicating Instruments
IS:2208	HRC Fuses
IS:13947 (Part-3)	Air break switches, air break disconnectors & fuse combination units for voltage not exceeding 1000V AC or 1200V DC
IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control gear
IS:6005	Code of practice for phosphating of Iron and Steel
IS:3231	Electrical relays for power system protection
IS:3842	Electrical relay for AC Systems
IS:5	Colours for ready mix paint
IEEE-484	Recommended Design for installation design and installation of large lead storage batteries for generating stations and substations
IEEE-485	Sizing large lead storage batteries for generating stations and substations
Wires and cables	
ASTMD-2863	Measuring the minimum oxygen concentration to support candle like combustion of plastics (oxygen index)
IS-694	PVC insulated cables for working voltages upto and including 1100 Volts
IS-1255	Code of practice for installation and maintenance of power cables, upto and including 33 kV rating
IS-1554 (P1 and P2)	PVC insulated (heavy duty) electric cables (part 1) for working voltage upto and including 1100 V Part (2) for working voltage from 3.3 kV upto and including 11kV
IS:1753	Aluminium conductor for insulated cables
IS:2982	Copper Conductor in insulated cables
IS-3961 (P1 to P5)	Recommended current ratings for cables
IS-3975	Mild steel wires, formed wires and tapes for armouring of cables
IS-5831	PVC insulating and sheath of electric cables
IS-6380	Elastometric insulating and sheath of electric cables
IS-7098	Cross linked polyethylene insulated PVC sheathed cables for working voltage upto and including 1100 volts
IS-7098	Cross-linked polyethylene insulated PVC sheathed cables for working voltage from 3.3kV upto and including 33 kV
IS-8130	Conductors for insulated electrical cables and flexible cords
IS-1753	Aluminum Conductors for insulated cables
IS-10418	Specification for drums for electric cables
IEC-60096 (part 0 to p4)	Radio Frequency cables
IEC-60183	Guide to the Selection of High Voltage Cables

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**ANNEXURE-C**

CODES	TITLE
IEC-60189 (P1 to P7)	Low frequency cables and wires with PVC insulation and PVC sheath
IEC-60227 (P1 to P7)	Polyvinyl Chloride insulated cables of rated voltages up to and including 450/750V
IEC-60228	Conductors of insulated cables
IEC-60230	Impulse tests on cables and their accessories
IEC-60287 (P1 to P3)	Calculation of the continuous current rating of cables (100% load factor)
IEC-60304	Standard colours for insulation for low-frequency cables and wires
IEC-60331	Fire resisting characteristics of Electric cables
IEC-60332 (P1 to P3)	Tests on electric cables under fire conditions
IEC-60502	Extruded solid dielectric insulated power cables for rated voltages from 1 kV upto to 30 kV
IEC-754 (P1 and P2)	Tests on gases evolved during combustion of electric cables
AIR conditioning and ventilation	
IS-659	Safety code for air conditioning
IS-660	Safety code for Mechanical Refrigeration
ARI:520	Standard for Positive Displacement Refrigeration Compressor and Condensing Units
IS:4503	Shell and tube type heat exchanger
ASHRAE-24	Method of testing for rating of liquid coolers
ANSI-B-31.5	Refrigeration Piping
IS:2062	Steel for general structural purposes
IS:655	Specification for Metal Air Dust
IS:277	Specification for Galvanised Steel Sheets
IS-737	Specification for Wrought Aluminium and Aluminium Sheet & Strip
IS-1079	Hot rolled cast steel sheet & strip
IS-3588	Specification for Electrical Axial Flow Fans
IS-2312	Propeller Type AC Ventilation Fans
BS-848	Methods of Performance Test for Fans
BS-6540 Part-I	Air Filters used in Air Conditioning and General Ventilation
BS-3928	Sodium Flame Test for Air Filters (Other than for Air Supply to I.C. Engines and Compressors)
US-PED-2098	Method of cold DOP & hot DOP test
MIL-STD-282	DOP smoke penetration method
ASHRAE-52	Air cleaning device used in general ventilation for removing particle matter
IS:3069	Glossary of Terms, Symbols and Units Relating to Thermal Insulation Materials

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)ANNEXURE-C

CODES	TITLE
IS:4671	Expanded Polystyrene for Thermal Insulation Purposes
IS:8183	Bonded Mineral Wool
IS:3346	Evaluation of Thermal Conductivity properties by means of guarded hot plate method
ASTM-C-591-69	Standard specification for rigid preformed cellular urethane thermal insulation
IS:4894	Centrifugal Fans
BS:848	Method of Performance Test for Centrifugal Fans
IS:325	Induction motors, three-phase
IS:4722	Rotating electrical machines
IS:1231	Three phase foot mounted Induction motors, dimensions of
IS:2233	Designations of types of construction and mounting arrangements of rotating electrical machines
IS:2254	Vertical shaft motors for pumps, dimensions of
IS:7816	Guide for testing insulation resistance of rotating machines
IS:4029	Guide for testing three phase induction motors
IS: 4729	Rotating electrical machines, vibration of, Measurement and evaluation of
IS:4691	Degree of protection provided by enclosures for rotating electrical machinery
IS:7572	Guide for testing single-phase ac motors
IS:2148	Flame proof enclosure for electrical apparatus
BS:4999(Part-51)	Noise levels
Galvanizing	
IS-209	Zinc Ingot
IS-2629	Recommended Practice for Hot-Dip galvanizing on iron and steel
IS-2633	Methods for testing uniformity of coating of zinc coated articles
ASTM-A-123	Specification for zinc (Hot Galvanizing) Coatings, on products Fabricated from rolled, pressed and forged steel shapes, plates, bars and strips
ASTM-A-121-77	Zinc-coated (Galvanized) steel barbed wire
Painting	
IS-6005	Code of practice for phosphating of iron and steel
ANSI-Z551	Gray finishes for industrial apparatus and equipment
SSPEC	Steel structure painting council
Fire protection system	
--	Fire protection manual issued by tariff advisory committee (TAC) of India
HORIZONTAL CENTRIFUGAL PUMPS	
IS:1520	Horizontal centrifugal pumps for clear, cold and fresh water
IS:9137	Code for acceptance test for centrifugal & axial pumps

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)ANNEXURE-C

CODES	TITLE
IS:5120	Technical requirement – Rotodynamic special purpose pumps
API-610	Centrifugal pumps for general services Hydraulic Institutes Standards
BS:599	Methods of testing pumps
PTC-8.2	Power Test Codes - Centrifugal pumps
DIESEL ENGINES	
IS:10000	Methods of tests for internal combustion engines
IS:10002	Specification for performance requirements for constant speed compression ignition engines for general purposes (above 20 kW)
BS:5514	The performance of reciprocating compression ignition (Diesel) engines, utilizing liquid fuel only, for general purposes
ISO:3046	Reciprocating internal combustion engines performance
IS:554	Dimensions for pipe threads where pressure tight joints are required on threads
ASME Power Test Code	Internal combustion engine PTC-17
--	Codes of Diesel Engine Manufacturer's Association, USA
PIPING VALVES & SPECIALITIES	
IS:636	Non percolating flexible fire-fighting delivery hose
IS:638	Sheet rubber jointing and rubber inserting jointing
IS:778	Gun metal gate, globe and check valves for general purpose
IS:780	Sluice valves for water works purposes (50 to 300 mm)
IS:901	Couplings, double male and double female instantaneous pattern for fire fighting
IS:902	Suction hose couplings for fire-fighting purposes
IS:903	Fire hose delivery couplings branch pipe nozzles and nozzle spanner
IS:1538	Cast iron fittings for pressure pipes for water, gas and sewage
IS:1903	Ball valve (horizontal plunger type) including floats for water supply purposes
IS:2062	SP for weldable structural steel
IS:2379	Colour Code for the identification of pipelines
IS:2643	Dimensions of pipe threads for fastening purposes
IS:2685	Code of Practice for selection, installation and maintenance of sluice valves
IS:2906	Sluice valves for water-works purposes (350 to 1200 mm size)
IS:3582	Basket strainers for fire-fighting purposes (cylindrical type)
IS:3589	Electrically welded steel pipes for water, gas and sewage (150 to 2000 mm nominal diameter)
IS:4038	Foot valves for water works purposes
IS:4927	Unlined flax canvas hose for fire fighting

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)ANNEXURE-C

CODES	TITLE
IS:5290	Landing valves (internal hydrant)
IS:5312 (Part-I)	Swing check type reflex (non-return) valves
IS:5306	Code of practice for fire extinguishing installations and equipment on premises
Part-I	Hydrant systems, hose reels and foam inlets
Part-II	Sprinkler systems
BS:5150	Specification for cast iron gate valves
MOTORS & ANNUNCIATION PANELS	
IS:325	Three phase induction motors
IS:900	Code of practice for installation and maintenance of induction motors
IS:996	Single phase small AC and universal electric motors
IS:1231	Dimensions of three phase foot mounted induction motors
IS:2148	Flame proof enclosure of electrical apparatus
IS:2223	Dimensions of flange mounted AC induction motors
IS:2253	Designations for types of construction and mounting arrangements of rotating electrical machines
IS:2254	Dimensions of vertical shaft motors for pumps
IS:3202	Code of practice for climate proofing of electrical equipment
IS:4029	Guide for testing three phase induction motors
IS:4691	Degree of protection provided by enclosure for rotating electrical machinery
IS:4722	Rotating electrical machines
IS:4729	Measurement and evaluation of vibration of rotating electrical machines
IS:5572	Classification of hazardous areas for electrical (Part-I) installations (Areas having gases and vapours)
IS:6362	Designation of methods of cooling for rotating electrical machines
IS:6381	Construction and testing of electrical apparatus with type of protection 'e'
IS:7816	Guide for testing insulation for rotating machine
IS:4064	Air break switches
IEC DOCUMENT 2 (Control Office) 432	Three Phase Induction Motor
VDE 0530 Part I/66	Three Phase Induction Motor
IS:9224 (Part-II)	HRC Fuses
IS:6875	Push Button and Control Switches
IS:694	PVC Insulated cables
IS:1248	Indicating instruments
IS:375	Auxiliary wiring & busbar markings

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)ANNEXURE-C

CODES	TITLE
IS:2147	Degree of protection
IS:5	Colour Relay and timers
IS:2959	Contactors
PG Test Procedures	
NFPA-13	Standard for the installation of sprinkler system
NFPA-15	Standard for water spray fixed system for the fire protection
NFPA-12A	Standard for Halong 1301 Fire Extinguishing System
NFPA-72E	Standard on Automatic Fire Detectors
--	Fire Protection Manual by TAC (Latest Edition)
NFPA-12	Standard on Carbon dioxide extinguisher systems
IS:3034	Fire of industrial building
--	Electrical generating and distributing stations code of practice
IS:2878	CO ₂ (Carbon dioxide) Type Extinguisher
IS:2171	DC (Dry Chemical Powder) type
IS:940	Pressurised Water Type
D.G. SET	
IS:10002	Specification for performance requirements for constant speed compression ignition (diesel engine) for general purposes
IS:10000	Method of tests for internal combustion engines
IS:4722	Rotating electrical machines-specification
IS:12063	Degree of protection provided by enclosures
IS:12065	Permissible limit of noise levels for rotating electrical machines
--	Indian Explosive Act 1932
Steel structures	
IS-228 (1992)	Method of Chemical Analysis of pig iron, cast iron and plain carbon and low alloy steels.
IS-802 (P1 to 3)	Code of practice for use of structural steel in overhead transmission line towers
IS-806	Code of practice for use of steel tubes in general building construction
IS-808	Dimensions for hot rolled steel beam, column channel and angle sections
IS-814	Covered electrodes for manual arc welding of carbon of carbon manganese steel
IS-816	Code of Practice for use of metal arc welding for general construction in Mild steel
IS-817	Code of practice for training and testing of metal arc welders. Part 1 : Manual Metal arc welding
IS-875 (P1 to P4)	Code of practice for design loads (other than earthquake) for buildings and structures
IS-1161	Steel tubes for structural purposes

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)ANNEXURE-C

CODES	TITLE
IS-1182	Recommended practice for radiographic examination of fusion welded butt joints in steel plates
IS-1363 (P1 to P3)	Hexagonal head bolts, screws & nuts of products grade C
IS-1364	Hexagon head bolts, screws and nuts of product grades A and B
IS-1367 (P1 to P18)	Technical supply condition for threaded steel fasteners
IS-1599	Methods for bend test
IS-1608	Method for tensile testing of steel products
IS-1893	Criteria for earthquake resistant design of structures
IS-1978	Line Pipe
IS-2062	Steel for general structural purposes
IS-2595	Code of practice for Radiographic testing
IS-3063	Single coil rectangular section spring washers for bolts, nuts and screws
IS-3664	Code of practice for ultrasonic pulse echo testing by contact and immersion methods
IS-7205	Safety code for erection of structural steel work
IS-9595	Recommendations for metal arc welding of carbon and carbon manganese steels
ANSI-B18.2.1	Inch series square and Hexagonal bolts and screws
ANSI-B18.2.2	Square and hexagonal nuts
ANSI-G8.14	Round head bolts
ASTM-A6	Specification for General Requirements for rolled steel plates, shapes, sheet piling and bars of structural use
ASTM-A36	Specifications of structural steel
ASTM-A47	Specification for malleable iron castings
ASTM-A143	Practice for safeguarding against embilement of Hot Galvanized structural steel products and procedure for detaching embriement
ASTM-A242	Specification for high strength low alloy structural steel
ASTM-A283	Specification for low and intermediate tensile strength carbon steel plates of structural quality
ASTM-A394	Specification for Galvanized steel transmission tower bolts and nuts
ASTM-441	Specification for High strength low alloy structural manganese vanadium steel
ASTM-A572	Specification for High strength low alloy colombium-Vanadium steel of structural quality
AWS D1-0	Code for welding in building construction welding inspection
AWS D1-1	Structural welding code
AISC	American institute of steel construction
NEMA-CG1	Manufactured graphite electrodes

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)ANNEXURE-C

CODES	TITLE
Piping and pressure vessels	
IS-1239 (Part 1 and 2)	Mild steel tubes, tubulars and other wrought steel fittings
IS -3589	Seamless Electrically welded steel pipes for water, gas and sewage
IS-6392	Steel pipe flanges
ASME	Boiler and pressure vessel code
ASTM-A120	Specification for pipe steel, black and hot dipped, zinc-coated (Galvanized) welded and seamless steel pipe for ordinary use
ASTM-A53	Specification for pipe, steel, black, and hot-dipped, zinc coated welded and seamless
ASTM-A106	Seamless carbon steel pipe for high temperature service
ASTM-A284	Low and intermediate tensile strength carbon-silicon steel plates for machine parts and general construction
ASTM-A234	Pipe fittings of wrought carbon steel and alloy steel for moderate and elevated temperatures
ASTM-S181	Specification for forgings, carbon steel for general purpose piping
ASTM-A105	Forgings, carbon steel for piping components
ASTM-A307	Carbon steel externally threaded standard fasteners
ASTM-A193	Alloy steel and stainless steel bolting materials for high temperature service
ASTM-A345	Flat rolled electrical steel for magnetic applications
ASTM-A197	Cupola malleable iron
ANSI-B2.1	Pipe threads (Except dry seal)
ANSI-B16.1	Cast iron pipe flanges and flanged fitting, Class 25, 125, 250 and 800
ANSI-B16.1	Malleable iron threaded fittings, class 150 and 300
ANSI-B16.5	Pipe flanges and flanged fittings, steel nickel alloy and other special alloys
ANSI-B16.9	Factory-made wrought steel butt welding fittings
ANSI-B16.11	Forged steel fittings, socket-welding and threaded
ANSI-B16.14	Ferrous pipe plug, bushings and locknuts with pipe threads
ANSI-B16.25	Butt welding ends
ANSI-B18.1.1	Fire hose couplings screw thread
ANSI-B18.2.1	Inch series square and hexagonal bolts and screws
ANSI-B18.2.2	Square and hexagonal nuts
ANSI-B18.21.1	Lock washers
ANSI-B18.21.2	Plain washers
ANSI-B31.1	Power piping
ANSI-B36.10	Welded and seamless wrought steel pipe
ANSI-B36.9	Stainless steel pipe
Other civil works standards	

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)ANNEXURE-C

CODES	TITLE
IS-269	33 grade ordinary portland cement
IS2721	Galvanized steel chain link fence fabric
IS-278	Galvanized steel barbed wire for fencing
IS-383	Coarse and fine aggregates from natural sources for concrete
IS-432 (P1 and P2)	Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement
IS-456	Code of practice for plain and reinforced concrete
IS-516	Method of test for strength of concrete
IS-800	Code of practice for general construction in steel
IS-806	Steel tubes for structural purposes
IS-1172	Basic requirements for water supply, drainage and sanitation
IS-1199	Methods of sampling and analysis of concrete
IS-1566	Hard-drawn steel wire fabric for concrete reinforcement
IS-1742	Code of Practice for Building drainage
IS-1785	Plain hard-drawn steel wire for pre-stressed concrete
IS-1786	High strength deformed Steel Bars and wires for concrete reinforcement
IS-1811	Methods of sampling Foundry sands
IS-1893	Criteria for earthquake resistant design of structures
IS-2062	Steel for general structural purposes
IS-2064	Selection, installation and maintenance of sanitary appliances-code of practices
IS-2065	Code of practice for water supply in buildings
IS-2090	High tension steel bars used in pre-stressed concrete
IS-2140	Standard Galvanized steel wire for fencing
IS-2470 (P1 & P2)	Code of practice for installation of septic tanks
IS-2514	Concrete vibrating tables
IS-2645	Integral cement waterproofing compounds
IS-3025 (Part 1 to Part 48)	Methods of sampling and test (Physical and chemical) for water and waste water
IS-4091	Code of practice for design and construction of foundations for transmission line towers and poles
IS-4111 (Part 1 to P5)	Code of practice for ancillary structures in sewerage system
IS-4990	Plywood for concrete shuttering work
IS-5600	Sewage and drainage pumps
National building code of India 1970	
USBR E12	Earth Manual by United States Department of the interior Bureau of Reclamation
ASTM-A392-81	Zinc/Coated steel chain link fence fabric
ASTM-D1557-80	test for moisture-density relation of soils using 10-lb (4.5 kg)

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**ANNEXURE-C**

CODES	TITLE
	rame land 18-in. (457 mm) Drop
ASTM-D1586(1967)	Penetration Test and Split-Barrel Sampling of Soils
ASTM-D2049-69	Test Method for Relative Density of Cohesionless Soils
ASTM-D2435	Test method for Unconsolidated, (1982) Undrained Strengths of Cohesive Soils in Triaxial Compression
BS-5075	Specification for accelerating Part I Admixtures, Retarding Admixtures and Water Reducing Admixtures
CPWD	Latest CPWD specifications
ACSR MOOSE CONDUCTOR	
IS:6745 BS:443-1969	Methods for Determination of Mass of zinc coating on zinc coated Iron and Steel Articles
IS:8263	Methods for Radio Interference
IEC:437-1973 NEMA:107-1964 CISPR	Test on High Voltage Insulators
IS:209, BS:3436-1961	Zinc Ingot
IS:398 Part - V IEC:209-1966	Aluminum Conductors for Overhead Transmission Purposes
BS:215(Part-II), IEC:209-1966	Aluminium Conductors galvanized steel reinforced extra high voltage (400 kV and above)
IS:1778, BS:1559-1949	Reels and Drums for Bare Conductors
IS:1521, ISO/R89-1959	Method for Tensile Testing of steel wire
IS:2629	Recommended practice for Hot dip Galvanising on Iron and Steel
IS:2633	Method for Testing Uniformity of coating of zinc Coated Articles
IS:4826/ ASTMA-472-729	Hot dip galvanised coatings on round steel wires
GALVANISED STEEL EARTH WIRE	
IS:1521, ISO/R:89-1959	Method for Tensile Testing of Steel Wire
IS:1778	Reels and Drums for Bare Conductors
IS:2629	Recommended practice for Hot Dip Galvanising on Iron and Steel
IS:2633	Methods for testing Uniformity of Coating of Zinc Coated Articles
IS:4826/ ASTM: A 475-72a BS:443-1969	Hot dip Galvanised Coatings on Round Steel Wires
IS:6745/ BS:443-1969	Method for Determination of mass of Zinc Coating on Zinc coated Iron and Steel Articles.
IS:209/ BS:3463-1961	Zinc ingot
IS:398 (Pt. I to P5:1992)/ BS:215 (Part-II	Aluminum Conductors for overhead transmission purposes

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)ANNEXURE-C

CODES	TITLE
Lighting Fixtures and Accessories	
IS:1913	General and safety requirements for electric lighting fittings
IS:3528	Water proof electric lighting fittings
IS:4012	Dust proof electric lighting fittings
IS:4013	Dust tight proof electric lighting fittings
IS:10322	Industrial lighting fittings with metal reflectors
IS:10322	Industrial lighting fittings with plastic reflectors
IS:2206	Well glass lighting fittings for use under ground in mines (non-flameproof type)
IS:10322	Specification for flood light
IS:10322	Specification for decorative lighting outfits
IS:10322	Luminaries for street lighting
IS:2418	Tubular fluorescent lamps
IS:9900	High pressure mercury vapour lamps
IS:1258	Specification for Bayonet lamp fluorescent lamp
IS:3323	Bi-pin lamp holder tubular fluorescent lamps
IS:1534	Ballasts for use in fluorescent lighting fittings. (Part-I)
IS:1569	Capacitors for use in fluorescent lighting fittings
IS:2215	Starters for fluorescent lamps
IS:3324	Holders for starters for tubular fluorescent lamps
IS:418	GLS lamps
IS:3553	Water tight electric fittings
IS:2713	Tubular steel poles
IS:280	MS wire for general engg. Purposes
Conduits, Accessories and Junction Boxes	
IS:9537	Rigid steel conduits for electrical wiring
IS:3480	Flexible steel conduits for electrical wiring
IS:2667	Fittings for rigid steel conduits for electrical wiring
IS:3837	Accessories for rigid steel conduits for electrical wiring
IS:4649	Adaptors for flexible steel conduits
IS:5133	Steel and Cast Iron Boxes
IS:2629	Hot dip galvanising of Iron & Steel
Lighting Panels	
IS:13947	LV Switchgear and Control gear(Part 1 to 5)
IS:8828	Circuit breakers for over current protection for house hold and similar installations
IS:5	Ready mix paints
IS:2551	Danger notice plates
IS:2705	Current transformers

