

BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

DOCUMENT No.	TB-445-316-CAC01	Rev no.-00	Prepared	Checked	Approved	
TYPE OF DOC.	TECHNICAL SPECIFICATION	NAME	NKT	MVK	SKS	
SPECIFICATION FOR CLAMP AND CONNECTOR		TITLE	SIGN			
		DATE	14.02.22	14.02.22	14.02.22	
		GROUP	TBEM	W.O. No.	445	
		CUSTOMER/ CONSULTANT	THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD./ DEVELOPMENT CONSULTANTS PRIVATE LIMITED, KOLKATA			
PROJECT	1X660MW, SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)					

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Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS			
Distribution			To	TBTS	O/C	TBMM	TBQM	TBCM
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The West Bengal Power Development Corporation Ltd. Bharat Heavy Electricals Ltd.
1X660MW Thermal power extension project Unit-5 at Sagardighi- 400KV Switchyard,
Doc. No. TB-445-316-CAC01, Rev. No.-0, Clamps and connectors –

SECTION 1 SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.1 SCOPE:

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of clamps and connectors complete with accessories as listed under this specification.

This section covers the specific technical requirements of clamps and connectors. This constitutes minimum technical parameters for the above item as specified by the customer (WBPDCCL). The offered equipment shall also comply with the General Technical Requirements for the project as detailed under section-3 of this specification.

The specification comprise of following sections:

- Section-1: Scope, specific technical requirements & Bill of Quantities.
- Section-2: Equipment specification under scope of supplies.
- Section-3: General technical requirements for all equipments under the project.
- Section-4: Equipment Data Sheet
- Section-5: Schedule of technical deviation

In case of any conflict between various sections, order of precedence shall be in the same order as listed above.

The equipment is required for the following project:

Name of customer : The West Bengal Power Development Corporation Ltd.

Name of Consultant : Development Consultants Private Ltd. Kolkata

Name of the project: 1X660MW thermal power extension project Unit-5 at
Sagardighi- 400KV Switchyard

1.2 SPECIFIC TECHNICAL REQUIREMENTS-

Technical Particulars Specific technical requirements like rated voltage, rated current, conductor details and type of connectors etc. are given in enclosed Annexure-I(Bill of Quantities for Equipment connectors). Other technical requirements for the connectors shall be as follows:

(A) The material with which they are made shall be:

- (i) Aluminum alloy to Grade A6 of IS 617-1959
- (ii) Brass to grade 3 of IS 292-1961
- (iii) Aluminium bronze to grade 2 of IS 305-1961
- (iv) Copper laminations for flexible connector grade FRTP-2 of IS 191-1967

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(B)Electrical parameters of clamps and connectors :

Sl. no.	Technical parameters	Value
1.	Nominal voltage (in kV)	400
2.	Highest system voltage (in kV)	420
3.	Corona extinction voltage (in rms)	320kV
4.	Fault current level(kA) for 3 second	50
5.	Basic impulse level (in kVp)	1425
6.	power frequency withstand voltage (in kV rms)	630
7.	Switching impulse withstand voltage(in kVp)	1050(ph to E) 1575(ph to ph)
8.	Frequency	50Hz
9.	Creepage	31mm/kV
10.	Minimum thickness of any part of clamps and connector(mm)	10
11.	Maximum radio interference voltage at 320KVrms for frequency between 0.5 MHz and 2 MHz & 266kV rms phase to ground voltage	1000 Micro volt for frequency between 0.5 MHz and 2 MHz.

Note- 1- The equipments connector suitable for Aluminium tube shall be such design that projected part of Aluminium tube should be fully covered to avoid entry of birds inside Alumimum tube.