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)ANNEXURE-C

CODES	TITLE
IS:9224	HRC Cartridge fuse links for voltage above 650V(Part-2)
IS:5082	Wrought aluminium and Al. alloys, bars, rods, tubes and sections for electrical purposes
IS:8623	Factory built Assemblies of Switchgear and Control Gear for voltages upto and including 1000V AC and 1200V DC
IS:1248	Direct Acting electrical indicating instruments
Electrical Installation	
IS:1293	3 pin plug
IS:371	Two to three ceiling roses
IS:3854	Switches for domestic and similar purposes
IS:5216	Guide for safety procedures and practices in electrical work
IS:732	Code of practice for electrical wiring installation (system voltage not exceeding 650 Volts.)
IS:3043	Code of practice for earthing
IS:3646	Code of practice of interior illumination part II & III
IS:1944	Code of practice for lighting of public through fares
IS:5571	Guide for selection of electrical equipment for hazardous areas
IS:800	Code of practice for use of structural steel in general building construction
IS:2633	Methods of Testing uniformity of coating on zinc coated articles
IS:6005	Code of practice for phosphating iron and steel
	INDIAN ELECTRICITY ACT
	INDIAN ELECTRICITY RULES
LT SWITCHGEAR	
IS:8623 (Part-I)	Specification for low voltage switchgear and control gear assemblies
IS:13947 (Part-I)	Specification for low voltage switchgear and control gear, Part 1 General Rules
IS:13947 (part-2)	Specification for low voltage switchgear and control gear, Part 2 circuit breakers
IS:13947 (part-3)	Specification for low voltage switchgear and control gear. Part 3 Switches, Disconnectors, Switch-disconnectors and fuse combination units
IS:13947 (part-4)	Specification for low voltage switchgear and control gear. Part 4 Contactors and motors starters
IS:13947 (part-5)	Specification for low voltage switchgear and control gear. Part 5 Control-circuit devices and switching elements
IS:13947 (part-6)	Specification for low voltage switchgear and control gear. Part 6 Multiple function switching devices
IS:13947 (part-7)	Specification for low voltage switchgear and control gear. Part 7 Ancillary equipments
IS:12063	Degree of protection provided by enclosures

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**ANNEXURE-C**

CODES	TITLE
IS:2705	Current Transformers
IS:3156	Voltage Transformers
IS:3231	Electrical relays for power system protection
IS:1248	Electrical indicating instruments
IS:722	AC Electricity meters
IS:5578	Guide for Marking of insulated conductors of apparatus terminals
IS:13703 (part 1)	Low voltage fuses for voltage not exceeding 1000V AC or 1500V DC Part 1 General Requirements
IS:13703 (part 2)	Low voltage fuses for voltage not exceeding 1000V AC or 1500V DC Part 2 Fuses for use of authorized persons
IS:6005	Code of practice of phosphating iron and steel
IS:5082	Wrought Aluminum and Aluminum alloys for electrical purposes
IS:2633	Hot dip galvanising

Note: If any standard is expired or does not exist anymore than other standard which has substituted it, shall be applicable.

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**Annexure-G****MQP & INSPECTION LEVEL REQUIREMENT**

Sl. No	Item / Equipment	Reference document for inspection	Inspection Level
A.01	LT Transformer /Power Transformer/ Reactor/ Converter Transformer/ Filter Reactor	MQP/ITP	IV
A.02	Bushing	MQP	IV
A.03	Insulating Oil	POWERGRID TS	III
A.04	Oil storage tank for transformers	MQP	III
A.05	Nitrogen injection based explosion prevention system	FAT/ITP	III
A.06	On Line oil drying system for transformers	POWERGRID TS	II**
A.07	On Line DGA and moisture monitoring system	POWERGRID TS	II**
A.08	Flow sensitive conservator isolation valve	POWERGRID TS	II**
A.09	Oil Filtration Machine	MQP	III
B.01	Circuit Breakers	MQP	IV
B.02	Current Transformers	MQP/ITP	IV
B.03	CVT/PT/IVT	MQP	IV
B.04	Isolators	MQP/ITP	IV
B.05	Surge Arrestors	MQP/ITP	III
B.06	Line Trap & Air Core Reactor	MQP/ITP	III
B.07	Point On switching device (CSD) for Circuit Breaker (wherever required)	FAT/ITP	IV
C.01	STATCOM including Valve, valve base electronics, DC capacitor, series reactor and all accessories	ITP	IV
C.02	Mechanically switched Reactor bank (3-ph) including all accessories (MSR Branches)	ITP	IV
C.03	Mechanically switched Capacitor bank (3-ph) including all accessories (MSC Branches)	ITP	IV
C.04	Harmonic Pass filters	ITP	IV
C.05	HT Capacitor	MQP	IV
D.01	Thyristor Valve	FAT/ITP	III
D.02	PLC Capacitors for HVDC	FAT/ITP	III
D.03	Valve Cooling system for	FAT/ITP	III

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**Annexure-G**

Sl. No	Item / Equipment	Reference document for inspection	Inspection Level
	HVDC		
D.04	AC/DC Filter Resistors	ITP	III
D.05	DC Current and Voltage measuring device for HVDC	FAT/ITP	III
D.06	Maintenance platform for valve hall	POWERGRID TS	II
D.07	Optical signal column for FSC	FAT/ITP	II
E.01	GIS including spares	MQP/ITP	IV
E.02	Dew Point Meter for GIS	POWERGRID TS	I*
E.03	Portable Partial Discharge monitoring system for GIS	POWERGRID TS	I*
E.04	Partial Discharge Monitoring System (Online) for GIS	ITP	III
E.05	PEB Structure and Puf Panels	MQP	III
F.01	Substation Automation system	FAT/MQP	III
F.02	Event Logger	POWERGRID TS	III
F.03	PLCC equipment Viz PLCC Terminal ,Carrier equipment, Protection Coupler , Coupling Device but excluding EPAX / HF Cable	MQP	III
F.04	Control & Relay Panels	MQP	III
G.01	EHV Cables	MQP/ITP	III
G.02	Power Cables & Control Cables	MQP	III
G.03	Cable Joints (11 kV and above)	POWERGRID TS	II
G.04	Cable Lugs & Glands / Clamps/Terminations	POWERGRID TS	I
H.01	LT Switchgear & ACDB/DCDB/MLDB/ELDB	MQP	III
H.02	Battery	POWERGRID TS	II
H.03	Battery Charger	MQP	III
H.04	UPS & Voltage Stabilizer	MQP/FAT	III
H.05	D. G. Set	FAT/ITP	III
H.06	Lighting Panel	POWERGRID TS	II
H.07	Lighting Poles	POWERGRID TS	II
H.08.1	Lighting Fixtures, Lighting Earthwire, Switches / sockets, Conduits, Lamps & fans including exhaust fans	POWERGRID TS	I
H.8.2	Solar based LEDs System including street light/pole solar panel, Inverter controller/LED fixture	FAT	III
H.09	MS/GI/PVC Pipes for cable	POWERGRID TS	I

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**Annexure-G**

Sl. No	Item / Equipment	Reference document for inspection	Inspection Level
	trenches and lighting		
H.10	Outdoor Receptacle	POWERGRID TS	I
H.11	Split A.C/window A.C./ precision AC/ Kiosk AC/ Cascade AC/ Tower AC	POWERGRID TS	I
H.12	Occupancy sensors for control of lighting	POWERGRID TS	I
H.13	Solar based street lighting pole including Solar Panel, Inverter, Controller, etc.	POWERGRID TS	III
H.14	Junction Box / Lighting Switch Boards / Bay MB / Portable Flood Light Panel	POWERGRID TS	II
H.15	Lighting transformer	POWERGRID TS	II
I.01	SF6 gas processing unit, SF6 gas Leakage detector, SF6 gas Analyzer	POWERGRID TS	I*
I.02	SF6 Gas	POWERGRID TS	I
I.03	Spark Gap	FAT/ITP	III
I.04	Time synchronizing Equipment (GPS Clock)	POWERGRID TS	I
I.05	Galvanized Cable trays	POWERGRID TS	II
I.06	Video Monitoring System	FAT/ITP	I
I.07	Public Address System (All Components)	POWERGRID TS	I
I.08	Building Management System (All components)	POWERGRID TS	I
I.09	Access Control System (All Components)	POWERGRID TS	I
I.10	Video Display system/ Video Projection system	POWERGRID TS	I
I.11	VESDA (smoke detector)	POWERGRID TS	I
I.12	High Mast Pole	MQP	III
J.01	Aluminium ladder	POWERGRID TS	I
J.02	Hume Pipes	POWERGRID TS	I
J.03	Castle Key	POWERGRID TS	I
J.04	Water Treatment plant (All components).	POWERGRID TS	I
J.05	Furniture	POWERGRID TS	I
J.06	DOL Starter	POWERGRID TS	I
J.07	Oil Sample Bottles and Syringe	POWERGRID TS	I
J.08	Test & Measuring Equipment, T&P	POWERGRID TS	I*
K.01	EOT Crane	POWERGRID TS	II

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**Annexure-G**

Sl. No	Item / Equipment	Reference document for inspection	Inspection Level
K.02	Boom Crane/Golf Cart/Platform Truck/Man Lift/ Fork Lift/ Lifts	POWERGRID TS	II
L.00	Fire Protection System		
L.001	Panels, Hydro pneumatic tank for fire protection system.	POWERGRID TS	III
L.002	Deluge valve, Strainers, MS/GI pipes, Pumps, motors, air compressor, and other valves, Diesel Engines	POWERGRID TS	II
L.003	Others	POWERGRID TS	I
M.00	HVAC SYSTEM		
M.001	Air Cooled Chiller	POWERGRID TS	III
M.002	Pump	POWERGRID TS	II
M.003	Air Handling Unit	POWERGRID TS	II
M.004	Fan Filter Unit With Centrifugal Blower	POWERGRID TS	II
M.005	Axial Flow Fan	POWERGRID TS	II
M.006	Main Climate Control Unit (Dehumidifier)	POWERGRID TS	I
M.007	Dampers	POWERGRID TS	II
M.008	Fire Dampers	POWERGRID TS	II
M.009	Pressure Gauge, Thermometers, Other Instruments / Sensors	POWERGRID TS	I
M.010	Grill, Diffuser, Jet Nozzle, Louvers etc	POWERGRID TS	I
M.011	Ducting	POWERGRID TS	III
M.012	M S Pipe	POWERGRID TS	II
M.013	Pipe Insulation Material	POWERGRID TS	I
M.014	Duct Insulation Material	POWERGRID TS	I
M.015	Underdeck Insulation Material	POWERGRID TS	I
M.016	Gate Valve & Non Return valve	POWERGRID TS	I
M.017	Y Strainer	POWERGRID TS	II
M.018	Ball Valve/ Motorised Butterfly Valve/ Balancing Valve	POWERGRID TS	I
M.019	Closed Expansion Tank	POWERGRID TS	II
M.020	Air Separator	POWERGRID TS	I
M.021	MCC /PLC /Electrical Panels	POWERGRID TS	III
M.022	Propeller Fan/ Conduit	POWERGRID TS	II
M.023	Air Filter/ Mixing Valve with Thermostat	POWERGRID TS	I

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**Annexure-G**

Sl. No	Item / Equipment	Reference document for inspection	Inspection Level
N.01	SDH Equipment	FAT/ITP	IV
N.02	Termination Equipment Primary/DI Multiplexer	FAT/ITP	IV
N.03	DACS	FAT/ITP	IV
N.04	Optical Amplifier	FAT/ITP	IV
N.05	FODP including pigtail, Joint Box, FDMS	FAT/ITP	II
N.06	IMPS	FAT/ITP	IV
N.07	Optical bypass switch	FAT/ITP	IV
N.08	Air Purifier	FAT/ITP	I
N.09	Patch cord & connector	FAT/ITP	I
N.10	NMS	FAT/ITP	IV
N.11	OPGW Cable	MQP/ITP/FAT	III
N.12	Hardware Fittings for OPGW cable	MQP/ITP	III
N.13	DCPS	FAT/ITP	III
N.14	Radio Links	FAT/ITP	III
N.15	SMPS based DC Power Supply (DCPS) system	FAT/ITP	III
N.16	WAMS (PMU & Accessories)	FAT/ITP	III
N.17	PUF Shelter	FAT/ITP	III
N.18	Aerial OFC/UGOFC/ADSS/FO Cable	FAT/ITP	III
N.19	DWDM	FAT/ITP	III
N.20	OTN	FAT/ITP	III
N.21	MPLS-TP Equipment	FAT/ITP	III
N.22	L2 Switch	FAT/ITP	III
N.23	IP-MPLS Router	FAT/ITP	III
N.24	HDPE Pipes	POWERGRID TS	II
N.25	Equipment Cabinets	POWERGRID TS	II
N.26	Main Distribution Frame	POWERGRID TS	I
N.27	Telephone system, EPAX, Telephone wires, Telephone sockets	POWERGRID TS	I
N.28	Fibre Optic Cable	MQP	III
N.29	Hardware Fittings for Fibre Optic cable	MQP	III
O.01	Re-rollers of MS/HT Angle Section and galvanized tower parts.	MQP	IV
O.02	Conductor	MQP	IV
O.03	Hardware fittings and Conductor & Earthwire Accessories	MQP	IV
O.04	Earth wire	MQP	IV

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**Annexure-G**

Sl. No	Item / Equipment	Reference document for inspection	Inspection Level
O.05	Insulator	MQP	IV
O.06	Bolts & Nuts of Gr 8.8 / 8	MQP	IV
O.07	Mono Pole	MQP	IV
O.08	Foundation Bolts & Anchor Bolts	POWERGRID TS	III
O.09	D-shackle/ Hanger / Links and associated Special bolt/nuts	MQP	III
O.10	Span Marker, Obstruction lights and Wind Measuring Equipment	POWERGRID TS	III
O.11	MS ROD rolled by Approved Re-roller of POWERGRID	MQP	III
O.12	MS ROD rolled by Approved steel producers of POWERGRID	POWERGRID TS	I
O.13	Spring Washers & Pack washers	POWERGRID TS	II
O.14	Bolts & Nuts Gr up to 5.6/5	POWERGRID TS	II
O.15	ACD & Barbed wire for ACD/Bird guard	POWERGRID TS	II
O.16	Danger Plate /Phase Plate / Number Plate / Circuit plate	POWERGRID TS	I
O.17	Sub Station Structure (lattice/pipe type)	MQP	III
O.18	Clamps & Connectors (including equipment connectors)	MQP	III
O.19	MS/ GI Flat, rod type, pipe type and other earthing material.	POWERGRID TS	II
O.20	Aluminium Tube & Busbar materials	POWERGRID TS	II
O.21	Pipe Type & Counter Poise Earthing	POWERGRID TS	II
O.22	DTS System	POWERGRID TS	II
<p>For Equipment where requirement of MQP is envisaged, ITP/FAT will be followed If sourced from off shore. For items required in S/S or T/L or TELECOM/LD&C , same inspection level as specified shall be followed for all the cases.</p> <p>* MICC for test and measuring equipment (inspection level I or II) shall be issued only after actual verification/ demonstration of satisfactory performance at site.</p> <p>** Though level-2 items, CIP/MICC can be issued also on review of TCs and visual inspection of these item.</p>			

ANNEXURE-J

LIST OF THE MAKES FOR WHICH TYPE TEST REPORTS NOT REQUIRED TO BE SUBMITTED

Sl. No.	ITEM DESCRIPTION	MAKE
A.	<i>Substation Accessories [Type Testing is not envisaged]</i>	
1.	Out door receptacles	CGL/B&C/BCH/Sakti, Chennai/Indo Asian/AVAIDS
2.	Trefoil clamp	Moulded Fibre Glass Products, Calcutta
3.	Diesel Engine	Cummins/Ruston & Hornsby/Greaves Cotton/Kirloskar/Mahindra/Ashok Leyland
4.	Alternator	AVK/KIRLOSKAR/STAMFORD/ Leroy Somer
5.	Motors	KEC/Siemens/NGEF/Crompton/ABB
6.	Cable Glands	Sunil & Co./Arup/ Comet/QPIE
7.	Junction Box	Sarvana/ECS/C&S/Vikas/ Maktel/Unilac/Jasper/ Amara raja/AVAIDS
8.	EPAX	MATRIX, BPL
9.	ACSR Conductor (Bersimis/Moose/Zebra)	Sterlite/Apar/HVPL/Sharavathy/Hiren Aluminium Ltd./Smita/Deepak Cables/Polycab wires/Cabcon/JSK
10.	AAC Conductor (BULL)	Sterlite/Cabcon /JSK
11.	G.S. Earthwire	Sharavathy/Bharat Wire Ropes/Ramswarup
12.	Lighting Fixtures	Phillips/CGL/Bajaj /Havels
13.	Lighting Transformer	Gujarat-Plug-In
14.	Lighting Panels	Vikas/Makel/Nitya/AVAIDS
15.	MCCB/ ACB/Protective relays of LT Switchgear Boards	All approved makes as per Compendium of Vendors
16.	EOT Crane	Reva
B.	<i>ACCESSORIES FOR TRANSFORMER & REACTOR [Earlier approved type test reports is applicable and not required to be submitted]</i>	
17.	BUCHHOLZ RELAY [Upto 765kV Transformer & Reactor]	(i) M/S CEDESPE, ITLAY [Model Type-EE 3 (Plug & Socket type)]/ (ii) M/s VIAT INSTRUMENTS PVT. LTD.KOLKATA [Model type-GOR-3M (Plug & Socket type)]
18.	PRESSURE RELIEF DEVICE [Upto 765kV Transformer & Reactor]	(i) M/S SUKRUT UDYOG, Pune [Model type-T-6-MS-15-SHB-PS (Plug & Socket type)] /
19.	MAGNETIC OIL LEVEL GAUGE [Upto 765kV Transformer & Reactor]	(i) M/S SUKRUT UDYOG PUNE [Model type-SO-HE-10-M-ATMS-PS (Plug & Socket type)], [Model Type:- SO-6-M-P-PS (Plug & Socket type)]/
20.	AIR CELL (FLEXIBLE AIR SEPARATOR) [Upto 765kV Transformer & Reactor]	Type test of following makes are not to be submitted (i) M/S PRONAL FRANCE / (ii) FUJIKURA,JAPAN / (iii) PRONAL ASIA, MALAYSIYA / (iv) SHENYANG HONGDA GENERAL RUBBER FACTORY /

ANNEXURE-J

LIST OF THE MAKES FOR WHICH TYPE TEST REPORTS NOT REQUIRED TO BE SUBMITTED

Sl. No.	ITEM DESCRIPTION	MAKE
		(v) BAODING XINKE RUBBER PRODUCT INSTITUTE, CHINA / (vi) M/S ZENITH INDUSTRIAL RUBBER PRODUCTS PVT. LTD. THANE/ (vii) M/S UNIRUB TECHNO PUNE
21.	OTI & WTI [Upto 765kV Transformer & Reactor]	(i) M/S PRESIMEASURE BANGALORE [Model type-1005A]
22.	OIL PUMP [Upto 765kV Transformer & Reactor]	(i) FLOWWELL PUMPS & METERS, BANGALORE [Model type-1220D, 1250D]
23.	COOLING FAN AND MOTOR ASSEMBLY [Upto 765kV Transformer & Reactor]	(i) M/S MARATHON LTD KOLKATA [Model Type:- 36M/K75-P8, 0.7kW, 725RPM, 22]/K37-P6, 0.25kW, 940RPM, AFF 915103, 0.625kW, 550RPM]
24.	Sudden Pressure Relay [Upto 765kV Transformer & Reactor]	(i) Qualitrol [Model/Drawing No.900-003-02 CS-46518, 900-003-32 CS-46369] / (ii) Shenyang KEQI Electrical Equipment Co. Ltd. [Model/Drawing No.SYJ9-50-25 TH]
25.	BUCHHOLZ RELAY [Upto 400kV Transformer & Reactor]	(i) M/S CEDASPE, ITALY [Model type-EE3 (Plug & Socket type)]/ (ii) VIAT INSTRUMENTS [Model type-GOR-3M (Plug & Socket type)]
26.	PRESSURE RELIEF DEVICE [Upto 400kV Transformer & Reactor]	(i) M/S SKURUT UDYOG, PUNE [Model type-T-6-MS-15-SHB-PS (Plug & Socket type)]
27.	MAGNETIC OIL LEVEL GAUGE [Upto 400kV Transformer & Reactor]	(i) M/S SUKRUT UDYOG PUNE [Model type-SO-HE-10-M-ATMS-PS (Plug & Socket type)], [Model Type: SO-6-M-P-PS (Plug & Socket type)]/ (ii) M/S YOGYA ENTERPRISES, JHANSI [Model type-SO-10 (Plug & Socket type)]
28.	AIR CELL (FLEXIBLE AIR SEPARATOR) [Upto 400kV Transformer & Reactor]	Type test of following makes are not to be submitted (i) M/S THE RUBBER PRODUCTS MUMBAI / (ii) M/S UNIRUB TECHNO PUNE / (iii) M/S PRONAL FRANCE/ (iv) M/S ZENITH INDUSTRIAL RUBBER PRODUCTS PVT. LTD. THANE / (v) SHENYANG HONGDA GENERAL RUBBER FACTORY, CHINA
29.	Sudden Pressure Relay [Upto 400kV Transformer & Reactor]	(i) Qualitrol [Model/Drawing No.900-003-02 CS-46518, 900-003-32 CS-46369] / (ii) VIAT INSTRUMENTS [Model/Drawing No.950 / (iii) Shenyang KEQI Electrical Equipment Co. Ltd. [Model/Drawing No.SYJ9-50-25 TH]
30.	RIP Bushing (52kV, 3150A)	ABB Micafil, Switzerland [Model/Drawing No. 1ZCD073617 (Rev F)]
31.	RIP Bushing (420kV, 1250A)	ABB, SWEDEN [Model/Drawing No.1ZSC005378A0001 REV. K]
32.	RIP Bushing (245kV, 1250A)	ABB, SWEDEN [Model/Drawing No.1ZSC005416A0001 (Rev. D)]
33.	RIP Bushing (245kV, 2000A)	ABB, SWEDEN [Model/Drawing No.1ZSC005373A0001]

ANNEXURE-J**LIST OF THE MAKES FOR WHICH TYPE TEST REPORTS NOT REQUIRED TO BE SUBMITTED**

Sl. No.	ITEM DESCRIPTION	MAKE
		(Rev. C)]
34.	RIP Bushing (420kV, 1250A)	HSP Germany [Model/Drawing No.327470]
35.	RIP Bushing (245kV, 2000A)	HSP Germany [Model/Drawing No.329260]
36.	RIP Bushing (52kV, 3150A)	HSP Germany [Model/Drawing No.329280]
37.	RIP Bushing (420kV, 1250A)	Izolyator, Russia [Model/Drawing No.686354.603]
38.	RIP Bushing (245kV, 2000A)	Izolyator, Russia [Model/Drawing No.686353.602]
39.	RIP Bushing (52kV, 3150A)	Izolyator, Russia [Model/Drawing No.686351.601]
40.	RIP Bushing (145kV, 1250A)	Izolyator, Russia [Model/Drawing No.686352.604]
41.	RIP Bushing (420kV, 1250A)	TRENCH, CHINA [Model/Drawing No.ECT 707 (C2)]
42.	RIP Bushing (245kV, 2000A)	TRENCH, CHINA [Model/Drawing No.ECT 617 (C3)]
43.	RIP Bushing (245kV, 1250A)	TRENCH, CHINA [Model/Drawing No.ECT 616 (C3)]
44.	RIP Bushing (145kV, 1250A)	TRENCH, CHINA [Model/Drawing No.ECT 516 (C3)]
45.	RIP Bushing (52kV, 1250A)	TRENCH, CHINA [Model/Drawing No.ECT 415 (C3)]
46.	RIP Bushing (52kV, 3150A)	TRENCH, CHINA [Model/Drawing No.ECT 419 (C3)]
47.	RIP Bushing (420kV, 1250A)	Xian China [Model/Drawing No.75706 (Rev 09)]
48.	RIP Bushing (245kV,2000A)	Xian China [Model/Drawing No.75618 (Rev 09)]
49.	RIP Bushing (52kV, 3150A)	Xian China [Model/Drawing No.75366 (Rev 03)]
50.	RIP Bushing (52kV, 3150A)	Xian China [Model/Drawing No.75332 (Rev 08)]
51.	OIP Bushing (800kV, 2500A)	ABB, SWEDEN [Model / Drawing No. GOE-2550-1600-2500-0.6-B, 1ZSC026186-AAM REV. H]
52.	OIP Bushing (420kV, 2500A)	ABB, SWEDEN [Model / Drawing No.GOE-1425-1150-2500-0.6, 1ZSC026186-AAL REV. F]
53.	OIP Bushing (800kV, 2500A)	TBEA, CHINA [Model / Drawing No.TBEA-500-765T-A0035-01, REV. 02]
54.	OIP Bushing (420kV, 2500A)	TBEA, CHINA [Model / Drawing No.TBEA-500-765T-A0035-02, REV. 02]
55.	OIP Bushing (420kV, 2500A)	TRENCH, CHINA [Model / Drawing No.OT-738-1 (C 5)]
56.	OLTC (500MVA, 765kV ICT)	MR Germany [Model/Drawing No. MI 1503 72.5/RC- 12231WR]
57.	OLTC (500MVA, 400kV ICT)	Easun MR, Chennai [Model/Drawing No. 3 x MI 1200 300/D 10.19.3W]
58.	OLTC (220kV & below rating transformer)	BHEL, Bhopal [Model/Drawing No.MIII 600 110/C 10.19.3W]
C.	TESTING EQUIPMENT FOR TRANSFORMER & REACTOR	
59.	Oil BDV Test Kit	Baur [Model/Drawing No.DTA 100C]
60.	Oil BDV Test Kit	Megger [Model/Drawing No.OTS 100AF]

ANNEXURE-J**LIST OF THE MAKES FOR WHICH TYPE TEST REPORTS NOT REQUIRED TO BE SUBMITTED**

Sl. No.	ITEM DESCRIPTION	MAKE
61.	Online Dissolved Gas (Multi-gas) and Moisture Analyser	A Eberle GmbH & Co. KG [Model/Drawing No.HYDROCAL 1008]
62.	Online Dissolved Gas (Multi-gas) and Moisture Analyser	Ningbo Ligong Online Monitoring Technology Co. LTD [Model/Drawing No.MGA2000]
63.	Online Dissolved Gas (Multi-gas) and Moisture Analyser	GE Energy [Model/Drawing No.KELMAN TRANSFIX]
64.	Online Dissolved Gas (Multi-gas) and Moisture Analyser	Qualitrol Company LLC [Model/Drawing No.SERVERON TM 8]
65.	On line Insulating Oil Drying System	CEE DEE Vacuum Equipment Pvt. Ltd. [Model/Drawing No.TRANSDRY CD-002]
66.	On line Insulating Oil Drying System	PTSS [Model/Drawing No.PTSS-TDS1GA6XS]
67.	Portable Dissolved Gas Analysis of Insulating Oil	GE Energy [Model/Drawing No. KELMAN TRANSPORT X]

NOTES:-

- 1.** For sub-station accessories mentioned at Sr. No. A above, model specific separate approval of type test report is not required.
- 2.** For Transformer/Reactor accessories & testing equipment mentioned at Sr. No. B & C above, wherever, model/drawing no. is specified separate approval of type test report and drawing/documents is not required, thus requirement of type test report validity of 10 years is not applicable.

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR) Annexure K (Rev 01)

Sl. No.	Power System Equipment	Minimum Local Content (%)
1	Power Transformers (up to 765 kV, including Generator Transformers)	60
2	Instrument Transformer (up to 765 kV)	60
3	Transformer Oil Dry Out System (TODOS)	60
4	Reactors up to 765 kV	60
5	Oil Impregnated Bushing (Up to 400kV)	60
6	Resin Insulated Paper (RIP) bushings (up to 145 kV)	50
7	Circuit Breakers (up to 765kV AC-Alternating Current)	60
8	Disconnectors, Isolators (up to 765kV AC)	60
9	Wave Trap (up to 765kV AC)	60
10	Oil Filled Distribution Transformers up to & including 33kV [Cold Rolled Grain Oriented (CRGO)/Amorphous, Aluminium/Copper wound]	60
11	Dry type Distribution Transformers up to & including 33kV (CRGO/Amorphous, Aluminium/Copper wound)	60
12	Conventional conductor	60
13	Accessories for conventional conductors	60
14	High Temperature/High Temperature Low Sag (HTLS) conductors (such as Composite core, GAP, ACSS, INVAR, AL59) and accessories	60
15	Optical ground wire (OPGW)- all designs	60
16	Fiber Optic Terminal Equipment (FOTE) for OPGW	50
17	OPGW related Hardware and accessories	60
18	Remote Terminal Unit (RTU)	50
19	Power Cables and accessories up to 33kV	60
20	Control cables including accessories	60
21	XLPE cables up to 220kV	60
22	Substation Structures	60
23	Transmission Line Towers	60
24	Porcelain (Disc/Long Rod) Insulators	60
25	Bus Post Insulators (Porcelain)	60
26	Porcelain Disc Insulators with Room Temperature Vulcanisation (RTV) coating	50
27	Porcelain Long Rod Insulators with Room temperature Vulcanisation (RTV) coating	50
28	Hardware Fittings for porcelain Insulators	60
29	Composite/Polymeric Long Rod Insulators	60
30	Hardware Fittings for Polymer Insulators	60
31	Bird Flight Diverter (BFD)	60
32	Power Line Carrier Communication (PLCC) system (up to 800kV)	60
33	Gas Insulated Switchgear (up to 400kV AC)	60
34	Gas Insulated Switchgear (above 400kV AC)	50
35	Surge/Lightning Arrester (up to 765kV AC)	60
36	Power Capacitors	60
37	Packaged Sub-station (6.6kV to 33kV)	60
38	Ring Main Unit (RMU) (up to 33kV)	60

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39	Medium Voltage (MV) GIS panels (up to 33kV)	60
40	Automation and Control system/Supervisory Control and Data Acquisition (SCADA) system in Power system	50
41	Control and Relay panel (including Digital/Numerical relays)	50
42	Electrical motors 0.37kW to 1MW	60
43	Energy meters excluding smart meters	50
44	Control and Power cables and accessories (up to 1.1kV)	60
45	Diesel Generating (DG) set	60
46	DC system (DC Battery & Battery Charger)	60
47	AC and DC Distribution board	60
48	Indoor Air Insulated Switchgear (AIS) up to 33kV	60
49	Poles (PCC, PSCC, Rolled Steel Joist, Rail Pole, Spun, Steel Tubular)	60
50	Material for Grounding/earthing system	60
51	Illumination system	60
52	Overhead Fault Sensing Indicator (FSI)	50
53	Power Quality Meters	50
54	Auxiliary Relays	50
55	Load Break Switch	50
56	Cranes, EOT cranes, gantry crane & chain pulley blocks, etc	60
57	Elevator	60
Fire Protection and Detection system		
58	Motor driven fire water pumps	60
59	Diesel engine driven fire water pumps	60
60	Hydrant system	60
61	High velocity water spray system	60
62	Medium velocity water spray system	60
63	Foam Protection system	60
64	Inert gas flooding system	60
65	Fire tenders	60
66	Portable fire-extinguishers	60

Section: Switchgear-INST (INSRUMENT TRANSFORMER) REV 11

Annexure-V (Revised): Actions required in case of defects observed during warrantee period

Equipment	Nature of problem	Corrective measures to be taken by contractor
CT/IVT/PT (Oil filled)	DGA Violation H ₂ > 300 ppm C ₂ H ₂ > 2 ppm	Refurbished or replaced
CT/IVT/PT (SF ₆ filled)	a) SF ₆ gas leakage b) High Dew point of SF ₆ gas (> -36 deg C at atm press)	a) Repair/ replacement b) Re-processing of gas and replacement of Gas in case of no improvement
CT/IVT/PT (Oil filled)	Violation of Tan delta Tan Delta: >0.5% (during pre-commisioning) >0.7% (in operation) or change w.r.t. to previous year value > 0.1%	Replacement
CT, IVT/PT & CVT	- Oil leakage - Low Oil level - Sec winding problem leading to open/ short circuit, saturation etc	Replacement or repair as per repair procedure approved by QA.
CVT	Secondary voltage drift: Upto ± 0.5 volts Healthy a) ± 0.5 or beyond	a) CVT to be replaced

***Replaced/Repaired/Refurbished Equipment (or part of equipment) shall have 2 years warranty without prejudice to contractual warranty period.**

METHODOLOGY FOR SUPPLY, INSTALLATION & SIZING OF CABLES**Supply of 1.1kV grade Cables:**

- The quantities of various type of 1.1kV grade power and control cables shall be assessed by POWERGRID. The Sizes of 1.1 kV grade Control cables to be adopted for installation is enclosed at Appendix I . For Sizes of Power Cable, Clause 1.1.4 of Section Power and control Cable rev 06 is amended at Appendix-II

For Applications in addition to those specified, appropriate cable size shall be considered by the contractor with prior approval of Employer during execution stage

- Supply of 1.1kV grade power and control cables of various sizes shall be as per unit quantities mentioned in BPS.
- The Cables from Control Room/SPR/ACDB/DCDB/BMK to Equipment Marshalling box (MB)/Local control Cubical (LCC) shall be considered under the BPS item for supply of cables.
- The Interpole cables between AIS Instrument Transformer (CT/CVT), Surge Arrester and associated Junction Box shall be as per unit quantities mentioned in BPS.
- The Interpole cables between Circuit Breaker, Isolator and associated Marshalling box shall be deemed to be included in price of Equipment.

Installation of 1.1kV grade Cables:

- The quantity of Installation of cables is to be assessed by the contractor for the complete scope of work specified in Section project.
- The installation of 1.1kV grade power and control cables (including interpole cable of Equipment & illumination cables) shall be quoted in "LOT" basis.
- Supply and installation of Cable accessories like lugs, glands etc. for entire cabling work shall be deemed to be included in Installation charges of cables quoted by contractor in Bid price schedule.
- No variation shall be admissible on account of Installation of Cables/supply and installation of associated accessories, irrespective of variation (either positive or negative) in supply quantity of Cable specified in BPS.

Extra Consumption of 1.1 kV Power and control cables.

The Contractor shall make every effort to minimise wastage of the cables during installation. The Permitted Overall scarp/wastage shall be limited to 0.50% of actual supplied quantity for each size of cables. Any wastage more than the above limit shall be recovered from the contractor. All balance unused cables shall be returned to the employer by rewinding in separate drums for each size with discrete markings on drums.

Cut pieces of Cables having length less than following shall be considered for Scrap. The Contractor shall dispose of the scrap (if any), at their own cost :

1.) Length less than 20 M

- a) Control Cable (3C, 5C, 7C & 10 Core)
- b) Power Cable(2CX 6Sqmm,4CX6Sqmm, 4CX16Sqmm)

2.) Length less than 50 M

- a) Control Cable having more than 10 Cores
- b) Power Cable of sizes above 16 Sq mm

For Illumination purpose, ACP's shall be supplied as per BPS. From ACP to luminous all the required cables, accessories(including lugs and gland for cables between MLDB & ACP) , SLP/JB etc as required shall be assessed and supplied by the contractor. The price of these items shall be deemed to be included in price of luminaries.

Appendix-I: Control Cable Sizes

S.No.	From	To	Proposed Cable size
1.	CB MB	CRP panels	i) 10CX2.5Sq mm ii) 19CX1.5 Sq mm iii) 27CX 1.5 Sq mm
2.	CB MB	Earth switch MB	i) 3CX 2.5 Sqmm ii) 5C X2.5 Sq mm
3.	Isolator MB	Earth switch MB	10CX2.5Sq mm
4.	Isolator MB	CRP panels	19CX1.5 Sq mm
5.	CT	CT JB	i) 5C X2.5 Sq mm ii) 10C X2.5 Sq mm
6.	CT JB	CRP panels	i) 5C X2.5 Sq mm ii) 10C X2.5 Sq mm
7.	CVT	CVT JB	i) 5C X2.5 Sq mm ii) 10C X2.5 Sq mm
8.	CVT JB	CRP panels	i) 5C X2.5 Sq mm ii) 10C X2.5 Sq mm
9.	LA	LA JB	3C X2.5 Sq mm
10.	LA JB	CRP panels	5C X2.5 Sq mm
11.	Reactor MB/CMB (for 1-Ph)	CRP panels	i) 3CX2.5Sq mm ii) 5CX2.5 Sq mm iii) 19CX 1.5 Sq mm iv) 27CX 1.5 Sq mm v) Paired Cables
12.	ICT MB/CMB (for 1-Ph)	CRP panels	i) 3CX2.5Sq mm ii) 5CX2.5 Sq mm iii) 19CX 1.5 Sq mm iv) 27CX 1.5 Sq mm v) Paired Cables

Note:

- i) For Applications in addition to those specified, appropriate cable size shall be considered by the contractor with prior approval of Employer during execution stage.
- ii) GTP of 1.5 Sq mm Cable shall be submitted during detailed engineering stage for employers approval.
- iii) In case, more nos. of runs or larger sizes of cables are required between two points based on design calculations, same shall deemed to be included in the scope of bidder.

Appendix-II Power cable sizes.

S.No.	From	To	Existing Cable size	Cable type
1.	Main Switch Board	LT Transformer	2-1C X 630 mm ² :For each phase 1-1C X 630 mm ² : for neutral	XLPE
2.	Main Switch Board	AC Distribution Board	2-3½C X 300 mm ²	XLPE
3.	Main Switch Board	Oil Filtration Unit	1-3½C X 300 mm ²	XLPE
4.	Main Switch Board	Colony Lighting	1-3½C X 300 mm ²	XLPE
5.	Main Switch Board	HVW pump LCP	1-3½C X 300 mm ²	XLPE
6.	Main Switch Board	Main Lighting distribution board	2-3½C X 300 mm ²	XLPE
7.	AC Distribution Board	D.G. Set AMF Panel	For 500 kVA DG set: 2-3½C X 300 mm ² For 250 kVA DG set: 1-3½C X 300 mm ²	XLPE
8.	AC Distribution Board	Emergency Lighting distribution board	3½C X 70mm ² :For 765/400kV S/s 3½C X 35mm ² :For 400/220kV S/s	PVC
9.	AC Distribution Board	ICT MB	3½C X 70mm ² :For 765/400kV S/s 3½C X 35mm ² :For 400/220kV S/s	PVC
10.	AC Distribution Board	Bay MB	3½C X 70mm ² :For 765/400kV S/s 3½C X 35mm ² For 400/220kV S/s	PVC
11.	Bay MB	AC Kiosk	1-4C X 16 mm ²	PVC
12.	AC Distribution Board	Battery Charger 220 V	1-3½C X 70 mm ²	PVC

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13.	AC Distribution Board	Battery Charger 48 V	1-3½C X 35 mm	PVC
14.	DCDB	Battery	2-1C X 150 mm ²	PVC
15.	DCDB	Battery Charger	2-1C X 150 mm ²	PVC
16.	DCDB	Protection/PLCC panel	1-4C X 16 mm ² : 765/400kV S/s 1-4C X 6 mm ² : 400/220kV S/s	PVC
17.	Main Lighting DB	Lighting panels(Indoor)	1-3½C X 35 mm ²	PVC
18.	Main Lighting DB	Lighting panels (outdoor)	1-3½C X 70 mm ²	PVC
19.	Main Lighting DB	Receptacles (Indoor)	1-3½C X 35 mm ²	PVC
20.	Main Lighting DB	Receptacles (Outdoor)	1-3½C X 70 mm ²	PVC
21.	Lighting Panel	Sub lighting panels	These Cables shall be included in Price of item for Lighting fixture	PVC
22.	Lighting Panel	Street Lighting Poles	These Cables shall be included in Price of item for Lighting fixture	PVC
23.	Lighting Panel/ Sub lighting panels	Lighting Fixtures (Outdoor)	These Cables shall be included in Price of item for Lighting fixture	PVC
24.	Bay MB	Equipment	1-4C X 16 mm ² : For CB 1-4C X 6 mm ² : For Isolator/earths switch 1-2C X 6 : For CT/CVT	PVC
25.	ELDB	Lighting panel	3½C X 70mm ² :For 765/400kV S/s 3½C X 35mm ² :For 400/220kV S/s	

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)ANNEXURE-I

Major Changes in Section GTR (Rev 15)

S.No	Clause ref	Existing Clause	Proposed Text	Reason/Backg round for proposed changes
1.	Clause 2.1 a)		<p>All equipment/materials/items, as per Annexure-K, as applicable under present scope of works, shall be procured and supplied from domestic manufacturers only</p> <p>Any imported equipment/material/item/parts/component (comprising of embedded systems) to be supplied under the contract shall be tested in the certified laboratories to check for any kind of embedded malware/trojans/cyber threats and for adherence to Indian Standards as per the directions issued by Ministry of Power/Govt. of India from time to time. In case of such import from specified "prior reference" countries, the requirement of prior permission from the Govt. of India including protocol for testing in certified and designated laboratories by Ministry of Power/Govt. of India shall also be complied with by the contractor.</p> <p>The bidder/contractor shall list out the products and components producing Toxic e-waste under the contract and shall furnish to the Employer the procedure of safe disposal at the time of closing of the contract</p>	New Clause Added..
2.	Clause 2.6	The bidder shall be responsible for safety of human and equipment during the working.....	The contractor shall be responsible for safety of human and equipment during the working.	
3.	Clause 3.2	The equipment to be furnished under this specification shall conform to latest issue with all amendments (as on the originally scheduled date of bid opening) of standard specified under Annexure-C of this section, unless specifically mentioned in the specification.	The equipment offered by the contractor shall at least conform to the requirements specified under relevant IS standard. In case of discrepancy between IS and other international standard, provisions of IS shall prevail. The Contractor shall also note that the list of standards presented in this specification at Annex-C is not complete. Whenever necessary, the list of standards shall be considered in conjunction with specific IS. If the IS standard is not available for an equipment/material, then other applicable International standard	Changes incorporated In line with recent Guidelines from GOI.