1.3 QUANTITIES:

Sr No.	Description	Current rating (A)	Total Qty. (Nos.)
1	420KV, 50KA FOR 3S, 3150A, CIRCUIT BREAKER (WITHOUT PIR) CONNECTOR SUITABLE FOR AL TUBE 4.5 INCH IPS, EXPANSION TYPE	3150	26
2	420KV, 50KA FOR 3S, 2000A, ISOLATOR (HDB) CONNECTOR SUITABLE FOR AL TUBE 4.5 INCH IPS, RIGID TYPE	2000	19
3	420KV, 50KA FOR 3S, 2000A, ISOLATOR (HDB) CONNECTOR SUITABLE FOR AL TUBE 4.5 INCH IPS, EXPANSION TYPE	2000	15
4	420KV, 50KA FOR 3S, 2000A, ISOLATOR (HDB) CONNECTOR SUITABLE FOR QUAD MOOSE	2000	42

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5	420KV, 50KA FOR 3S, 3150A, 1 -PHASE 6 CORE CURRENT TRANSFORMER(CT) CONNECTOR SUITABLE FOR AL TUBE 4.5 INCH IPS, RIGID TYPE	2500	26
6	420KV, 50KA FOR 3S, 3150A, 1 -PHASE 6 CORE CURRENT TRANSFORMER(CT) CONNECTOR SUITABLE FOR AL TUBE 4.5 INCH IPS, EXPANSION TYPE	2500	13
7	400KV 50KA FOR 3S 1 -PHASE , 3 CORE CAPACITOR VOLTAGE TRANSFORMER(CVT) CONNECTOR SUITABLE FOR TWIN MOOSE	-	4
8	420KV, 50KA FOR 3S, POST INSULATOR CONNECTOR SUITABLE FOR AL TUBE 4.5 INCH IPS, THROUGH TYPE(RIGID/SLIDING)	-	9
9	420KV, 50KA FOR 3S, PI CONNECTOR SUITABLE FOR AL TUBE 6 INCH IPS, RIGID/ EXPANSION TYPE	4000	45
10	420KV, 50KA FOR 3S, POST INSULATOR CONNECTOR SUITABLE FOR AL TUBE 6 INCH IPS, THROUGH TYPE (RIGID/ SLIDING) TYPE	-	7
11	420KV, 50KA FOR 3S, POST INSULATOR CONNECTOR SUITABLE FOR TWIN MOOSE THROUGH TYPE	1600	4
12	420KV, 50KA FOR 3S, POST INSULATOR CONNECTOR SUITABLE FOR QUAD MOOSE THROUGH TYPE	3150	4
13	420KV, 50KA FOR 3S, 1600A, STATION TRANSFORMER BUSHING CONNECTOR SUITABLE FOR TWIN MOOSE	1600	4
14	420KV, 50KA FOR 3S, 1600A, GENERATOR TRANSFORMER BUSHING CONNECTOR SUITABLE FOR TWIN MOOSE	1600	4
15	400KV, 50KA FOR 3S, 3150A, TEE CONNECTOR SUITABLE FOR AL TUBE 4.5 INCH IPS TO QUAD CONDUCTOR AS PER TS	3150	19
16	420KV, 50KA FOR 3S, 3150A, TEE CONNECTOR SUITABLE FOR AL TUBE 6 INCH IPS TO QUAD CONDUCTOR AS PER TS	3150	19
17	420KV, 50KA FOR 3S, 3150A, TEE CONNECTOR SUITABLE FOR QUAD MOOSE TO QUAD MOOSE	3150	94

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18	420KV, 50KA FOR 3S, 1600A, TEE CONNECTOR SUITABLE FOR QUAD MOOSE TO TWIN MOOSE	1600	15
19	420KV, 50KA FOR 3S, 1600A, PG CLAMP SUITABLE FOR TWIN MOOSE TO TWIN MOOSE	1600	9
20	420KV FLEXIBLE SPACERS SUITABLE FOR QUAD ACSR MOOSE CONDUCTOR	-	635
21	420KV FLEXIBLE SPACERS SUITABLE FOR TWIN ACSR MOOSE CONDUCTOR	-	31
22	420KV CORONA END BELL FOR 4.5" IPS AL. TUBE	-	14
23	420KV CORONA END BELL FOR 6" IPS AL. TUBE	-	12
24	420KV ALUMINIUM WELDING SLEEVE SUITABLE FOR 4.5" AL. TUBE	-	21
25	420KV ALUMINIUM WELDING SLEEVE SUITABLE FOR 6" AL. TUBE	-	53
26	PG CLAMP FOR 2 NOS. SHIELD WIRES OF DIA 12MM EACH	-	43
27	STRAIN CLAMP FOR SHIELD WIRE (WIRE DIA 12MM)	-	40
28	PAD CONNECTOR TO SUIT 12MM DIA GS WIRE AND 75X10 MM GS FLAT	-	24
29	CLAMP FOR SHIELD WIRE ON STRUCTURE (CLEAT TYPE) FOR DIA 12MM	-	454
30	CLAMP FOR 75X10MM GI STRIP & LATTICE STRUCTURE	-	1701
31	CLAMP FOR 50X6MM GI STRIP & LATTICE STRUCTURE	-	630