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Major Changes in Section GTR (Rev 15)

			(IEC/Equivalent), as per the specification, shall be accepted.	
4.	Clause 3.3	The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to compliment each other.	The Contractor shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to compliment each other.	
5.	Clause 3.4	The Contractor shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IS/IEC.	The equipment offered by the contractor shall confirm to relevant IS standard. The list of such IS standards are given at Annexure-C. In case There is discrepancy between IS and other international standard then provision in IS shall prevail. The Contractor shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IS. If the IS standard is not available for relevant equipment's/ Material is supplied from foreign country, then other internationally standard (IEC/Equivalent) will be accepted.	Changes incorporated In line with recent Guidelines from GOI
6.	Clause 4.1	The 800kV and 420kV system is being designed to limit the switching surge over voltage of 1.9 p.u. and 2.5 p.u., respectively and the power frequency over voltage of 1.4 p.u. and 1.5 p.u., respectively. In case of the 420kV system, the initial value of the temporary overvoltages could be 2.0 p.u. for 1-2 cycles. The equipment furnished under this specification shall perform all its functions and operate satisfactorily without showing undue strain, restrike etc under such over voltage conditions.	Switching surge over voltage and power frequency over voltage is specified in the system parameters below. In case of the 420kV system, the initial value of the temporary over voltages could be 2.0 p.u. for 1-2 cycles. The equipment furnished under this specification shall perform all its functions and operate satisfactorily without showing undue strain, restrike etc under such over voltage conditions.	To avoid repetition.
7.	Clause 4.4	The bidder shall design terminal connectors of the equipment taking into account various forces that are required to withstand.	The bidder Contractor shall design terminal connectors of the equipment taking into account various forces as mentioned at Sl.No.4.3 that are required to withstand.	

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SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

ANNEXURE-I

Major Changes in Section GTR (Rev 15)

8.	<p>Clause 4.6</p> <p>4.6 System parameters 132kV,66kV,33kV & 11kV System</p> <table border="1" data-bbox="341 1165 462 1690"> <tr> <th>S.No</th> <th>Description of parameters</th> <th>66kV System</th> </tr> <tr> <td>9</td> <td>Rated Short circuit current</td> <td>31.5kA</td> </tr> </table>	S.No	Description of parameters	66kV System	9	Rated Short circuit current	31.5kA	<p>4.6 System parameters 132kV,52kV,66kV,33kV & 11kV System</p> <table border="1" data-bbox="341 588 576 1155"> <tr> <th>S.No</th> <th>Description of parameters</th> <th>66kV System</th> </tr> <tr> <td>9</td> <td>Rated Short circuit current</td> <td>31.5kA/25kA* for 3 Sec/</td> </tr> </table> <p>* For Tertiary loading Equipment's fault level shall be 25kA for 3 Sec. For Other Switchyards shall be as specified in Section Project</p> <ul style="list-style-type: none"> Further Parameters of 52 kV System is also added Sectional Clearance of 66kV System is updated in line with Safety regulation of CEA 	S.No	Description of parameters	66kV System	9	Rated Short circuit current	31.5kA/25kA* for 3 Sec/	
S.No	Description of parameters	66kV System													
9	Rated Short circuit current	31.5kA													
S.No	Description of parameters	66kV System													
9	Rated Short circuit current	31.5kA/25kA* for 3 Sec/													
9.	<p>Clause 5.2</p> <p>The Contractor shall submit 4 (four) sets of drawings/ design documents /data detailed bill of quantity and 1 (one) set of test reports for the approval of the Employer. The contractor shall also submit the softcopy of the above documents in addition to hardcopy.</p>	<p>The Contractor shall submit 4 (four) sets of All Engineering Documents (drawings/ design documents /data / detailed bill of quantity and 1 (one) set of test reports) through Online Document Review and Engineering Approval Management System(Herein after DREAMS) for the approval of the Employer. The contractor shall also submit the softcopy of the above documents in addition to hardcopy</p>													
10.	<p>Clause 5.7</p> <p>Approval Procedure Note (2) All drawings should be submitted in softcopy form, however substation design drawings like SLD, GA, all layouts etc. shall also be submitted in AutoCAD Version. SLD, GA & layout drawings shall be submitted for the entire substation in case of substation extension also</p>	<p>Approval Procedure Note (2) All drawings should be submitted in softcopy form DREAMS, however further substation design drawings like SLD, GA, all layouts etc. shall also be submitted in AutoCAD Version as supporting documents in DREAMS. SLD, GA & layout drawings shall be submitted for the entire substation in case of substation extension also.</p> <p>For Civil drawings, associated documents shall be submitted in</p>													

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SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

ANNEXURE-I

Major Changes in Section GTR (Rev 15)

11.	Clause 6.1.7	All oil, grease and other consumables used in the Works/Equipment shall be purchased in India unless the Contractor has any special requirement for the specific application of a type of oil or grease not available in India. If such is the case, he shall declare in the proposal, where such oil or grease is available. He shall help Employer in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.	STAAD/Excel format as supporting document in DREAMS. All oil, grease and other consumables used in the Works/Equipment shall be purchased in India unless the Contractor has any special requirement for the specific application of a type of oil or grease not available in India. If such is the case, he shall declare source of oil/grease /other consumables in the proposal GTP/Drawings , where such oil or grease is available. He shall help Employer in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.	
12.	Clause 6.2.4	Degree of Protection 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 IP-55 or higher degree of protection shall be submitted for approval.	Degree of Protection The degree of protection shall be in accordance with IS/IEC60947; IS/IEC60529 . Type test report of relevant Degree of Protection test , shall be submitted for approval.	IS 13947 is superseded by IS/IEC 60947 IS 12063 is superseded by IS/IEC 60529
13.	Clause 6.3.1	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 Employer. The rating plate of each equipment shall be according to IEC requirement.	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, Customer 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 Employer. The rating plate of each equipment shall be according to IS/ IEC requirement.	
14.	Clause 9.2	The reports for all type tests as per technical specification shall be furnished by the Contractor alongwith equipment / material drawings. However, type test reports of similar equipments/ material already accepted in POWERGRID shall	The reports for all type tests as per technical specification shall be furnished by the Contractor alongwith equipment / material drawings. However, type test reports of similar equipments/ material already accepted in POWERGRID shall be applicable for all projects with similar requirement. The type tests conducted earlier should have	In line with CEA Guidelines for Validity of Type tests

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SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

ANNEXURE-I

Major Changes in Section GTR (Rev 15)

	<p>be applicable for all projects with similar requirement. The type tests conducted earlier 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 POWERGRID or representative of POWERGRID or Utility or representative of POWERGRID or Utility or representative of accredited test lab.</p> <p>Unless otherwise specified elsewhere, the type test reports submitted shall be of the tests conducted within last 10 (ten) years from the date of NOA. In case the test reports are of the test conducted earlier than 10 (ten) years from the date of NOA, the contractor shall repeat these test(s) at no extra cost to the Employer</p>	<p>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 POWERGRID/representative of Utility /authorized POWERGRID/representative of accredited test lab/ representative of NABCB certified agency shall also be acceptable.</p> <p>Unless otherwise specified elsewhere, the type test reports submitted shall be of the tests conducted within the years specified below from the date of NOA. In case the test reports are of the test conducted earlier than the years specified below from the date of NOA, the contractor shall repeat these test(s) at no extra cost to the Employer.</p> <table border="1" data-bbox="732 598 1284 1144"> <thead> <tr> <th>S. No</th> <th>Name of Equipment</th> <th>Validity of type test(in years)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Power Transformer</td> <td>5</td> </tr> <tr> <td>2</td> <td>LT Transformer</td> <td>5</td> </tr> <tr> <td>3</td> <td>Shunt Reactor</td> <td>5</td> </tr> <tr> <td>4</td> <td>OLTC</td> <td>10</td> </tr> <tr> <td>5</td> <td>Bushing of Power Transformers/Reactors</td> <td>7</td> </tr> <tr> <td>6</td> <td>Fittings and accessories for Power transformers & Reactors</td> <td>10</td> </tr> <tr> <td>7</td> <td>Circuit Breaker</td> <td>10</td> </tr> <tr> <td>8</td> <td>Isolator</td> <td>10</td> </tr> <tr> <td>9</td> <td>Lighting Arrester</td> <td>10</td> </tr> <tr> <td>10</td> <td>Wave Trap</td> <td>10</td> </tr> <tr> <td>11</td> <td>Instrument transformer</td> <td>7</td> </tr> <tr> <td>12</td> <td>GIS & Hybrid GIS</td> <td>10</td> </tr> </tbody> </table>	S. No	Name of Equipment	Validity of type test(in years)	1	Power Transformer	5	2	LT Transformer	5	3	Shunt Reactor	5	4	OLTC	10	5	Bushing of Power Transformers/Reactors	7	6	Fittings and accessories for Power transformers & Reactors	10	7	Circuit Breaker	10	8	Isolator	10	9	Lighting Arrester	10	10	Wave Trap	10	11	Instrument transformer	7	12	GIS & Hybrid GIS	10
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			<table border="1"> <tr> <td>13</td> <td>LT Switchgear</td> <td>10</td> </tr> <tr> <td>14</td> <td>Cable and associated accessories</td> <td>10</td> </tr> <tr> <td>15</td> <td>Relays</td> <td>7</td> </tr> <tr> <td>16</td> <td>Capacitors</td> <td>10</td> </tr> <tr> <td>17</td> <td>Battery & Battery Charger</td> <td>7</td> </tr> <tr> <td>18</td> <td>Conductor & Earth wire</td> <td>10</td> </tr> <tr> <td>19</td> <td>Insulators (Porcelain/Glass)</td> <td>10</td> </tr> <tr> <td>20</td> <td>Composite Insulators</td> <td>5</td> </tr> <tr> <td>21</td> <td>PLCC</td> <td>5</td> </tr> </table> <p>Note For all other equipment's validity of type test shall be 10 years from date of NOA</p> <p>Further, 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 or any/all type tests not carried out, same shall be carried out without any additional cost implication to the Employer.</p> <p>The Contractor shall intimate the Employer the detailed program about the type tests atleast two (2) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies</p> <p>The list of makes of various items, for which Type test reports are not required to be submitted are specified in Compendium of Vendor Annex-J</p> <p>The minimum weight of the zinc coating shall be 610 gm/sq.m and minimum average thickness of coating shall be 86 microns for all items having thickness 6mm and above and 900 gm/sq.m for coastal area (30km from sea shore approximately if defined in Section Project) or as specified in Section-Project. For items lower than 6mm thickness requirement of coating thickness shall be as per relevant ASTM. For</p>	13	LT Switchgear	10	14	Cable and associated accessories	10	15	Relays	7	16	Capacitors	10	17	Battery & Battery Charger	7	18	Conductor & Earth wire	10	19	Insulators (Porcelain/Glass)	10	20	Composite Insulators	5	21	PLCC	5
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15.	Clause no. 9.5	The list of makes of various items, for which Type test reports are not required to be submitted are specified in Compendium of Vendors (COV).																												
16.	Clause 12.2	The minimum weight of the zinc coating shall be 610 gm/sq.m and minimum average thickness of coating shall be 86 microns for all items having thickness 6mm and above and 900 gm/sq.m for coastal area (30km from sea shore approximately) or as specified in Section-																												

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		<p>Project. For items lower than 6mm thickness requirement of coating thickness shall be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sq.m minimum and 900 gm/sq.m for coastal area as specified in Section-Project</p>	<p>surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sq.m minimum and 900 gm/sq.m for coastal area as specified in Section-Project</p>																									
17.	Clause 12.3.2	<p>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</p>	<p>Hot Phosphating shall be done for phosphating process under pretreatment of sheets 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</p>																									
18.	Clause 12.3.6	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">S.No</th> <th style="width: 20%;">PIPE LINE</th> <th style="width: 15%;">BASE COLOUR</th> <th style="width: 15%;">PIPE LINE</th> <th style="width: 15%;">BASE COLOUR</th> <th style="width: 25%;">BAND COLOUR</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td> <td>Hydrant and Emulsifier system pipeline</td> <td style="text-align: center;">Fire red</td> <td>Hydrant and Emulsifier system pipeline</td> <td style="text-align: center;">Fire red</td> <td></td> </tr> </tbody> </table>	S.No	PIPE LINE	BASE COLOUR	PIPE LINE	BASE COLOUR	BAND COLOUR	1	Hydrant and Emulsifier system pipeline	Fire red	Hydrant and Emulsifier system pipeline	Fire red		<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">S.No</th> <th style="width: 20%;">PIPE LINE</th> <th style="width: 15%;">BASE COLOUR</th> <th style="width: 15%;">PIPE LINE</th> <th style="width: 15%;">BASE COLOUR</th> <th style="width: 25%;">BAND COLOUR</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td> <td>Hydrant and Emulsifier system pipeline</td> <td style="text-align: center;">Fire red</td> <td>Hydrant and Emulsifier system pipeline</td> <td style="text-align: center;">Fire red</td> <td></td> </tr> </tbody> </table>	S.No	PIPE LINE	BASE COLOUR	PIPE LINE	BASE COLOUR	BAND COLOUR	1	Hydrant and Emulsifier system pipeline	Fire red	Hydrant and Emulsifier system pipeline	Fire red		
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19.	Clause no. 12.3.8			<p>Band colour is required for Emulsifier system detection line only if both water and air detection lines are present at the same substation. Further, band colour shall be applied at an interval of 2 meters approx. along the length and minimum width of band shall be 25mm.</p>	New Clause added																							
20.	Clause No. 13.14			<p>Erection, testing and commissioning of Transformers, Reactors, Circuit breakers, Isolators, Substation automation system, Control & protection panels, PLCC, PMU, Telecommunication Equipments, NIFPS System ,</p>	New Clause added																							

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Major Changes in Section GTR (Rev 15)

		copper with ACSR conductors/AAC conductors/Aluminium tube	to designation of IS:617 with 2mm thick bimetallic liner/strip and all test shall conform to IS:617	b)	For connecting equipment terminal ends of copper with ACSR conductors/AA conductors/Aluminium tube	Bimetallic connectors made from aluminum alloy casting, conforming to designation A6-6000 of IS:617 with 2mm thick bimetallic liner/strip and all test shall conform to IS:617	
24.	Clause 17.11	Clamps and connectors should be type tested on 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. Type test once conducted shall hold good. The requirement of test conducted within last ten years, shall not be applicable	Clamps and connectors should be type tested on 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. Type test once conducted shall hold good. 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) [for 400kV and above] and RIV (dry) test [for 132kV and above voltage level clamps]	i) Temperature rise test (maximum temperature rise allowed is 35°C over 50°C ambient) ii) Short time current test iii) Corona (dry) [for 400kV and above] and RIV (dry) test [for 132kV and above voltage level clamps] iv) Resistance test and tensile test Pullout strength test v) Cantilever strength test on bus support clamps & connectors	Clamps and connectors should be type tested on minimum three samples 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. Type test once conducted shall hold good. The requirement of test conducted within last ten years, shall not be applicable	

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	iv) Resistance test and tensile test	
25.	<p>All types of boxes, cabinets etc. shall generally conform to & be tested in accordance with IS-5039/IS-8623, IEC-60439, as applicable, and the clauses given below:</p> <p>Control cabinets, junction boxes, Marshalling boxes, & terminal boxes, & terminal boxes shall be made of stainless steel of atleast 1.5 mm thick or aluminum enclosure of atleast 1.6 mm thick and shall be dust, water and vermin proof. Stainless steel used shall be of grade SS304 (SS316 for coastal area) or better. The box shall be properly braced 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.</p>	<p>All types of boxes, cabinets etc. shall generally conform to & be tested in accordance with IS-5039/IS-8623, IEC-60439 IS/IEC 61439-0, as applicable, and the clauses given below:</p> <p>Control cabinets, junction boxes, Marshalling boxes & terminal boxes, Out door ACDB cum DCDB panels shall be made of stainless steel of atleast 1.5 mm thick or aluminum enclosure of atleast 1.6 mm thick and shall be dust, water and vermin proof. Stainless steel used shall be of grade SS304 (SS316 for coastal area) or better. The box shall be properly braced 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.</p> <p>Control cabinets, junction boxes, marshalling boxes & terminal boxes, out-door ACDB cum DCDB panels shall have adequate space/clearance as per guidelines/technical specifications to access/replace any component. Necessary component labelling to be also done on non-conducting sheet.</p> <p>For CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES MARSHALLING BOXES FOR OUTDOOR EQUIPMENT Junction Box, wire should be as per IS or equivalent IEC with FRLS grade</p> <p>Machine laid PU Foam gasket may be permitted for use in Control Cabinets etc.</p>
26.	<p>Control cabinets, junction boxes, Marshalling boxes, & terminal boxes shall be made of stainless steel of atleast 1.5 mm thick or aluminum enclosure of atleast 1.6 mm thick and shall be dust, water and vermin proof. Stainless steel used shall be of grade SS304 (SS316 for coastal area) or better. The box shall be properly braced 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.</p>	

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SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)ANNEXURE-I

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27.	Clause 18.4	Cabinet/boxes shall be provided with double hinged doors with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere	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. Cabinet boxes with width more than 700 mm shall be double door double hinged with padlocking type.
28.	Clause 18.13	The enclosure of bay marshalling kiosk, junction box, terminal box and control cabinets shall conform to IP-55 as per IS:13947 including application of 2KV rms for 1 (one) minute, insulation resistance and functional test after IP-55 test	The enclosure of bay marshalling kiosk, junction box, terminal box and control cabinets shall conform to IP-55 as per IS/IEC60947 including application of minimum 1KV rms for 1 (one) minute, insulation resistance and functional test after IP-55 test
29.	Clause 20.13	The Contractor shall furnish all wire, conduits and terminals for the necessary interphase electrical connections (where applicable) as well as phases and common terminal boxes or control cabinets. For equipments rated for 400 kV and above the wiring required in these items shall be run in metallic ducts or shielded cables in order to avoid surge over voltages either transferred through the equipment or due to transients induced from the EHV circuits.	The Contractor shall furnish all wire, conduits and terminals for the necessary interphase electrical connections (where applicable) as well as equipments rated for 400 kV and above the wiring required in these items shall be run in metallic ducts or shielded cables in order to avoid surge over voltages either transferred through the equipment or due to transients induced from the EHV circuits.
30.	Clause 20.14	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 Contractor shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.	- Clause deleted
31.	Clause 21.3.2	All fuses shall be of HRC cartridge type	All fuses shall be of HRC cartridge type conforming to relevant IS

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Major Changes in Section GTR (Rev 15)

		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 of the fuse rating and voltage	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 of the fuse rating and voltage	
32.	Clause 22.8	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.	-	Clause deleted
33.	Clause 22.10	No.	All switchgear/equipments, insulator strings, bushings, bus post insulators shall be designed for minimum creepage distance of 31mm/kV or 25mm/kV as mentioned against each substation in section project under "PHYSICAL AND OTHER PARAMETERS" Zinc coating for galvanized lattice and pipe structures, all ferrous parts of composite long rod insulators and earthing conductors shall not be less than 900 gm/sq-m irrespective of other values mentioned elsewhere in technical specification/drawings at substations where creepage distance is considered as 31mm/kV. In case, different designs of lattice and pipe structures other than Employer supplied structures are required to be adopted in view of higher creepage (31mm/kV) of the switchgear/equipments, insulator strings, bushings & bus post insulators etc., Design, supply & erection of such structures shall be in the scope of contractor against respective standard structure. However dimensional details (except height) shall not be less than that specified in standard structure drawing of respective equipments.	New Clause added
			Silicon RTV coating:- Equipment/insulators (except equipments with polymer insulator) including mandatory spares being supplied at	

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ANNEXURE-I

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			substations where creepage distance is considered as 31mm/kV shall be with Silicon RTV coating. The price of RTV coating shall be included in the installation cost of respective equipment.	
34.	Clause No.-24	TECHNICAL REQUIREMENT OF EQUIPMENTS Following equipment shall be offered from the manufacturer(s) who meets the technical requirements as stipulated here, provided the same equipment are not covered under the Bidder's Qualifying requirement of the Bidding Documents.	24. TECHNICAL REQUIREMENT OF EQUIPMENTS 24.1 Following equipment shall be offered from the Indian Manufacturing Facilities of manufacturer(s) who meets the technical requirements as stipulated here, provided the same equipment are not covered under the Bidder's Qualifying requirement of the Bidding Documents.	
35.	Clause 24.1	24.1 Technical requirements for 765/400/220/132/110kV* Air Insulated Switchgear (AIS) Equipment* (i.e Circuit Breaker, Isolator, Current Transformer, Capacitive Voltage transformer, Inductive Voltage transformer, Surge Arrester and Wave Trap) (i) The manufacturer(s) whose equipment(s) are offered, must have, manufactured, type tested (as per IEC/IS standard) and supplied (as per IEC/IS or equivalent standard) or higher voltage class equipment(s), which are in satisfactory operation# for atleast two (2) years as on the date of NOA. (ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India for the offered equipment and not meeting the requirement stipulated in (i) above, can also be considered provided that	24.1 Technical requirements for 765/400/220/132/110kV* Air Insulated Switchgear (AIS) Equipment* (i.e Circuit Breaker, Isolator, Current Transformer, Capacitive Voltage transformer, Inductive Voltage transformer, Surge Arrester and Wave Trap) (i) The manufacturer(s) whose equipment(s) are offered, must have, manufactured, type tested (as per IEC/IS or equivalent standard) and supplied (as per IEC/IS or equivalent standard) or higher voltage class equipment(s), which are in satisfactory operation# for atleast two (2) years as on the date of NOA. (ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India for the offered equipment and not meeting the requirement stipulated in (i) above, can also be considered provided that	

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Sl. No.	Item Description	Unit	Data
	vii) Minimum Volume Resistivity at 20 degree C		
	viii) Minimum Volume Resistivity at 70 degree C		
	ix) Minimum Tensile Strength	Kg/sq cm	
	x) Minimum Elongation percentage at rupture	%	
	xi) Identification of Cores		
16	1.2/50 μ s Impulse wave withstand voltage	kV _p	
17	1-min Power-frequency withstand voltage	kV	
18	Max. dielectric stress at the conductor	kV/cm	
19	Max. dielectric stress at the conductor screen	kV/cm	
20	Insulation Screen		
	i) Material		
	ii) Extruded/ wrapped		
	iii) Nominal thickness	mm	
	iv) Colour		
21.	Metal sheath		
	i) Material / composition		
	ii) Minimum radial thickness	mm	
	iii) Max. working stress		
22.	Nominal diameter over metallic sheath	mm	
23.	Nominal radial clearance allowed under metal sheath	mm	
24.	Type and Material of Filler		
25.	Armour		
	i) Material and Type		
	ii) Thickness	mm	
26.	Outer Sheath		
	i) Material		
	ii) Type		
	iii) Colour		
	iv) Minimum radial thickness	mm	
	v) Tolerance on nominal thickness of sheath		
	vi) Minimum tensile strength		
	vii) Minimum Elongation percentage at rupture	%	
	viii) Oxygen Index		
	ix) Temperature Index		
	x) Accelerated Water Absorption		
	xi) * Dielectric Constant after 24 hours		
	xii) * Increase in Capacitance		
	a) 1-14 days		
	b) 7-14 days		
	xiii) Retention of dielectric strength (min)		
	xiv) Acid Gas Generation		
	xv) Smoke Density generation		
27.	Method of Application		
	i) Insulation		
	ii) Inner Sheath		
	iii) Outer Sheath		

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S. No.	Item Description	Unit	Data
28.	Nominal overall diameter of completed single-core cable	mm	
29.	Nominal weight of completed cable	kg/m	
30.	Min. bending radius of the cable	mm	
31.	Max. drum length of cable	m	
32.	Approx. shipping weight and size of drums	m	
33.	Charts for Derating Factors enclosed –		
	i) Variation in Ambient Temperature		
	ii) Variation in Ground Temperature		
	iii) Variation in Ground resistivity		
	iv) Spacing Factors –		
	a) Cables laid in ground		
	b) Cables laid on racks in RCC trenches with covers		
	c) Cables laid in air		
	d) Cables laid in pipes/ ducts		

ANNEXURE - A
SCHEDULE OF TECHNICAL DEVIATIONS

Bidder shall list below all technical deviation clause wise w.r.t. tender specifications:

<u>S.No.</u>	<u>Page No.</u>	<u>Clause No.</u>	<u>Deviation</u>	<u>Reason / Justification</u>
--------------	-----------------	-------------------	------------------	-------------------------------

Any deviation not specifically brought out in this section shall not be admissible for any commercial implication at later stage. Except to the technical deviations listed in this schedule, bidder's offer shall be considered in full compliance to the tender specifications irrespective of any such deviation indicated / taken elsewhere in the submitted offer.

Date:

Tenderer's Stamp & Signature

Technical Specification - **33kV XLPE Power Cable**
Doc No. - **TB-434-507-014**

Section 5

CHECK LIST

TECHNICAL REQUIREMENTS FOR 33KV XLPE CABLE

Sl.	Particulars	Reply by bidder.	
1	TECHNICAL QUALIFYING REQUIREMENT		
1.1	Papers for qualifying requirement enclosed.	Confirmed	Yes/No
1.2	The bid shall be submitted by the Manufacturer of the 33kV Cable. Bids submitted by agents will not be considered.	Confirmed	Yes/No
1.3	All the documents shall be submitted in English. Translated pages should be attested by the bidder.	Confirmed	Yes/No
2	Un-priced Offer -.		
2.1	Confirm that all items have been quoted. (If any item has not been quoted, the same shall be specifically brought out in Schedule of Technical Deviation)	Confirmed	Yes/No
3	Cable Lengths		
3.1	Confirm to supply of cables as per section-1	Confirmed	Yes/No
3.2	Cables shall be supplied in 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. Drums offered shall conform to relevant standards.	Confirmed	Yes/No
4	Technical		
4.1	Technical Deviations		
4.1.1	Confirm that the cable has been offered as per the requirements of Technical Specification and Technical Deviation sheet has been submitted. Deviations mentioned elsewhere in the bid will not be considered.	Confirmed	Yes/No
4.1.2	Technical Deviation sheet has been submitted.	Confirmed	Yes/No
5	Bar chart		
5.1	Bidder will submit detailed bar chart indicating all the milestones from Engineering till manufacturing/ testing, dispatch to site.	Confirmed	Yes/No
6	TYPE TESTS REQUIREMENTS		
6.1	The 33kV Cables should have been type tested (as per relevant IEC / IEEE standard).	Confirmed	Yes/No
6.2	Type test report for 33kV cable system shall be submitted with the bid. Differences, if any, in the items offered and those which have been Type tested shall be clearly brought out along with explanation for suitability. Type test reports will be vetted by BHEL/ PGCIL at contract stage and if the same is not acceptable to BHEL/PGCIL, bidder has to repeat type tests without any cost and delivery extension.	Confirmed and enclosed with bid	Yes/No

Technical Specification - **33kV XLPE Power Cable**
 Doc No. - **TB-434-507-014**

Sl. Particulars**Reply by bidder.**

6.3	The test - reports submitted shall be of the tests conducted within last 10(ten) years prior to date of NoA i.e. 01-01-2025	Confirmed	Yes/No
6.4	In case the test reports are not found technically valid during contract stage by BHEL/ Powergrid or if the tests were conducted earlier than 10 (ten) years prior to the date of bid opening, the bidder shall repeat these test(s) <u>at no extra cost to the purchaser and no delivery implication.</u>	Confirmed	Yes/No
7	INSPECTION & TESTING		
7.1	Inspection and Testing shall be as approved Quality Plan.	Confirmed	Yes/No
7.2	Validity of SMQP by PGCIL	Confirmed	Yes/No
8	Construction as per clause 2.4 of Section 2	Confirmed	Yes/No

Signature of Authorised Representative**with company seal****Date:****Place:****Phone:****Fax:****E-mail:****Mobile:****Website:**

Annexure – TQR 33kV XLPE Power Cable

TECHNICAL PRE QUALIFICATION REQUIREMENT

Name of Project: (i) 765/400/ 220kV Mandsaur S/s & extension of 765kV Indore S/s (SS-43T)
(ii) 765/400/ 220kV Kurawar (new) S/s & extension of 765kV Mandsaur s/s,
400kV shujalpur S/s & 400kV ashtha s/s (SS-47T)
(iii) 765kV AIS Pkg for Establishment of 765/400/220kV Barmer-I, Sirohi
Extn.and Fatehgarh-3 Extn. Substation (SS-46T)

Name of Customer: POWERGRID Corporation of India Ltd. (PGCIL)

Name of Item : 33kV XLPE Power Cable

TECHNICAL PRE-QUALIFICATION REQUIREMENT
The bidder must have manufactured and supplied in a single contract atleast 5 Kms of 11 KV or higher grade XLPE insulated power cables.

SUPPORTING DOCUMENTS TO BE ATTACHED		
<i>(As applicable as per PQ requirement)</i>		
Sr	Required Criteria	Supporting Documents to be submitted by bidder along with technical bid
1	Manufacturing	Approved Drawings / GTP / Approved Quality Plan / Factory Inspection Test Report etc
2	Supply	PO / Dispatch clearance / LR / Material Receipt certificate at site / installation or commissioning certificate e.t.c

Notes (General points):

1. Consideration of offer shall be subject to customer's approval of bidder's, if applicable.
2. Bidder to submit all supporting documents in English. If documents submitted by bidder are in language other than English, a self- attested English translated document should also be submitted.
3. Notwithstanding anything stated above, BHEL reserves the right to assess the capabilities and capacity of the bidder to perform the contract, should the circumstances warrant such assessment in the overall interest of BHEL.
4. After satisfactory fulfilment of all the above criteria / requirement, offer shall be considered for further evaluation as per NIT and all the other terms of the tender.

PREPARED BY

Rahul Ahuja
Manager (TBEM)

[Signature]
12/1/2026

REVIEWED BY

Asif Rizvi
Sr. Manager (TBEM)

[Signature]
12/1/26

APPROVED BY

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Vivek Kapil
AGM (TBEM)

12-1-26



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IEEMA (PVC)/MV SCREEN CABLE/2019 (R-1)

Effective from: 01 April 2023

Cir. No. 07/DIV/CAB/05

08 May 2023

To Cable Division and Utilities/SEBS, listed of purchasing organisations

Sub: Amendment to Price Variation Clause for MV Cables

IEEMA MV Cable PV formula is applicable from Sep 2019. With the coming demand for cables; Cable manufacturers' requested IEEMA to publish following missing factors from formula document of MV Cable effective from Sep 2019; since some of the users were procuring such cables and demanding these factors and also for the correction in the SMIF factor for Copper Wire Metallic Screen for MV and EHV cables.

IEEMA Cable Technical committee discussed the subject in depth and IEEMA collected the variation factors and finalised in consensus. The average factors are tabled in annexure which are effective from 01 Apr 2023 and accordingly modified the formulae, attached with circular.

New evolved variation factors and corrections in formulae are as below:

1. Variation factors for Polymer (CCFAL/CCFCu), Table: H5 (a) are added for Single core unarmored XLPE insulated 3.3 to 33 KV Power cables with Al / Cu conductor
2. Variation factors for 33 KV (UE) and 3.3 KV (screened) are added
3. The formula for copper screen factor given in IEEMA MV Cable PV clause for all formulae wef Sep 19 is for copper wires only and copper tape binder if provided, its area would be additional.

The SMIF, weight factor for Copper Wire Metallic Screen has been modified as under:

SMIF = $(A \times D \times LF)/1000$, where D = Density (= 8.89 for Cu), LF = Lay Factor (=1.07, for Copper Wire Metallic Screen and counter helix tape)

4. Considering the fluctuations in the prices; and as suggested by members, IEEMA will be publishing a separate price for XLPE for EHV Cables (Above 66 KV) in IEEMA Cable price variation circular from 01 Apr 2023 onwards. This price will be applicable for XLPE in all EHV Cable (Above 66 KV) formulae from 01 Apr 2023 onwards. And correction/change in existing "XLPE - HV Cable" being mentioned in IEEMA Price circulars with "XLPE - MV Cable" applicable for MV cables.
5. For the better clarity and application of prices, it is also agreed upon to change/replace the existing PVC grades "CW 22" & "HR-11" being mentioned in IEEMA Price circulars with generic PVC names as under;

CW 22 to be changed to "PVC" &
 HR 11 to be changed to "HR PVC"





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IEEMA (PVC)/MV SCREEN CABLE/2019 (R-1)

Effective from: 01 April 2023

As discussed and agreed in consensus, the understanding for above generic PVC grades is that "PVC" will be considered for PVC insulation and PVC sheath of General Purpose PVC insulated LV cables as per IS 1554 (I) suitable max conductor temperature of 70 °C, whereas "HRPVC" will be considered for Heat Resisting PVC insulation and Heat Resisting PVC sheath of HRPVC insulated LV Cables as per IS 1554 (I) and also for Heat Resisting PVC sheath of XLPE insulated LV cables as per IS 7098 (I) & Heat Resisting PVC sheath of XLPE insulated HT Cables as per IS 7098 (Part-2).

6. There is regular requirement of 3.3 kV DC cables for Metro Projects, with Galvanized Steel (GS) wire/strip armouring, in view of this, Variation Factors for GS wire/ Strip armouring for Single core 3.3 KV cables are collected and the table of average variation factor is evolved.
7. As suggested by stake holders and in consensus with IEEMA Cable Tech committee, prices of Steel for armouring for following thickness are published in IEEMA Cable PVC from 01 Jan 2023 and are effective/applicable from 01 Jan 2023.
 Round wire 2.0 mm dia, Round wire 2.5 mm dia, Round wire 3.15 mm dia, Round wire 4.0 mm dia

We are enclosing amended price variation clause for MV Cables along with applicable table of variation factors and additional table of variation factors which are effective from 01 Mar 2023. We recommend all stakeholders to incorporate these changes in all the contracts/tenders henceforth for settlement of price variation from 01 Apr 2023 onwards.

Director

Encl.: Amended PV clause for MV Cables along with table of variation Factors



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IEEMA (PVC)/MV SCREEN CABLE/2019 (R-1)

Effective from: 01 April 2023

Material Price Variation Clause for 3.3-33 KV XLPE Insulated Armoured Single & Three core Screen Cables

The Price quoted/confirmed is based on the input cost of raw materials/components as on the date of quotation, and the same is deemed to be related to the prices of raw materials as specified in the price variation clause given below. In case of any variation in these prices, the price payable shall be subject to adjustment up or down in accordance with the formulae provided in this document.

Terms used in price variation formulae:

- P Price payable as adjusted in accordance with above appropriate formula (in Rs/Km)
 Po Ex-Works Price quoted/confirmed (in Rs/Km)

ALUMINIUM

AIF Variation factor for Aluminium

AI Price of Aluminum. This price is as applicable **one** month prior to the date of delivery.

Alo Price of Aluminium. This price is as applicable **one** month prior to the date of tendering.

COPPER

CuF Variation factor for copper

Cu Price of CC copper rods. This price is as applicable **one** month prior to the date of delivery.

Cuo Price of CC copper rods. This price is as applicable **one** month prior to the date of tendering.

POLYMER COMPOUND (PVC/PE/Zero Halogen low smoke)

PVC Price of PVC Compound / PE / Zero Halogen low smoke. This price is as applicable on **one** month prior to the date of delivery.

PVCo Price of PVC Compound / PE / Zero Halogen low smoke. This price is as applicable on **one** month prior to the date of tendering.

(the relevant price of Polymer Compound is to be selected depending upon the type of compound used for the cable)

CCFAI Variation factor for PVC compound / PE / Zero Halogen low smoke for aluminum conductor cable.

CCFCu Variation factor for PVC compound / PE / Zero Halogen low smoke for copper conductor cable.

XLPE COMPOUND

Cc price of XLPE compound. This price is as applicable on first working day of the month, **one** month prior to the date of delivery.



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Effective from: 01 April 2023

Cco Price of XLPE compound. This price is as applicable on first working day of the month, **one** month prior to the date of tendering.

XLFAL Variation factor for XLPE compound for aluminum conductor cable.

XLFCU Variation factor for XLPE compound for Copper conductor cable.

STEEL

FeF Variation factor for steel

FeW Variation factor for round wire steel armouring

Fe Price of Steel Strips/steel wire. This price is as applicable on the first working day of the month, **one** month prior to the date of delivery.

Feo Price of steel strips/steel wire. This price is as applicable on first working day of the month, **one** month prior to the date of tendering

COPPER TAPE

SMIFS Variation factor for Copper tape

SMIF1 Price of CC copper rods. This price is as applicable **one** month prior to the date of delivery.

SMIF0 Price of CC copper rods. This price is as applicable **one** month prior to the date of tendering.

The above prices and indices are as published by IEEMA vide Circular reference IEEMA (PVC)/CABLE (R-1)/--/-- for the month i.e. **one** month prior to the date of tendering.

The date of delivery is the date on which the cable is notified as being ready for inspection/dispatch (in the absence of such notification, date of manufacturer's dispatch note is to be considered as the date of delivery) or contracted delivery date (including any agreed extension thereto) whichever is earlier.

Notes: All prices of raw materials are exclusive of GST amount. The details of prices are as under:

1. Price of Aluminium is LME average Cash SELLER Settlement price of Primary Aluminium in US\$ per MT as published by London Metal Bulletin (LME) including Premium for Aluminium Ingot in US\$ per MT is converted in Indian Rs./MT.
2. Price of PVC Compound (in Rs/MT) is the ex-works price, as quoted by the manufacturer/s
3. Price of XLPE Compound (in Rs/MT) is the ex-works price, as quoted by the manufacturer/s
4. Price of Polymer Compound (in Rs/MT) is the ex-work price, as quoted by the manufacturer/s
5. Price of Zero halogen low smoke (LSZH) (in Rs/MT) is the ex-work price, as quoted by the manufacturer/s
6. Price of CC copper rods (in Rs/MT) is ex-works price as quoted by the primary producer
7. Price of galvanized steel strip / steel wire (in Rs/MT) is ex-works price as quoted by the manufacturer for Round steel Wire and Flat steel strip (the relevant price of steel strip or steel wire is to be selected depending upon the type of armouring of the cable)

IEEMA (PVC)/MV SCREEN CABLE/2019 (R-1)**Effective from: 01 April 2023****Price variation formulae****G. For Aluminium conductor XLPE insulated 3.3 to 33 kV Single Core Armoured power cables**

$P = P_o + AIF (AI - AIo) + XLFAL(CC - Cco) + SMIFS (SMIF1 - SMIF0) + CCFAl (PVCc - PVCco)$
For Single Core unarmoured cables Aluminium factor (AIF) shall be referred from Table ALP

Table References:

ALP	Aluminium conductor Factor in single core (for unarmoured cable) ; AIF
H1	Aluminium Armour Factor for Armour with Al Cond.
H2(a)	XLPE Compound Factor ; XLFAI
H3(a)	Copper Tape Factor ; SMIFS
H5(a)	Polymer factor for Single core cable ; CCFAl

Note: For cases where specific Earth Fault Current through Screen is required, Screen area as approved by the customer in Datasheet/Earth Fault Current calculation of Screen shall be used to derive SMIF as below:

If A= Area of Metallic Screen in Approved Datasheet / Calculation Sheet

D= Density= 8.89 for Cu. & 2.703 for Al; LF = Lay Factor (=1.07, for Copper Wire Metallic Screen and counter helix tape)

$$SMIF = (A \times D \times LF) / 1000$$

H. For Copper conductor XLPE insulated 3.3 to 33 kV Single Core Armoured power cables

$P = P_o + CuF (Cu - Cu0) + XLFCu(CC - Cco) + SMIFS (SMIF1 - SMIF0) + AIF(AI - AIo) + CCFAl (PVCc - PVCco)$

For Single Core unarmoured cables Aluminium factor (AIF) shall be 0

Table References:

CuP	Copper conductor Factor in single core ; CuF
H2(a)	XLPE Compound Factor ; XLFCu
H3(a)	Copper Tape Factor ; SMIFS
H4(a)	Aluminium Armour factor ; AIF
H5(a)	Polymer factor for Single core cable ; CCFCu

Note: For cases where specific Earth Fault Current through Screen is required, Screen area as approved by the customer in Datasheet/Earth Fault Current calculation of Screen shall be used to derive SMIF as below

If A= Area of Metallic Screen in Approved Datasheet / Calculation Sheet

D= Density= 8.89 for Cu. & 2.703 for Al; LF = Lay Factor (=1.07, for Copper Wire Metallic Screen and counter helix tape)

$$SMIF = (A \times D \times LF) / 1000$$

IEEMA (PVC)/MV SCREEN CABLE/2019 (R-1)

Effective from: 01 April 2023

I. For Aluminium conductor XLPE insulated 3.3 to 33 kV Three Core Armoured power cables

$$P = P_o + AIF (AI - AIo) + XLFAL(CC-Cco) + SMIF (SMIF1-SMIF0) + FeF(FeF1-FeF0) + CCFAl (PVCc - PVCco)$$

For unarmoured Three Core cables, Steel Armour factor (FeF for Strip & FeW for Wire) shall be 0

Table References:

ALP	Aluminium conductor Factor in three core; AIF
H2(b)	XLPE Compound Factor ; XLFAl
H3(b)	Copper Tape Factor ; SMIF
H4(b)	Steel Strip Armour Factor ; FeF
H4(c)	Steel Wire Armour ; FeW
H5(b)	Polymer factor for Three Core cable ; CCFAl

Note: For cases where specific Earth Fault Current through Screen is required, Screen area as approved by the customer in Datasheet/Earth Fault Current calculation of Screen shall be used to derive SMIF as below

If A= Area of Metallic Screen in Approved Datasheet / Calculation Sheet

D= Density= 8.89 for Cu. & 2.703 for Al; LF = Lay Factor (=1.07, for Copper Wire Metallic Screen and counter helix tape)

$$SMIF = (A \times D \times LF)/1000$$

J. For Copper conductor XLPE insulated 3.3 to 33 kV Three Core Armoured power cables

$$P = P_o + CuF (Cu - Cuo) + XLFCu(CC-Cco) + SMIF(SMIF1-SMIF0) + FeF(FeF1-FeF0) + CCFCu (PVCc - PVCco)$$

For Three Core unarmoured cables, Steel Armour factor (FeF for Strip & FeW for Wire) shall be 0

Table References:

CuP	Copper conductor Factor in three core; CuF
H2(b)	XLPE Compound Factor; XLFCu
H3(b)	Copper Tape Factor; SMIF
H4(b)	Steel Strip Armour Factor; FeF
H4(c)	Steel Wire Armour Factor; FeW
H5(b)	Polymer factor for Three Core cable; CCFCu

Note: For cases where specific Earth Fault Current through Screen is required, Screen area as approved by the customer in Datasheet/Earth Fault Current calculation of Screen shall be used to derive SMIF as below

If A= Area of Metallic Screen in Approved Datasheet / Calculation Sheet

D= Density= 8.89 for Cu. & 2.703 for Al; LF = Lay Factor (=1.07, for Copper Wire Metallic Screen and counter helix tape)

$$SMIF = (A \times D \times LF)/1000$$



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IEEMA (PVC)/MV SCREEN CABLE/2019 (R-1)

Effective from: 01 April 2023

K. For Aluminium conductor XLPE insulated 3.3 kV Single Core Armoured power cables

$$P = P_o + AIF (AI - A_{lo}) + XLFAL(CC - C_{co}) + CCFAI (PVCc - PVC_{co}) + FeF(FeF1 - FeF0)$$

For Single Core unarmoured cables Aluminium factor (AIF) shall be referred from Table ALP

Table References:

ALP	Aluminium conductor Factor in single core (for unarmoured cable) ; AIF
H1	Aluminium Armour Factor for Armour with Al Cond.
H2(a)	XLPE Compound Factor ; XLFAL
H4(d)	Steel Strip Armour Factor ; FeF / Steel Wire Armour Factor ; FeW for 3.3KV cables
H5(a)	Polymer factor for Single core cable ; CCFAI