Note-The overall contract value may vary by $\pm 20\%$ at contract execution stage.

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1.4 TYPE TESTS:

Bidder shall submit valid type test reports (as per relevant IEC/IS standard) for the tests carried out within last five years from the date of techno commercial bid opening (i.e. **18.03.2018**) . The reports should have been conducted on identical or similar equipment/components to those offered. In case type test reports are more than 5 years old (from the date of techno commercial bid opening) or the reports of type tests are found to be technically unacceptable , the type test shall be conducted by the vendor without cost and delivery implication to BHEL.

1.5 INSPECTION & TESTING:

Before being fitted on the equipment, all components shall be subjected to routine tests at the Contractors factory, as per the relevant IEC/IS standards. A detailed test report proving the successful passing of such tests shall be provided.

Prior to dispatch, the routine & acceptance tests shall be carried out on equipment in accordance with the applicable IEC /IS and the material shall be offered for final inspection to BHEL and WBDPCL in accordance with agreed quality plan with 3 weeks advance information.

1.6 QUALITY PLAN:

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

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SECTION 2

2.1 GENERAL

This section covers the general technical requirements of Spacers, Aluminium Welding Sleeves, Clamps and Connectors. In case of any discrepancies between the requirements mentioned in this section and those specified in other sections of this specification, this shall prevail after Section 1 and shall be treated as binding requirements.

2.2 APPLICABLE STANDARDS

The Spacers, Aluminium Welding Sleeves, **Clamps and Connectors** shall strictly conform to the following Indian and International standards, as appropriate:

Electric Power Connectors	IS-5561 (Latest)
Electric Power Connectors for substation	NEMA-CC1
Connectors for use between aluminium or Aluminium-copper overhead conductors	NEMA-CC3
Spacers & spacer dampers for twin/Quad Horizontal Bundle conductors	IS 10162
Aluminium and aluminium alloy ingots and Castings for general engineering purposes.	IS 617:1994
Hexagon head bolts, screws and nuts of Product grades C	IS 1363 (All parts) : 1992
Hexagon head bolts, screws and nuts of Product grades A and B	IS 1364 (All parts) : 1992
Technical supply conditions for threaded Fasteners.	IS 1367 Part 1,2,3,13)
Fitting for aluminium and steel cord aluminium Conductors for overhead power lines	IS 2121:1962
Methods for testing uniformity of coating of Zinc coated articles.	IS 2622: 1986
Electroplated coating of zinc on iron and steel	IS 1573:1986
Hexagonal bolts & nuts (M42 to m150)	IS 3138:1966
Metric screw threads	IS 4218(Parts 1 to 4,6)
Spacers & spacer dampers for twin Horizontal bundle conductors	IS 10162: 1982
Fasteners: hexagonal products width Across flats.	ISO 272

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Fasteners, screws & studs	ISO 898
Hot dip zinc coatings on structural steel And other allied products.	IS 4759:1984
Recommended practices for hot dip Galvanizing of iron and steel.	IS 2629:1985
Wrought Aluminium and Aluminium Alloy bars, rods, tubes and sections for electrical purposes	IS 5082: 1981
Dimensions for Wrought Aluminium and Aluminium Alloys, Extruded Round Tubes	IS 2673:1979
Dimensions and tolerance for Wrought Aluminium and Aluminium alloys drawn around tube	IS 2678:1987
Methods of test for resistance of metallic electrical resistance material	IS 3635:1966