Note: For cases where specific Earth Fault Current through Screen is required, Screen area as approved by the customer in Datasheet/Earth Fault Current calculation of Screen shall be used to derive SMIF as below

If A= Area of Metallic Screen in Approved Datasheet / Calculation Sheet

D= Density= 8.89 for Cu. & 2.703 for Al; LF = Lay Factor (=1.07, for Copper Wire Metallic Screen and counter helix tape) **SMIF = (A x D x LF)/1000**

L. For Copper conductor XLPE insulated 3.3 kV Single Core Armoured power cables

$$P = P_o + CuF (Cu - Cu_0) + XLFCu(CC - C_{co}) + AIF(AI - A_{lo}) + CCFAI (PVCc - PVC_{co}) + FeF(FeF1 - FeF0)$$

For Single Core unarmoured cables Aluminium factor (AIF) shall be 0

Table References:

CuP	Copper conductor Factor in single core ; CuF
H2(a)	XLPE Compound Factor ; XLFCu
H4(a)	Aluminium Armour factor ; AIF
H4(d)	Steel Strip Armour Factor ; FeF / Steel Wire Armour Factor ; FeW for 3.3KV cables
H5(a)	Polymer factor for Single core cable ; CCFCu

Note: For cases where specific Earth Fault Current through Screen is required, Screen area as approved by the customer in Datasheet/Earth Fault Current calculation of Screen shall be used to derive SMIF as below

If A= Area of Metallic Screen in Approved Datasheet / Calculation Sheet

D= Density= 8.89 for Cu. & 2.703 for Al; LF = Lay Factor (=1.07, for Copper Wire Metallic Screen and counter helix tape) **SMIF = (A x D x LF)/1000**

The PV factor for metallic screen will be computed based on approved screen area in case of cables having a specific short circuit capacity

Authorized Signatory

IEEMA (PVC)/MV SCREEN CABLE/2019 (R-1)

Effective from: 01 April 2023

TABLE ALP

VARIATION FACTOR FOR ALUMINIUM (AIF)
POWER CABLES WITH ALUMINIUM CONDUCTOR
(EXCLUDING SINGLE CORE ARMoured CABLES)

Nominal Cross Sectional Area (in Sq. mm.)	1 core	3 core
25	0.073	0.219
35	0.101	0.302
50	0.137	0.410
70	0.197	0.593
95	0.274	0.821
120	0.346	1.036
150	0.425	1.279
185	0.533	1.605
240	0.703	2.099
300	0.879	2.635
400	1.126	3.374
500	1.418	4.256
630	1.828	5.494
800	2.340	7.018
1000	2.951	8.834

IEEMA (PVC)/MV SCREEN CABLE/2019 (R-1)

Effective from: 01 April 2023

TABLE CUP

VARIATION FACTOR FOR COPPER CONDUCTOR (CUF)
POWER CABLES WITH COPPER CONDUCTOR

Nominal Cross Sectional Area (in Sq. mm.)	1 core	3 core
25	0.240	0.720
35	0.332	0.993
50	0.451	1.348
70	0.648	1.950
95	0.901	2.700
120	1.138	3.407
150	1.398	4.207
185	1.753	5.279
240	2.312	6.904
300	2.891	8.667
400	3.703	11.097
500	4.664	13.998
630	6.012	18.070
800	7.696	23.082
1000	9.706	29.055

IEEMA (PVC)/MV SCREEN CABLE/2019 (R-1)**Effective from: 01 April 2023**

Table : H1
VARIATION FACTOR FOR ALUMINIUM (AIF)
ALUMINIUM ARMoured SINGLE CORE XLPE INSULATED 3.3 TO 33 KV CABLES

Nominal Cross Sectional Area (in Sq. mm.)	Aluminium Factor for Aluminium Armoured Cable with Aluminium Conductor							
	3.3 KV(E) unshielded Arm	3.3 KV(E) shielded Arm	6.6 KV (E)	11 KV (E)/ 6.6 KV (UE)	11 KV (UE)	22 KV (E)	33 KV (E)	33 KV (UE)
35	0.251	0.268	0.284	0.301	0.344	0.358	0.473	0.528
50	0.312	0.324	0.336	0.352	0.397	0.408	0.672	0.695
70	0.385	0.397	0.409	0.423	0.469	0.501	0.723	0.775
95	0.476	0.488	0.500	0.518	0.637	0.656	0.856	0.883
120	0.561	0.574	0.586	0.601	0.726	0.744	0.949	0.985
150	0.653	0.666	0.678	0.696	0.823	0.842	1.050	1.094
185	0.773	0.785	0.797	0.893	0.949	0.965	1.183	1.247
240	0.997	1.030	1.063	1.083	1.139	1.154	1.387	1.463
300	1.209	1.240	1.271	1.283	1.333	1.307	1.753	1.877
400	1.438	1.497	1.556	1.565	1.620	1.636	2.046	2.217
500	1.873	1.887	1.901	1.910	2.110	2.128	2.484	2.613
630	2.337	2.349	2.361	2.369	2.580	2.595	2.978	3.147
800	3.007	3.039	3.071	3.080	3.145	3.163	3.588	3.789
1000	3.737	3.739	3.741	3.749	3.804	3.822	4.565	4.891

IEEMA (PVC)/MV SCREEN CABLE/2019 (R-1)**Effective from: 01 April 2023**

TABLE : H2 (a)
VARIATION FACTOR FOR XLPE(XLFAI/XLFCu)
SINGLE CORE ARMOURED /UNARMOURED XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH AI / Cu CONDUCTOR

Nominal Cross-Sectional Area (in Sq. mm.)	XLPE Factor for Armoured/ Unarmoured Cable with AL /CU Conductor							
	3.3 KV(E) unscreened Arm	3.3 KV(E) screened Arm	6.6 KV (E)	6.6 KV (UE) / 11 KV (E)	11 KV (UE)	22 KV (E)	33 KV (E)	33 KV (UE)
25	0.110	0.117	0.131	0.170	0.279	-	-	-
35	0.122	0.129	0.137	0.175	0.284	0.317	0.522	0.575
50	0.135	0.144	0.151	0.191	0.307	0.341	0.563	0.620
70	0.155	0.165	0.172	0.215	0.342	0.379	0.615	0.678
95	0.174	0.185	0.193	0.241	0.377	0.417	0.670	0.732
120	0.192	0.205	0.212	0.262	0.407	0.449	0.713	0.785
150	0.209	0.223	0.229	0.283	0.437	0.481	0.757	0.832
185	0.228	0.244	0.250	0.308	0.471	0.518	0.809	0.888
240	0.255	0.271	0.279	0.343	0.519	0.569	0.883	0.961
300	0.280	0.296	0.322	0.372	0.560	0.613	0.943	1.030
400	0.326	0.345	0.392	0.420	0.625	0.683	1.041	1.133
500	0.388	0.407	0.461	0.469	0.694	0.757	1.142	1.236
630	0.467	0.490	0.520	0.529	0.777	0.845	1.265	1.356
800	0.567	0.595	0.593	0.602	0.874	0.949	1.407	1.494
1000	0.656	0.688	0.665	0.660	0.955	1.036	1.525	1.624

Note : XLPE factors include Semicons for Conductor & Insulation screen

IEEMA (PVC)/MV SCREEN CABLE/2019 (R-1)**Effective from: 01 April 2023**

TABLE – H2 (b)
VARIATION FACTOR FOR XLPE (XLFAI/XLFCu)

THREE CORE ARMoured /UNARMoured XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH Al / Cu CONDUCTOR

Nominal Cross-Sectional Area (in Sq. mm)	3.3 KV unarmoured Arm	3.3 KV armoured Arm	6.6 KV (E) ARM	6.6 KV (UE)/ 11 KV (E) ARM	11 KV (UE) ARM	22 KV (E) ARM	33 KV (E) ARM	33 KV (UE) ARM
25	0.315	0.315	0.394	0.511	0.838	-	-	-
35	0.339	0.350	0.427	0.545	0.880	0.982	1.638	-
50	0.378	0.387	0.474	0.600	0.957	1.065	1.751	1.858
70	0.435	0.445	0.541	0.679	1.067	1.183	1.916	2.034
95	0.489	0.499	0.604	0.755	1.171	1.295	2.071	2.194
120	0.537	0.554	0.661	0.822	1.265	1.396	2.210	2.355
150	0.585	0.601	0.719	0.890	1.359	1.497	2.350	2.494
185	0.642	0.660	0.784	0.968	1.468	1.614	2.513	2.665
240	0.717	0.734	0.873	1.074	1.615	1.773	2.732	2.882
300	0.781	0.804	1.006	1.167	1.744	1.928	2.919	3.089
400	0.886	0.910	1.227	1.314	1.948	2.130	3.229	3.399
500	0.956	1.085	1.421	1.446	2.148	2.381	3.588	3.689
630	1.129	1.285	1.582	1.609	2.382	2.630	3.940	4.068

Note : XLPE factors include Semicons for Conductor & Insulation screen

IEEMA (PVC)/MV SCREEN CABLE/2019 (R-1)**Effective from: 01 April 2023****TABLE – H3 (a)****VARIATION FACTOR FOR COPPER TAPE (SMIFS)**

SINGLE CORE ARMoured /UNARMoured XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH Al / Cu CONDUCTOR

Nominal Cross-Sectional Area in sq.mm.	3.3 KV Screened	6.6 KV (E)	6.6 KV (UE) / 11 KV (E)	11 KV (UE)	22 KV (E)	33 KV (E)	33 KV (UE)
	ARM	ARM	ARM	ARM	ARM	ARM	ARM
35	0.016	0.018	0.020	0.025	0.026	0.016	0.035
50	0.016	0.019	0.022	0.026	0.028	0.035	0.038
70	0.020	0.022	0.024	0.029	0.030	0.037	0.040
95	0.022	0.024	0.026	0.031	0.032	0.039	0.043
120	0.022	0.025	0.028	0.032	0.034	0.041	0.045
150	0.025	0.027	0.029	0.034	0.035	0.042	0.046
185	0.027	0.029	0.031	0.036	0.038	0.045	0.049
240	0.030	0.032	0.034	0.039	0.040	0.047	0.052
300	0.034	0.035	0.036	0.043	0.043	0.050	0.054
400	0.039	0.040	0.041	0.046	0.047	0.054	0.062
500	0.045	0.045	0.045	0.050	0.051	0.058	0.066
630	0.048	0.049	0.050	0.054	0.056	0.063	0.071
800	0.055	0.055	0.055	0.060	0.061	0.068	0.077
1000	0.056	0.060	0.058	0.065	0.066	0.073	0.082

IEEMA (PVC)/MV SCREEN CABLE/2019 (R-1)**Effective from: 01 April 2023**

TABLE – H3 (b)
VARIATION FACTOR FOR COPPER TAPE (SMIF)

THREE CORE ARMOURED /UNARMOURED XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH Al / Cu CONDUCTOR

Nominal Cross-Sectional Area in sq.mm.	3.3 KV Screened	6.6 KV (E)	6.6 KV (UE) / 11 KV (E)	11 KV (UE)	22 KV (E)	33 KV (E)	33 KV (UE)
	ARM	ARM	ARM	ARM	ARM	ARM	
35	0.049	0.055	0.061	0.072	0.079	-	-
50	0.053	0.059	0.065	0.076	0.083	0.104	0.123
70	0.059	0.065	0.071	0.082	0.090	0.111	0.130
95	0.065	0.071	0.077	0.088	0.096	0.117	0.137
120	0.071	0.077	0.083	0.094	0.101	0.123	0.144
150	0.076	0.082	0.088	0.099	0.106	0.128	0.149
185	0.082	0.088	0.094	0.105	0.113	0.134	0.157
240	0.091	0.097	0.103	0.114	0.121	0.143	0.166
300	0.102	0.106	0.110	0.122	0.129	0.150	0.174
400	0.120	0.122	0.124	0.135	0.142	0.164	0.198
500	0.134	0.135	0.136	0.147	0.155	0.176	0.211
630	0.149	0.149	0.149	0.160	0.168	0.190	0.228

IEEMA (PVC)/MV SCREEN CABLE/2019 (R-1)**Effective from: 01 April 2023**

TABLE : H4 (a)
VARIATION FACTOR FOR ALUMINIUM (AIF)
SINGLE CORE ARMOURED XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH
Cu CONDUCTOR

Nominal Cross Sectional Area (in Sq. mm.)	Aluminium Factor for Aluminium Armoured Cable with Copper Conductor							
	3.3 KV(E) unscreened Arm	3.3 KV(E) screened Arm	6.6 KV (E)	11 KV (E)/ 6.6 KV (UE)	11 KV (UE)	22 KV (E)	33 KV (E)	33 KV (UE)
35	0.153	0.170	0.187	0.204	0.247	0.258	0.372	0.426
50	0.179	0.191	0.203	0.220	0.262	0.275	0.425	0.456
70	0.196	0.208	0.219	0.233	0.278	0.311	0.444	0.501
95	0.213	0.225	0.237	0.254	0.373	0.392	0.470	0.523
120	0.228	0.241	0.253	0.268	0.393	0.410	0.488	0.545
150	0.243	0.256	0.269	0.287	0.414	0.432	0.504	0.567
185	0.261	0.273	0.285	0.381	0.437	0.455	0.526	0.600
240	0.324	0.357	0.389	0.410	0.465	0.480	0.556	0.633
300	0.365	0.397	0.428	0.440	0.490	0.510	0.737	0.834
400	0.432	0.452	0.471	0.480	0.536	0.552	0.783	0.895
500	0.489	0.503	0.517	0.526	0.726	0.744	0.844	0.955
630	0.544	0.556	0.568	0.572	0.787	0.801	0.902	1.034
800	0.706	0.747	0.787	0.797	0.862	0.880	0.982	1.111
1000	0.824	0.845	0.865	0.867	0.923	0.940	1.324	1.504

IEEMA (PVC)/MV SCREEN CABLE/2019 (R-1)**Effective from: 01 April 2023****TABLE : H4 (b)****VARIATION FACTOR FOR STEEL STRIP ARMOUR (FeF)****THREE CORE ARMoured XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH Al / Cu CONDUCTOR**

Nominal Cross Sectional Area Sq. mm.	3.3 KV (E) unscreened arm	3.3 KV (E) screened arm	6.6 KV (E)	11 KV (E) / 6.6 KV (UE)	11 KV (UE)	22 KV (E)	33 KV (E)	33 KV (UE)
25	0.551	0.553	0.604	0.656	0.814	-	-	-
35	0.645	0.645	0.645	0.731	0.879	0.937	-	-
50	0.675	0.684	0.703	0.761	0.937	0.966	1.181	1.301
70	0.761	0.764	0.761	0.849	0.996	1.055	1.289	1.393
95	0.820	0.828	0.849	0.907	1.083	1.113	1.348	1.454
120	0.879	0.924	0.907	0.966	1.142	1.172	1.406	1.531
150	0.966	0.988	0.966	1.055	1.201	1.259	1.494	1.592
185	1.025	1.051	1.055	1.113	1.259	1.318	1.553	1.668
240	1.142	1.147	1.142	1.231	1.377	1.406	1.641	1.760
300	1.231	1.258	1.259	1.318	1.465	1.524	1.758	1.852
400	1.348	1.402	1.406	1.435	1.582	1.641	1.876	1.990
500	1.454	1.500	1.573	1.642	1.714	1.758	2.095	2.100
630	1.632	1.680	1.745	1.943	1.889	1.918	2.150	2.280

TABLE : H4 (c)**VARIATION FACTOR FOR STEEL WIRE ARMOUR (FeW)****THREE CORE ARMoured XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH Al / Cu CONDUCTOR**

Nominal Cross Sectional Area in Sq. mm	3.3 KV (E) Unscreened arm	3.3 KV (E) screened arm	6.6 KV (E)	11 KV (E) / 6.6 KV (UE)	11 KV (UE)	22 KV (E)	33 KV (E)	33 KV (UE)
25	1.258	1.358	1.457	1.612	2.509	1.503	-	-
35	1.361	1.465	1.569	1.853	2.644	2.797	2.517	-
50	1.682	1.685	1.687	2.321	2.800	2.921	4.569	4.603
70	1.938	1.959	1.979	2.503	3.219	3.347	4.809	4.935
95	2.202	2.355	2.507	2.718	4.019	4.200	5.437	6.553
120	2.371	2.523	2.675	2.882	4.241	4.416	6.713	6.820
150	2.776	2.812	2.847	3.265	4.447	4.621	6.976	7.088
185	3.121	3.215	3.309	4.148	4.726	5.289	7.356	7.489
240	3.758	3.993	4.227	4.442	5.442	6.651	7.718	7.890
300	4.099	4.562	5.024	5.182	6.894	7.084	8.187	8.359
400	5.750	6.161	6.572	6.658	7.433	7.657	8.760	8.960
500	6.716	6.747	6.777	6.861	7.588	7.797	8.830	9.629
630	6.767	7.116	7.465	7.477	8.209	8.386	9.413	10.365

IEEMA (PVC)/MV SCREEN CABLE/2019 (R-1)**Effective from: 01 April 2023****TABLE : H4 (d)****VARIATION FACTOR FOR STEEL WIRE ARMOUR (FeW/FeF)****SINGLE CORE ARMoured XLPE INSULATED 3.3 KV POWER CABLES WITH Al / Cu CONDUCTOR**

Nominal Cross section area in sq. mm	Single Core 3.3 kV	
	FeF	FeW
25	0.276	0.385
35	0.303	0.409
50	0.314	0.442
70	0.331	0.528
95	0.341	0.584
120	0.369	0.629
150	0.395	0.676
185	0.423	0.731
240	0.464	0.92
300	0.504	0.982
400	0.573	1.215
500	0.613	1.359
630	0.696	1.518

TABLE : H5 (a)**VARIATION FACTOR FOR Polymer (CCFAL/CCFCu)****SINGLE CORE ARMoured XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH Al / Cu CONDUCTOR**

Nominal Cross Sectional Area (in Sq. mm)	3.3 KV(E) Unscreened ARM	3.3 KV(E) screened ARM	6.6 KV (E) ARM	6.6 KV (UE) / 11 KV (E) ARM	11 KV (UE) ARM	22 KV (E) ARM	33 KV (E) ARM	33 KV (UE) ARM
35	0.123	0.197	0.259	0.278	0.330	0.376	0.468	0.493
50	0.152	0.209	0.272	0.294	0.379	0.394	0.483	0.530
70	0.170	0.227	0.295	0.317	0.404	0.419	0.508	0.583
95	0.184	0.244	0.317	0.338	0.435	0.449	0.554	0.609
120	0.197	0.261	0.337	0.392	0.457	0.472	0.576	0.634
150	0.194	0.303	0.389	0.413	0.477	0.492	0.597	0.656
185	0.224	0.322	0.414	0.445	0.502	0.539	0.674	0.767
240	0.276	0.354	0.456	0.479	0.558	0.573	0.711	0.806
300	0.294	0.377	0.489	0.506	0.587	0.602	0.811	0.915
400	0.333	0.450	0.569	0.578	0.687	0.703	0.866	0.974
500	0.367	0.493	0.675	0.679	0.809	0.826	1.056	1.139
630	0.438	0.611	0.735	0.739	0.873	0.928	1.168	1.290
800	0.529	0.734	0.863	0.866	1.027	1.05	1.189	1.380
1000	0.648	0.880	1.031	1.035	1.138	1.158	1.402	1.619

Note: The above factors are for PVC and Zero Halogen low smoke (LSZH) and for PE factor, the above factor will be multiplied by 0.63

IEEMA (PVC)/MV SCREEN CABLE/2019 (R-1)**Effective from: 01 April 2023****TABLE : H5 (a)****VARIATION FACTOR FOR Polymer (CCFAL/CCFCu)****SINGLE CORE UNARMoured XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH Al / Cu CONDUCTOR**

Nominal Cross Sectional Area (in Sq. mm)	3.3 KV(E) Unscreened ARM	3.3 KV(E) screened ARM	6.6 KV (E) ARM	6.6 KV (UE) / 11 KV (E) ARM	11 KV (UE) ARM	22 KV (E) ARM	33 KV (E) ARM	33 KV (UE) ARM
35	0.158	0.191	0.224	0.252	0.323	0.342	0.361	0.380
50	0.177	0.209	0.240	0.269	0.342	0.361	0.520	0.539
70	0.198	0.232	0.265	0.296	0.370	0.391	0.551	0.572
95	0.233	0.261	0.288	0.318	0.396	0.450	0.582	0.636
120	0.253	0.282	0.310	0.342	0.454	0.477	0.613	0.636
150	0.269	0.299	0.328	0.361	0.476	0.500	0.638	0.662
185	0.292	0.323	0.354	0.420	0.508	0.532	0.719	0.743
240	0.322	0.371	0.419	0.455	0.547	0.572	0.766	0.791
300	0.355	0.408	0.461	0.490	0.585	0.610	0.863	0.888
400	0.423	0.474	0.524	0.539	0.683	0.711	0.932	0.960
500	0.477	0.553	0.629	0.635	0.743	0.825	1.059	1.141
630	0.548	0.620	0.691	0.697	0.866	0.898	1.144	1.176
800	0.672	0.749	0.826	0.833	1.016	1.051	1.320	1.355
1000	0.789	0.877	0.964	0.964	1.099	1.200	1.488	1.589

Note: The above factors are for PVC and Zero Halogen low smoke (LSZH) and for PE factor the above factor will be multiplied by 0.63

TABLE : H5 (b)**VARIATION FACTOR FOR POLYMER (CCFAI / CCFCu)****THREE CORE ARMoured XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH Al / Cu CONDUCTOR**

Nominal Cross Sectional Area (in Sq. mm)	3.3 KV (E) Unscreened ARM	3.3 KV (E) screened ARM	6.6 KV (E) ARM	6.6 KV (UE) / 11 KV (E) ARM	11 KV (UE) ARM	22 KV (E) ARM	33 KV (E) ARM	33 KV (UE) ARM
35	0.374	0.634	0.990	1.142	1.604	1.782	-	
50	0.445	0.702	1.119	1.260	1.834	2.046	2.864	3.070
70	0.547	0.863	1.290	1.396	2.011	2.284	3.219	3.380
95	0.594	0.990	1.440	1.647	2.269	2.428	3.367	3.721
120	0.732	1.214	1.692	1.877	2.498	2.715	3.646	4.020
150	0.812	1.355	1.906	2.061	2.767	2.931	3.927	4.216
185	0.960	1.589	2.086	2.406	3.028	3.180	4.166	4.529
240	1.130	1.832	2.484	2.744	3.398	3.580	4.589	4.917
300	1.219	2.201	2.912	3.161	3.840	4.016	5.029	5.325
400	1.313	2.561	3.530	3.664	4.353	4.666	5.736	5.911
500	1.652	3.138	3.925	3.971	4.621	4.878	5.913	6.625
630	1.949	3.774	4.487	4.982	5.225	5.477	6.696	7.445

Note: The above factors are for PVC and Zero Halogen low smoke (LSZH) and for PE factor the above factor will be multiplied by 0.63

BANK GUARANTEE FOR PERFORMANCE SECURITY

Bank Guarantee No:

Date:

To

NAME

& ADDRESSES OF THE BENEFICIARY

Dear Sirs,

In consideration of the Bharat Heavy Electricals Limited ¹ (hereinafter referred to as the 'Employer' which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns) incorporated under the Companies Act, 1956 and having its registered office at BHEL House Siri Fort New Delhi-110049 through its Unit at BHEL, TBG, Noida having awarded to (Name of the Vendor / Contractor / Supplier) having its registered office at _____ ² hereinafter referred to as the 'Contractor/Supplier', which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns), a contract Ref No PO No.....dated³ valued at Rs.....⁴ (Rupees -----)/FC.....(in words.....) for⁵ (hereinafter called the 'Contract') and the Contractor having agreed to provide a Contract Performance Guarantee, equivalent to% (.... Percent) of the said value of the Contract to the Employer for the faithful performance of the Contract,

we,, (hereinafter referred to as the Bank), having registered/Head office at and inter alia a branch at being the Guarantor under this Guarantee, hereby, irrevocably and unconditionally undertake to forthwith and immediately pay to the Employer a maximum amount Rs ----- (Rupees -----) without any demur, immediately on a demand from the Employer, .

Any such demand made on the Bank shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. _____.

We undertake to pay to the Employer any money so demanded notwithstanding any dispute or disputes raised by the Contractor/ Supplier in any suit or proceeding pending before any Court or Tribunal relating thereto our liability under this present being absolute and unequivocal.

The payment so made by us under this Guarantee shall be a valid discharge of our liability for payment thereunder and the contractors/supplier shall have no claim against us for making such payment.

We thebank further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said Contract and that it shall continue to be enforceable till all the dues of the Employer under or by virtue of the said Contract have been fully paid and its claims satisfied or discharged.

We BANK further agree with the Employer that the Employer shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Contract or to extend time of performance by the said Contractor/Supplier from time to time or to postpone for any time or from time to time any of the powers exercisable by the Employer against the said Contractor/Supplier and to forbear or enforce any of the terms and conditions relating to the said Agreement and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said Contractor/Supplier or for any forbearance, act or omission on the part of the Employer or any indulgence by the Employer to the said Contractor/Supplier or by any such matter or thing whatsoever which under the law relating to sureties would but for this provision have effect of so relieving us.

The Bank also agrees that the Employer at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor, in the first instance without proceeding against the Contractor and notwithstanding any security or other guarantee that the Employer may have in relation to the Contractor's liabilities.

This Guarantee shall remain in force upto and including.....⁶ and shall be extended from time to time for such period as may be desired by Employer.

This Guarantee shall not be determined or affected by liquidation or winding up, dissolution or change of constitution or insolvency of the Contractor/Supplier but shall in all respects and for all purposes be binding and operative until payment of all money payable to the Employer in terms thereof.

Unless a demand or claim under this guarantee is made on us in writing on or before the⁷we shall be discharged from all liabilities under this guarantee thereafter.

We BANK lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Employer in writing.

Notwithstanding anything to the contrary contained hereinabove:

- a) The liability of the Bank under this Guarantee shall not exceed.....⁸
- b) This Guarantee shall be valid up to⁹
- c) Unless the Bank is served a written claim or demand on or before _____¹⁰ all rights under this guarantee shall be forfeited and the Bank shall be relieved and discharged from all liabilities under this guarantee irrespective of whether or not the original bank guarantee is returned to the Bank.

We, _____ Bank, have power to issue this Guarantee under law and the undersigned as a duly authorized person has full powers to sign this Guarantee on behalf of the Bank.

For and on behalf of
(Name of the Bank)

Dated.....

Place of Issue.....

¹ NAME AND ADDRESS OF EMPLOYER I.e Bharat Heavy Electricals Limited

² NAME AND ADDRESS OF THE VENDOR /CONTRACTOR / SUPPLIER.

³ DETAILS ABOUT THE NOTICE OF AWARD/CONTRACT REFERENCE

⁴ PROJECT/SUPPLY DETAILS

⁵ BG AMOUNT IN FIGURES AND WORDS

⁶ VALIDITY DATE

⁷ DATE OF EXPIRY OF CLAIM PERIOD

⁸ BG AMOUNT IN FIGURES AND WORDS.

⁹ VALIDITY DATE

¹⁰ DATE OF EXPIRY OF CLAIM PERIOD

Note:

1. Units are advised that expiry of claim period may be kept 2/3 months after validity date.
2. In Case of Bank Guarantees submitted by Foreign Vendors-
 - a. **From Nationalized/Public Sector / Private Sector/ Foreign Banks (BG issued by Branches in India)** can be accepted subject to the condition that the Bank Guarantee should be enforceable in the town/city or at nearest branch where the Unit is located i.e. Demand can be presented at the Branch located in the town/city or at nearest branch where the Unit is located.
 - b. **From Foreign Banks (wherein Foreign Vendors intend to provide BG from local branch of the Vendor country's Bank)**
 - b.1 In such cases, in the Tender Enquiry/ Contract itself, it may be clearly specified that Bank Guarantee issued by **any of the Consortium Banks only** will be accepted by BHEL. As such, Foreign Vendor needs to make necessary arrangements for issuance of Counter- Guarantee by Foreign Bank in favour of the Indian Bank (BHEL's Consortium Bank). It is advisable that all charges for issuance of Bank Guarantee/ counter- Guarantee should be borne by the Foreign Vendor. The tender stipulation should clearly specify these requirements.
 - b.2 **In case, Foreign Vendors intend to provide BG from Overseas Branch of our Consortium Bank** (e.g. if a BG is to be issued by SBI Frankfurt), the same is acceptable. However, the procedure at **sl.no. b.1** will required to be followed.
 - b.3 The BG issued may preferably be subject to Uniform Rules for Demand Guarantees (URDG) 758 (as amended from time to time). In case, of Foreign Vendors, the BG Format provided to them should clearly specify the same.
 - b.4 The BG should clearly specify that the demand or other document can be presented in electronic form.

Sl.	Name of the bank
1	State Bank of India
2	Canara Bank
3	Axis Bank
4	Bank of Baroda
5	Central Bank
6	Citi Bank N.A.
7	Deutsche Bank **
8	Exim Bank
9	Federal Bank Limited
10	HDFC Bank Limited
11	Hongkong and Shanghai Banking Corporation Ltd
12	Indian Bank
13	ICICI Bank Limited
14	IDBI Bank Limited
15	IndusInd Bank Limited
16	Indian Overseas Bank
17	Kotak Mahindra Bank Limited
18	Punjab National Bank
19	RBL Bank Ltd.
20	Standard Chartered Bank
21	Union Bank of India
22	Yes Bank Limited
	TOTAL



भारतीय स्टेट बैंक
State Bank Of India

(17313) - CORPORATE ACCOUNTS GROUP NEW DELHI
4TH & 5TH FLOOR REDFORT CAPITAL PARSVNATH TOWERS, BHAI VEER
SINGH MARG
GOLE MARKET NEW DELHI 110001
Tel: 11-23475566 Fax: 23475566 IFS Code : SBIN0017313

केवल 3 महीने के लिए वैध / VALID FOR 3 MONTHS ONLY

D	D	M	M	Y	Y	Y	Y

PAY

को या उनके आदेश पर **OR ORDER**

रुपये RUPEES

अदा करें ₹

25-05-2019

खा. सं.
A/c No.

30206227732

Cancelled.

VALID UPTO ₹ 50 LACS AT NON-HOME BRANCH

CURRENT A/C

PREFIX:
0523500062

BHEL TRANSMISSION BUSINESS DIVISION

MULTI-CITY CHEQUE Payable at Par at All Branches of SBI

Please sign above

⑈ 266 26 5 ⑈ 1 1000 256 2 ⑈ 000 139 ⑈ 29

HSE CONDITIONS

at a *GLANCE* (for bidders)

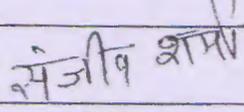
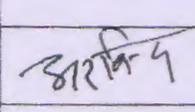
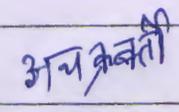


Health Safety and Environment Management



Transmission Business Group, Noida

	Transmission Business Group HSE Department, HQ, Noida	Doc No. TBG/HSE/NIT-01 Rev No. : 01 Date: 22.10.21
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DOCUMENT CONTROL			
Document number:	TBG/HSE/NIT-01		
Issue number:	00	Issue date:	08.01.2020
Revision number:	01	Revision date :	22.10.2021
	Prepared by	Checked by	Approved and Issued for use by
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Signature			
Date	22.10.2021	22.10.2021	22.10.2021
Doc. copy issue no. :		Doc. copy issue date :	
Issued to :	Name	Designation	Signature
Issued by :	Name	Designation	Signature



BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS GROUP



Transmission Business Group

HSE Department, HQ, Noida

Doc No. TBG/HSE/NIT-01

Rev No. : 01

Date: 22.10.21

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BHEL TBG through its long experience and policy, has developed a culture to consider wellbeing of the society, protection of environment and occupational health and safety of its workers first. TBG has also a culture of transparency in all its business activities. In line to this culture, this NIT annexure is prepared as a peeping window in to the TBG HSE requirements which need to be 100% complied by the successful bidders while executing the contract. Interested bidders should go through these HSE conditions:

1. BHEL HSE Policy



In BHEL, Health, Safety and Environment (HSE) responsibilities are driven by our commitment to protect our employees and people we work with, community and environment. BHEL believes in zero tolerance for unsafe work/non-conformance to safety and in minimizing environmental footprint associated with all its business activities. We commit to continually improve our HSE performance by:

- Developing safety and sustainability culture through active leadership and by ensuring availability of required resources.
- Ensuring compliance with applicable legislation, regulations and BHEL systems.
- Taking up activities for conservation of resources and adopting sound waste management by following Reduce/Recycle/Reuse approach.
- Continually identifying, assessing and managing environmental impacts and Occupational Health & Safety risks of all activities, products and services adopting approach based on elimination/substitution/reduction/control.
- Incorporating appropriate Occupational Health, Safety and Environment criteria into business decisions, design of products & systems and for selection of plants, technologies and services.
- Imparting appropriate structured training to all persons at workplace and promoting awareness amongst customers, contractors and suppliers on HSE issues.
- Reviewing periodically this policy and HSE Management Systems to ensure its relevance, appropriateness and effectiveness.
- Communicating this policy within BHEL and making it available to interested parties.

June 5, 2018

Atul Sobti
Chairman & Managing Director

Creating  of tomorrow

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2. Legal Compliances:

- a. Statutory Provisions:** All the sub-contractors are to comply with client specific rules and procedures, the National legislations and codes, in particular the following or their revised versions:

Srl. No	Acts/Rules Name	Srl. No	Acts/Rules Name
1	The Factories Act 1948, Amendment Act 1947	11	Contractor labour Act, 1970 (Regulation and abolition)
2	The Environment Act 1986	12	Provident fund Act, 1952
3	Workmen's Compensation Act, 1923	13	Payment of gratuity Act, 1972
4	Building and Other Construction Workers (Regulation of employment and condition of service) Act, 1996	14	Indian Explosives Act and the explosives Rules 2008
5	Buildings and Other Construction Workers Welfare Act, 1996	15	The Gas Cylinder Rules, 2016, Static and Mobile Pressure Vessels (Unfired) Rules 2016
6	Payment of wages Act, 2017 Equal remuneration Act,	16	The Indian Electricity Act 2003 and Indian Electricity Rules 2005
7	Minimum wages Act.1948	17	The Atomic Energy Act, 2015
8	Employers liability Act, 1938	18	The atomic energy (Radiation Protection) Rules. 2004
9	Industrial dispute Act, 1947	19	National Fire Protection Association (NFPA),
10	maternity benefit amendment act 2017	20	National Building Code of India 2016 etc.

b. Indian Standard (IS) Codes related to HSE

All the sub-contractors are to comply with client specific rules and procedures, the National legislations and codes in particular the following or their revised versions:

Srl	IS Code	Applies on
1	IS: 4081 -1986	Safety code for Blasting and Related Drilling operations
2	IS: 3764 -1992	Safety code for excavation work
3	IS: 5121 -1969	Safety code for pilling and other deep foundations

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4	IS: 2750 -1964	Specification for steel scaffoldings
5	IS: 3696 (Part-I)-1987	Safety code for scaffolds and Ladders: Part- I Scaffolds
6	IS: 3696 (Part-II) -1991	Safety code for scaffolds and Ladders: Part –II Ladders
7	IS: 4082 -1977	Recommendations on stacking and storage of construction materials at site (First revision)
8	IS: 4130-1976	Safety code for demolition of building (First revision)
9	IS: 4912-1978	Safety requirements for floor and wall openings, railings and toe boards (First revision)
10	IS: 5916- 1970	Safety code for constructions involving use of hot bituminous materials
11	IS: 7205 -1974	Safety code for erection of structural steel work
12	IS: 7969 -1975	Safety code for handling and storage of building materials
13	IS: 8989 -1978	Safety code for erection of concrete framed structures
14	IS: 7293 -1974	Safety code for working with construction machinery
15	IS: 2212 -1991	Pipe lines –Identification –Colour code
16	IS: 5216 -1982	Recommendations on safety procedures & practices in Electrical works (Part -I &II)
17	IS: 875 -1964	Code of practice for structural safety of buildings and loading standards
18	IS: 10386 -1983	General aspects Part-1 -1983, Part-2 -1982, Part-6 -1983, Part-10 -1983- Amenities, Protective clothing and equipment, construction, storage, handling, detection and Safety measures for gases, chemicals and flammable liquids
19	IS: 10500-2012	Drinking water (Specification)
20	IS: 10291 -1982	Code of dress in civil engineering works
21	IS: 2925-1984	Safety helmets
22	IS: 1179-1967	Welding helmets
23	IS: 7524 -1979 (Part-I)	Safety goggles
24	IS: 9167 -1979	Ear muff /Ear plugs
25	IS: 6994 -1973 (Part-I)	Canvas hand gloves, Cotton hand gloves, Chrome leather gloves
26	IS: 4770 -1991	Rubber hand gloves tested for 15,000 volts
27	IS: 3521 -1999	Full body safety harness
28	IS: 11057 -1984	Specification for Industrial safety nets
29	IS: 13415 -1992	Protective Barriers in & around buildings (Code of safety)

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30	IS: 13416 -1992	Preventive measures against Hazards at work places-Recommendations part-I Falling materials hazards Prevention part-I
31	IS: 13416 -1992	Preventive measures against Hazards at work places-Recommendations part-II Fall Prevention
32	IS: 15298 -2011 (Part 1&2)	Personal Protective Equipment -Safety shoes
33	IS: 12254 -1993	Poly vinyl chloride (PVC) industrial boots
34	IS: 5557:2004	Industrial and Protective Rubber knee and Ankle boots
35	IS: 2878 -2004	Co2 Type fire extinguisher
36	IS: 2171 -1999	Dry chemical powder fire extinguisher
37	IS: 13849 – 1993	Fire extinguisher for ABC fires
38	IS: 10204-2001	Mechanical Foam type extinguisher (Foam used shall conform to IS: 4989 -1974 and Co2 cartridge shall conform to IS: 4947 -1985)
39	IS: 3786 -1983	Methods for computation of Frequency rate and Severity rates for Industrial injuries and classification of Industrial accidents (First revision)

c. The Sub-contractors need to

- Attend HSE familiarization program at TBG-HQ with his site management team. This will be a half day long awareness session on HSE requirements and compliances which the agency is supposed to fulfil during contract execution at site. The session shall be taken by TBG HSE department on intimation by TBSM.
- Request for issuance of Form-V in their name from customer on behalf of BHEL
- Get the Labour license registration from concerned Labour office.
- Get the BOCW Registration done along with the labour license.
- Get their labourers registered under BOCW for benefits provided by the office.
- Maintain Seven registers of labours as per BOCW requirement.
- Ensure payment of wages to labours not less than the current minimum wages applicable in the premises.
- Ensure PF deduction of labourers and submission of proof to BHEL office (Wage sheet, ECR & Challan copies) duly signed.
- Submit Labour Payment Certificate by 10th of Every month.
- File timely returns, get renewals done and submit a copy to BHEL office.

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- Get Workmen's Compensation policy before the start of work, covering all the labourers and staff,
 - Policy should clearly mention the project name and location,
 - should be as per labour class and wage.
 - Should cover all the height workers with clear mention of Max. height.
 - Policy should be submitted to BHEL office and renewal before expiry.
- Issue employment card to every worker.

3. Labour Welfare and Medical Facilities

a. Labour Welfare

1. Declaration of normal working hours and weekly off day, Payment day & intervals
2. Paid rest days & holidays.
3. Payment of overtime @ twice the normal wage rate.
4. No labour shall be allowed overtime >12 hrs/week, limited to 48 hrs/month.
5. Rest and lunch area.
6. Separate Male/Female Toilets and Lavatories, clearly marked in local Language and provided with signage.
7. Cold and clean drinking water facility suitable to strength and near workplace
8. Creche for children of female workers as per BOCW requirements
9. Arranging labour accommodation in hygienic environment with the facilities of Water (Drinking, Sanitation), washing and bathing area, toilets in sufficient nos., clean and safe camps and surrounding, access road, well illuminated camp and roads, mode of contact, transport facility, first aid centre, 24x7 Security etc.
10. Cooking and eating place to be maintained in hygienic condition
11. General awareness of health and hygiene.

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b. Medical facilities and Health centres

- Availability of first aid box at every work location and agency office, with contents as per BOCW requirement.
- Emergency vehicle (four wheeler) at work place
- Availability of stretchers in emergency vehicle and in office.
- Trained first aider
- Medical check-up for all the supervisors and workers including cooks, at the time of induction and annually thereafter.
- Tetanus Vaccination for all in every six months.
- Identification and tie-up with nearby reputed hospital(s) and display of their contact number in Emergency contact list.

4. House Keeping & Storage

Housekeeping is a continuous process and is the part of work. Agencies shall maintain safe and presentable housekeeping all the time in their respective areas, common work locations and passage areas. Roads, passages, staircases, entrance/exit gates shall always be maintained obstruction free. No material shall be left or stacked at the roof edges. Agency shall make arrangements to remove scraps on regular basis and dispose them at a space provided by customer, clearly fenced and marked by the sub-contractor as **"SCRAP YARD"**. Suitable arrangement like dedicated housekeeping team and tractor/hydra should be identified for this work.

Construction materials like shuttering materials, staging materials, cables, re-bars, cements bags, earthing flats and rods, FF pipes, surplus soil etc should be stored/stacked properly such that it should neither pose threat to safety of man nor should obstruct the free movement of man and machineries.

Every sub-contractor should have separate and well maintained storage area for his own materials, T&Ps, PPEs and BHEL issued materials. Consumables like diesel, cotton, grease, oil, paint, admixtures and other fire potential materials should be stored separately with suitable firefighting facility.

Fire capacity of store area to be assessed and accordingly fire extinguishers shall be planned suiting the class and capacity of fire. Sand heaps may also be stacked in open store yards suitably to use in case of fires.

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5. Site Safety

a. Induction and others safety trainings

Every sub-contractor shall make arrangement to provide induction training as per BHEL and/or customer requirement on a pre-approved and fixed module to all its new inductees irrespective of class or grade of appointment/hire. He shall also arrange the required facilities for induction training such as board, marker, dummy, posters/banners with all the mandatory PPEs.

Sub-contractor shall also arrange for periodic trainings on fire-fighting, first aid, CPR, importance and use of PPEs, electrical safety, hot work safety, Height work safety, confined space, deep excavations and barricading, concreting work safety etc.

b. Appointment of Safety Officer/Supervisor

Every sub-contractor shall appoint at least one full time qualified safety officer having qualification and experience as specified in Schedule-VIII of BOCW Act-1996. He shall not be assigned any duty/work other than assisting in upliftment of safety practices. He shall perform his duties in accordance with the requirements of Schedule-VIII of BOCW-1996. He shall ensure daily TBT, induction training, health check-up and other such compliances as per HSEP-14 on regular basis. In case of non-appointment, agency shall be penalized as per provisions in clause no. 7.0 of HSEP-14 (HSE Plan for Site Operations (subcontractors))

c. Safety organisation, Safety committees and meetings

Safety officer shall report directly to the head of the projects of the sub-contractor management. There shall be some appointed or nominated safety stewards from each sub-group like shuttering, bar-bending, concreting, brick work, material handling, structure erection, cable laying, pipe work, maintenance, batching plant, housekeeping etc.