2.3 CONSTRUCTIONAL FEATURES

CLAMPS AND CONNECTORS

- 2.3.1 All power clamps and connectors shall conform to IS:5561(Latest) or equivalent IEC .
- 2.3.2 Bolts , nut , washers , shackle , etc. required for other purpose shall be of forged steel with adequate strength and the surface shall be so protected as to offer maximum resistance to corrosion . Malleable iron wherever used for any part shall be of best quality and shall corresponds to latest amendments of relevant IS. Bolts shall be so located that pressure is uniformly distributed from bolts over the contact surface.
- 2.3.3 Where copper to aluminium 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. The design details of the joints shall be furnished to the Purchaser by the Contractor.
- 2.3.4 No current carrying part of any clamp shall be less than **10 mm thick**. Various fittings and accessories of the clamps & connectors shall be so designed as to eliminate sharp edges & maintain bright smooth surface. All bolts, nuts, rivets etc. shall have round profiles. For bimetallic clamps, copper alloy liner of minimum thickness of **4 mm shall be cast integral with the aluminium body**.
- 2.3.5 All clamps and connectors for connection with equivalent ACSR conductors shall have high tensile Aluminium body . U –bolt and nut for the clamps shall be made of non magnetic material e.g. chromium steel . The connectors shall be free from cavities blowholes and such other defects. All sharp edges and corners shall be blurred and rounded off. All connectors shall be designed corona free.
- 2.3.6 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 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.

- 2.3.7 All current carrying parts shall be designed and manufactured to have minimum contact resistance.

SPACERS

- 2.3.8 Bundle spacers shall have enough strength so as to restore normal spacing of conductors after displacement by winds , short circuits etc. without damage or permanent deformation . The spacers shall have long life without fatigue or wear and shall have gentle but firm grip on conductor . They shall be able to withstand all the electromagnetic and electrostatic forces under different operating conditions including dead short circuit.
- 2.3.9 The spacers shall be one piece construction and shall not have separate small components . The material used in spacers shall be corrosion resistant and made of Aluminium alloy of an approved type.
- 2.3.10 The spacers shall be flexible enough so as to avoid distortion or damage to the conductors themselves. Rigid spacers are not acceptable.
- 2.3.11 The spacers shall be capable of being installed or removed from the energised line by means of hot line tools without completely separating the components.
- 2.3.12 The spacers shall not have any projection cuts , abrasions etc. which may cause corona radio interference . They shall have enough strength to resist any deformation, which may cause their RI performance to change . The units shall be corrosion resistance . Ferrous parts, if used shall have magnetic losses not more than 5 watt for 600 Amp 50 Hz AC. Elastomers if used shall be resistance to ozone , sunshine and ageing.

ALUMINIUM WELDING SLEEVES FOR 4.5" and 6" IPS ALUMINIUM TUBE

- 2.3.13 Aluminium used shall be grade 63401 WP (range 2) conforming to IS:5082.
- 2.3.14 Length of Welding Sleeve shall be minimum 600 mm and shall be suitable for 4.5"IPS/ 6"IPS Aluminium Tube.

2.4 Tests

In accordance with the stipulations of the specification, the Spacers, Aluminium Welding Sleeves, Clamps and Connectors shall be subject to type, acceptance, sample and routine tests as per relevant IS/IEC.

In accordance with the requirements stipulated under section 3, the Spacers, Aluminium Welding Sleeves, Clamps and Connectors **should have been type tested** as per IEC/IS and shall be subject to routine and acceptance tests in accordance with IS/IEC document. Type test reports of the tests conducted earlier on similar equipment shall be submitted. It is the responsibility of the supplier to get the test reports approved from the ultimate customer (WBPDCL) with no commercial implications to BHEL. If the valid type test reports are not available with the bidder then the tests shall be conducted by the bidder free of cost.