A safety committee shall be formed including members from different agencies, BHEL and customer covering at-least 50% participation from workers. Safety committee shall meet on weekly basis or as may be decided by customer, outcomes shall be complied as committed.

d. Personal Protective Equipments.

Unless mentioned otherwise, there will be three mandatory PPEs- Safety shoes, Safety Helmet and Reflective jackets conforming to relevant IS codes as mentioned above.

Every person entering in the project premises shall use above mandatory PPEs.

There will be other PPEs too based on the work requirement like:

Twin lanyard full body harness, fall arresters and life lines for height workers,

Face shield for welders and grinders, Induction helmets and Electrical resistant shoes with FRP/PVC toe for electricians and commissioning engineers, Gum boots for concrete workers and manual excavators, Goggle for gas cutters and grinders, Aprons for welders, shoulder pads for material handlers, Hand gloves – Leather for binders/welders/grinders, certified Rubber gloves

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for electricians, PVC for concrete/cement handlers, cotton-housekeeping team/brick coolies/erectors, cable laying men and other material handlers. Dust mask for cement handlers.

e. Material Handling

BHEL as a policy discourages continuous manual handling. Material handling contributes a major portion in the project and hence proper means (mechanical/ electrical powered) should be deployed appropriately for this work. Cranes/Faranas/hydras should not be used for material transportation for long distances(>100m), if such movement is un-avoidable, it must be accompanied by a trained signal man. Long materials should be guided by tagline. Roads for material movement should be free from obstructions. Lifting appliances must be in good condition and must have test/inspection certificates.

Lifting tackles like- D-shackles, chains, ropes, slings, belts shall be periodically inspected and shall have valid test certificate and/or third party inspection certificates.

Painted/galvanized structures/materials to be lifted by adequate capacity nylon belts only.

If a machine undergoes a major maintenance, fresh TPI shall be required before use.

Hydraulic/pneumatic machines shall be free from leakages. Daily checklist to be filled and witnessed by the concerned supervisor before start of the work.

f. Vehicle/Machinery Documents and other safety requirements

- Crawler mounted boom cranes/Tyre mounted telescopic cranes/tower cranes
 1. Valid third party inspection certificate.
 2. Valid Insurance policy
 3. Registration Certificate (if applicable)
 4. Valid Pollution under control (PUC) (if applicable)
 5. Fitness certificate from RTO (if applicable)
 6. Operator's valid license, experience and/or competence certificate.
 7. Swing horn
 8. Reverse horn
 9. Boom aviation light
 10. Approved Load chart (inside cabin)
 11. Fire extinguisher (inside cabin)
 12. First aid kit (inside cabin)
 13. Boom angle indicator
 14. Hook Latch
 15. Reflector strips on around cabin and on boom
- Loader backhoe (JCB), crawler excavators (Poclain), Hydra,
 1. Valid third party inspection certificate.
 2. Valid Insurance policy
 3. Registration Certificate (if applicable)
 4. Valid Pollution under control (PUC) (if applicable)

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5. Fitness certificate from RTO (if applicable)
6. Operator's valid commercial license, experience and/or competence certificate.
7. Reverse horn
8. Approved Load chart (inside cabin) (Hydra)
9. Fire extinguisher (inside cabin)
10. First aid kit (inside cabin)
11. Hook Latch (Hydra)
12. Reflector strips on around cabin and on boom

- **Tipper, Transit mixtures (TM), Self-loading concrete mixture (Ajax Fiori), Tractors**

1. Valid third party inspection certificate.
2. Valid Insurance policy
3. Registration Certificate
4. Valid Pollution under control (PUC)
5. Fitness certificate from RTO
6. Operator's valid commercial Heavy license, experience and/or competence certificate.
7. Reverse horn
8. Fire extinguisher (inside cabin)
9. First aid kit (inside cabin)
10. Reflector strips on around cabin and on body

Note: 1. Tractors may be allowed with Light Commercial/non-commercial license on customer's consent.

- **Cars, Taxis, scooters, motor cycles and other public carriers**

- Valid 2/4 wheeler license (as applicable- commercial/non-commercial)
- Registration Challan
- Valid Insurance
- Pollution under control

g. Man-lifts (Cherry pickers), Scissors Lifts

1. Trained operator with experience/competence certificate and license
2. Valid third party inspection certificate.
3. Valid Insurance policy
4. Registration Certificate (if applicable)
5. Valid Pollution under control (PUC) (if applicable)
6. Swing horn
7. Reverse horn
8. Boom aviation light
9. Fire extinguisher (inside cabin)
10. First aid kit (inside cabin)
11. Reflector strips on around cabin and on boom

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Note:

1. No one shall ride man-lift bucket without safety belt, safety shoes, helmet and reflective jacket.
2. Not more than 3 persons at a time will board in bucket of man-lift (without any heavy materials) including operator.
3. Operator will not leave the machine while persons are elevated and working.
4. No one other than the authorised operator will operate the man lifts/Scissors lifts.

h. Excavation

Prior permission/clearance from customer is a must for excavations in areas where underground service services such as gas/water/oil/chemical/electrical lines may be routed. Due precautions shall be taken during excavation in such area. Excavations near water bodies (ponds/canals etc.) shall be done with sand/soil bags ready to plug water from accidental damaged/burst of edges. All the excavations shall be done by either step cutting (min. 600mm step at every 1.5m depth) or slope cutting at 1:2(X:Y axis) (or greater depending upon the soil condition). Where step cutting/slope cutting is not possible due to space constraints, shoring/shuttering or sheet piling to be used to check collapse of soil.

Excavated soil shall be stacked away from edge of the pit, at-least 1.5 meters or half of the depth whichever is higher. Height of the stack shall not exceed 2m in height.

Ramps shall be provided for access of the workers in large pits and ladder of metal/good built for small pits. Ladders shall be of sufficient length protruding at least 1m above the ground level.

Pumps of adequate capacity shall be available for pumping out of water. No lone worker shall be allowed to work in any excavation. Overloaded vehicle shall not be allowed near excavated pits.

i. Bar bending and Binding

Bar bending machine shall be installed under shed/roof. It shall be properly earthed and maintained for operation. Housekeeping of the area shall be team's responsibility on daily basis. All be bar benders shall be given hand gloves (leather/cotton) in addition to mandatory PPEs. Scrap shall be segregated and moved to scrap yard on regular basis. Bar bending station shall be located away from Main plying roads/passages. The station shall be well illuminated, shall have a maintained first aid kit and potable water. Station shall be located in such a way that the movement of the material be minimised.

j. Concreting

No electric vibrators shall be allowed to use. All the concrete workers shall be issued gum boots, safety helmets, reflective jackets and PVC hand gloves. Free fall of concrete from chute shall not exceed 1m in height. Heavy machineries/ vehicles shall be kept at least 2m away from the edge. Emergency vehicle shall be available near concreting work. Late night works shall be avoided, if it is unavoidable, a prior permission from BHEL/Customer is mandatory.

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k. Welding, Gas Cutting & other hot works

Welding: Only experienced welders should be deployed for welding jobs. Welders shall be provided with apron, hand gloves, arm pads, leg pads, face shield and safety shoes. Welding leads shall be joint less and insulated. Power input point shall be fully covered at machine.

Gas cutting: If LPG is being used, domestic cylinder is strictly prohibited inside the project premises, (not allowed for site kitchen too). Hose pipes shall be in good condition without cracks, cuts, punctures or joints. Ends should be clamped with worm clamps. Dial gauges shall be of good quality and duly calibrated. Flash back arresters is a must for both oxygen/acetylene or LPG/Oxygen combination. Cylinders shall be stored, transported and used in vertical position only. When not in use, they shall be capped. Empty and filled cylinders to be stored separately with distinct marking.

Cylinders shall neither be rolled on the ground nor thrown during loading/unloading.

Grinding: Grinder shall be given clear glass face shield, apron, safety shoes, ear muffs and hand gloves. Grinder machines shall have wheel guard. Plug tops to be used for power connection preferably three wire type. Only trained persons shall be allowed to use grinders, abrasive cutters. Electrical connection shall be free from cuts, joints etc.

l. Erection & Height Work

Only trained fitters and experienced helpers shall be engaged in erection work. Step bolts of lattice towers shall be checked for full tightness with spring washers before use. Height pass shall be issued to the identified group of erectors who have passed medical test and have working experience at height. Name of such workers shall be displayed at appropriate place. These workers only shall be allowed to work at height. Height work shall not be permitted in high wind/bad weather condition, during raining or in night/dark.

m. Electrical Safety

BHEL usually provided single point power source and sub-contractors draw power from there. Otherwise agencies make their own arrangement for construction power like DG sets etc. Sub-contractors shall submit their load requirement (amperage & phase) to BHEL before start of work. Accordingly, they shall make arrangements to draw power and distribution arrangements too in a safe way. MCCBs and HRC fuses to be put in circuit for short circuit and overload protections and RCCBs of 30mA sensitivity to be put at each distribution panel for human safety. Earthing pits shall be installed at each distribution point and maintained below three Ohm resistivity which shall be inspected randomly. The distribution points shall be clean, free from vegetation and water logging, easily accessible and covered/protected from three sides and top for rain. Earthing of DBs shall be done by 25x3mm GI flats connected from proper earth pits. Insulation mat, PVC Sheet/Wooden plank to be placed before DBs as platform. DB Sheds shall be legibly marked with name of agency, contact no of electrician and SLD of that DB. Only industrial plugs and sockets shall be allowed. Three wire (Phase, neutral and earth) system shall be used for tools, lights and machineries and two wire power draw shall be strictly prohibited. PTW and LOTO system shall be maintained to work on LT system. Name and contact no of authorised electricians who will be responsible of electrical power facility maintenance shall be submitted to BHEL by Agencies. Unauthorised sharing of power from one agency to other is strictly prohibited. Electricians shall use standard PPEs and insulated tools only. Standard and tested/certified discharge rods to be used in the areas where there is a possibility

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of residual current or induction charge. The induction rod to be connected to the earth first and removed in the last. Induction helmets only to be used in the charged area. Electricians to be provided with electrical resistant safety shoes having FRP/PVC toe.

n. Dust Gases and fumes

Sub-contractor shall make arrangements to avoid accumulation of dust fumes and gases. Cement handlers inside store or at batching plant and gravel spreader shall be given effective nose masks and jaggery (at least 200g per person per day). DG sets and other machineries like cranes excavators etc. shall have valid and effective PUC certificate and shall have maintained engine with silencer. No IC engine operated machine shall be used in confined and covered area like hall, sheds, store etc. where accumulation due to lack of ventilation can increase to harmful levels. Dedicated arrangements (tanker or tractor with sprinkler) shall be made by the sub-contractors (individual or jointly) to continuously subside the dusts arising out of the movement of the vehicles roads/passages. Welding activities near roof accumulates harmful gases. Welders in such positions shall be provided with effective masks conforming to IS standards.

o. Vehicular Traffic

Speed limits defined within the premises shall strictly be followed by the drivers/commuters of construction as well as other vehicles.

Every construction machinery, man-lift shall display the name, contact no and passport size photograph of the authorised operator (There can be one or more authorised operators).

No one other than operator and co-operator shall sit inside the cabin of any construction machine while it is working.

Construction machineries (tractor, trucks, tippers, JCBs, hydra, Fassi cranes etc. shall never be used as mode of public transport. Machineries like Ajax Fiori and hydra shall not be driven in back direction except for small distances. No overloaded vehicle shall be permitted entry in the project premises.

Over speeding shall be reported and driver/operator shall be barred from entry or shall be penalised.

Drunken drivers shall be barred from entry in the project.

Carrying harmful weapons like knives (>6"), guns etc. shall permanently disqualify the person from entry in project premises.

p. Barricading and floor openings

Every pit deeper than 4 feet (1.2m) shall be barricaded immediately after excavation and will remain barricaded till backfilling.

Pits/trenches drains near roads, passages whether temporary or permanent shall be hard barricaded and well illuminated. Roof edges and openings shall be strictly hard barricaded and illuminated. Height works like masonry works, structure erection, erection by cranes, Lattice tower/beam erection areas shall be barricaded to restrict entry. Areas under charging/commissioning shall be barricaded and caution boards shall be displayed on newly charged areas.

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q. Scaffold & Ladder

No bamboo/wooden scaffold shall be allowed to be used. Only tubular steel scaffolds with couplers conforming to the relevant IS codes shall be allowed with base plates. Standard steel or wooden planks to be used as platforms and no packing materials shall be used. All the platforms shall be built with provisions of **top rail at 1m height, mid rail at 0.5m height and toe boards of min 6" height** at floor level. Minimum width of platform shall be 900mm and if wheel barrow is to be used then 1200mm. Means of access to be provided in the form of ladders, ramps or staircase. Multilevel work platforms or those platforms having passage underneath shall be provided with safety net, screen or canopy at each level for protection from falling objects. Platforms shall be free from concrete, debris or other materials. Platforms shall not extend out of the putlogs and shall be secured and fastened. Decking shall be made non-skidding.

Scaffolds under erection shall be tagged **"RED"**, under repair/maintenance/inspection shall be tagged **"YELLOW"** and ready for use shall be tagged **"GREEN"**

Only metal ladders in the construction site and FRP ladders in charged areas shall be allowed. Ladders made from packing materials shall not be used. Ladders shall be securely fixed at bottom, top and long ladders at middle points too at an interval not more than 2400mm and must have a landing at every 6m. Inclination angle should be approximately 1:4 (X:Y) or 75deg. Ladder must extend at least 1m above the platform/access area. Gap between two rungs shall not exceed 300mm. Portable ladder should not be more than 4m in length. Minimum width of the ladder shall not be less than 300mm.

Use of Mobile aluminium scaffold is preferably advisable for erection of transformers/reactors.

r. Illumination

The sub-contractor shall ensure that the areas such as work stations, buildings, batching plants, passages/roads, stores, rest areas, power sources, staircases etc. are illuminated sufficiently to make safe work conditions at site and shall not be less than the relevant IS standards. Excavations/ below ground level structures near passages/roads shall also be sufficiently illuminated.

s. Safety banners/posters, caution boards

Sub-contractors shall display boards and banners in sufficient quantity having safety signs, slogans, important messages, pictures, cautions at prominent locations to promote safety and spread awareness for important precautions such as "Deep Excavation Ahead", "Speed Limit", "Charged Area", "Do not operate", "Hard hat area", "No smoking Zone" etc. Boards containing messages of Emergency contacts, First aid facility, rates of minimum wages, working hours, rest day etc. should be displayed at specific areas.

t. Waste management and disposal

Sub-contractor shall make suitable and effective arrangement to remove waste material from site on regular basis and store them in an identified and safe location. Disposal of wastes shall also be done as per manufacturer's instructions or as per the guidelines laid by legal authorities. Re-bars, Cement bags, packing material (wooden/metal/plastic/paper), paint, oil, grease, cables (armour, sheathing, insulation), civil debris, metal chips, GI sheet scraps, batteries etc. are the common waste materials. Sub-contractor

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shall arrange disposal of the hazardous wastes/materials in conformance to the legal and contractual requirements only.

u. Inspection of PPEs, T&Ps, Machineries and lifting appliances

All the PPEs, T&P and lifting appliances purchased newly by sub-contractors shall have test certificates which shall be submitted to BHEL office periodically or on demand. There shall be at least monthly joint inspection schedule for inspection of healthiness of all the PPEs, T&Ps and lifting appliances. All the lifting appliances shall be tested and examined by a competent person before taking into use for the first time or after it has undergone any alterations or repairs liable to affect its strength or stability

and also once at least in every twelve months. To confirm quality of the PPEs as per the relevant IS codes, BHEL may ask sub-contractors to get any or all types of PPEs tested through NABL approved lab as per relevant IS codes. At any stage, the 100% cost of such tests shall be in the scope of respective sub-contractors.

v. Cable Laying

Sub-contractor shall ensure cable trenches free from water, mud, debris, snakes, Scorpios, lizards before start of the work in trenches. Cable drum rollers shall be used to pull cables out of drums to avoid twisting of cables. Hand gloves, Safety shoes/gum boots, reflective jackets, safety helmets shall be provided to the workers. Cable laying area shall be well illuminated.

w. Fire Protection

Every sub-contractor has to maintain their working area, store and office area free from bushes. Stacking of flammable materials like wood, paper, plastic, paint, oil, grease, fuel, cotton, gases etc. at isolated place disconnected from other storage and office areas. Adequate arrangements of firefighting means like suitable extinguishers, fire/water buckets, water tanks, sand dunes etc. shall be made by the agency depending upon the fire capacity assessed or as per MSDS. Fire drills and trainings on how to operate fire extinguishers and how to react in case of fire breakouts shall be the part of regular training program. Guards and store persons must be a regular participant of such training programs. A list of trained firefighting persons and periodicity of such training programs shall be submitted to BHEL by every agency and same to be adhered. Sufficient number of fire extinguishers with suitable class shall be placed at such locations where there can be fire hazard like stores, pantry, office, DG set, electrical distribution panels etc.

x. Fencing of exposed rotating parts

Exposed rotating parts poses great threat to the person in vicinity. Such parts need to be fenced/covered. Guards are mandatory of grinders, abrasive cutters. Flywheels of the engines of heavy machines, Diesel engines, DG sets need to be covered. Electric winch machines, pulleys, chains, shafts, exhaust fans at reachable height, table fans, need to be caged/fenced. Such fencing/guard shall not be removed while machinery is in operation.

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y. Emergency preparedness response plan and periodic mock drills.

Sub-contractor shall comply JSA (Job Safety Analysis) and arrange to mitigate the effects of identified possible hazards. He shall also define following in response to emergency preparedness:

An emergency assembly point and put a board of the same with information to all in induction training.

Have facility of ambulance or tie-up with nearest hospital for service in minimum possible time (Max-30min) if there is not ambulance inside the premises.

Ensure availability of emergency vehicle with driver all the time at site during work.

Conduct mock-drills on possible risks like electrocution, fall from height, fire, heat stroke etc., record responses and take photographs to submit in BHEL office. Stretchers availability in emergency vehicle or at work place should be well accessible. Provide fire extinguishers of right type at right place in right quantity with information to all. Display emergency contact nos. to various risk locations and at office, service building or at major work locations. Provide first aid training by doctors for and display names of such trained first aiders and fire fighters. Rescue kit with trained staff or man lift or both to rescue a man hanging by safety belt at height. Provide running water tap near chemical storage and handling points. Agencies shall follow emergency response plan prepared by BHEL in each area of work, store and office.

z. Safety reports & Reporting of accidents

BHEL will provide "formats and checklists" for the purpose of records/documents pertaining to the compliance of aforesaid clauses. Agencies shall be responsible for strict adherence and compliance for timely generation and fill-up of the checklists and reports. These shall be submitted on weekly and monthly basis as specified in the formats.

Agency shall also promote such an environment that the near misses, incidents and accidents are reported by every person, whosoever witnesses them. These shall help in analysing the trend and taking measures in reducing/stopping the accidents/incidents. Initial reporting can be in any form-by call, SMS, WhatsApp, e-mail, letter etc.

Major and fatal accidents or high potential incidents shall be investigated for root cause and outcomes shall be immediately implemented to check recurrences.

6. General conditions and penalty clauses

Following are the general conditions:

PPEs shall not only bear the ISI mark but also be conforming to the required standards, 100% compliance of the PPEs is mandatory.

Over speeding of vehicles shall attract penalty/notice and recurrence will attract debarring from entry into project premises.

Hiding of facts like incidents, accidents, fake/forged reports/certificates shall also attract penalty/ notice or both. Only approved third party agencies shall be allowed to inspect the machines, T&Ps. Reports shall directly be sent to BHEL/customers by the third parties.

Insurance and TPIs to be renewed before expiry. Machines, T&Ps shall not be allowed to work if renewal delayed. Continuity of WC policy to be maintained religiously by the respective agencies.

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Agency shall submit the status report of his labour license, BOCW registration, WC Policy, insurance & TPI validity on monthly basis with list of machineries and T&Ps

Sub-contractors shall also maintain a buffer stock of all the PPEs in at least 20% excess to the present strength of the work force.

If construction power is not drawn as per the guidelines laid in clause no. 5(m), given above, BHEL may take-up this work at the risk and cost of the agency and/or may withhold a sum of min. Rs. 50,000/- (Rs. Fifty Thousand) or more as the site in-charge deems fit till the system is aligned as per aforesaid requirement.

Agencies shall be responsible for the compliance of the above requirements. Failure in one or more clauses/area shall attract a notice or monitory penalty or a combination of above.

Monitory penalty will be

- Rs. 1000/- per person/incident per day for non-conformity in above areas.
- A Major/severe accident shall attract a penalty of Rs. 2,00,000/- per head
- Fatality or permanent disability with total loss of earning capacity, if any, will attract a penalty of Rs. 5,00,000/- (Rs. Five Lakh).
- Further fatality/permanent disability shall attract double the last penalty imposed on the agency.
- Above penalties are exclusive of medical expenses of the victim or compensation to the family through insurance policy (WC Policy or group insurance).
- **Penalties imposed by customer shall be fully transferable to the sub-contractor. In the event of above cases, penalties shall be imposed whichever will be higher.**
- Evaluation of agency's performance on HSE compliance shall be done as per BHEL guide lines/system.

Revision History

Revision Date	Revision No.	Old Text	New Text	Reason	Revised by (with sign)
03.05.2019	00	N/A	Full Document	New Release	
12.10.2021	01	Nil	Attend HSE familiarization program at TBG-HQ with his site management team. This will be a half day long awareness session on HSE requirements and compliances which the agency is supposed to fulfil during contract execution at site. The session shall be taken by TBG HSE department on intimation by TBSM. (at page no. 4)	For better understanding of HSE requirements to agency. (HSE Review meeting dated 23.08.2021)	
12.10.2021	01	Edition	Inclusion of penalty provisions in case of non-deployment of safety person(page-7)	Introduction of HSEP-14	

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