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2.4.2 Tests for CLAMPS AND CONNECTORS

A Type Tests

Clamps and connectors should be type tested as per latest IS:5561 and shall also be subjected to routine tests as per IS:5561. The valid type test reports shall be submitted. The following is the list of type tests:

- i) Temperature rise test (max. temp. rise allowed is 35°C over 50°C ambient)
- ii) Short time current test
- iii) Corona (dry) and RIV (dry) test (for 220 kV and higher voltage level clamps)
- iv) Resistance test
- v) Tensile test
- vi) Dimensional Check
- vii) Galvanization test (where applicable)

B Acceptance Test

The following is the list of Acceptance tests:

- i) Resistance test
- ii) Tensile test
- iii) Dimensional Check
- iv) Galvanization test (where applicable)

C Routine Test

The following is the list of Routine tests:

- i) Visual Check
- ii) Dimensional Check

2.4.3 Tests for SPACERS

The valid type test reports shall be submitted. Each type of spacers shall also be subjected to the acceptance tests and routine tests:

A Type Tests

- i) Clamp slip tests

The sample shall be installed on test span of twin conductor bundle string or quadruple conductor bundle string (as applicable) at a tension of 44.2 kN. One of the clamps of the sample when subjected to a longitudinal pull of 2.5 kN parallel to the axis of the conductor shall not slip on the conductor. The permanent displacement between the conductor and the clamp of sample measured after removal of the load shall not exceed 1.0 mm. similar tests shall be performed on the other clamp of the same sample.

- ii) Fault current test as per CI 5.14.2 of IS: 10162
- iii) Corona extinction voltage test (dry).
- iv) RIV test (Dry)
- v) Resilience test (if applicable)
- vi) Tension test

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- vii) Log decrement test (if applicable)
- viii) Compression test
- ix) Galvanizing test

B Acceptance test (As per IS: 10162)

- i) Visual examination
- ii) Dimensional verification
- iii) Movement test
- iv) Clamp slip test
- v) Clamp bolt torque test (if application)
- vi) Assembly torque test
- vii) Compression test
- viii) Tension test
- ix) Galvanizing test
- x) Hardness test for neoprene (if applicable)
 The shore hardness of different points on the elastometer surface of cushion grip clamp shall be measured by shore hardness meter. It shall be between 65 to 80.
- xi) Ultimate Tensile Strength Test .The UTS of the retaining rods shall be measured. It shall not be less than 35 kg./Sq. mm.

C Routine test

- i) Visual examination
- ii) Dimensional verification

2.4.4 Test for Aluminium Welding Sleeve

A TYPE TEST

The valid type test reports shall be submitted in accordance with IS 5082 are as follows:

- i) Chemical composition (CI 6.2)
- ii) Straightness of tube (CI 10.3 & 11.2.2)
- iii) Tensile strength testing (Mechanical test) (CI 8.1)
- iv) Conductivity (Electrical test) (CI 9.1.1). The electrical resistivity shall be determined either by direct measurement or upon machined test pieces. For determination of electrical resistivity reference may be made to IS 3635 (CI 9.1).
- v) Measurement of wall thickness and ovality of the tube shall be measured by ultrasonic method (CI 10.0)
- vi) 0.2% Proof testing on both parent metal and aluminium tube after welding (CI 8.1)
- vii) Size and dimension As per IS 2673
- viii) Elongation test

B ROUTINE TEST

In accordance with stipulations of the specification, Routine tests shall be conducted on tubular bus conductors as per IS : 5082. Also the wall thickness and ovality of the tube shall be measured by the ultrasonic method. In addition to the above tests, 0.2% proof tests on both parent metal and Aluminium tube after welding shall be conducted.

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SECTION-3

3.0 GENERAL

This section stipulates the General Technical Requirements under the Contract and will form an integral part of the Technical Specification.

The provisions under this section are intended to supplement general requirements for the materials, equipments and services covered under other respective sections and are not exclusive.

However in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall hold good.

3.1 PROJECT INFORMATION AND SYSTEM PARAMETERS

a)	Customer/ Purchaser/ Owner	The West Bengal Power Development Corporation Ltd.
b)	Consultant/Owner's Engineer	Development Consultants Private Ltd. Kolkata
c)	Project Title	1X660MW thermal power extension project Unit-5 at Sagardighi- 400KV Switchyard
d)	Location	Site is located at Manigram village of Murshidabad district in West Bengal and around 240km from Kolkata. 13km north of Sagardighi town by the side of the SMGR(Sagardighi Manigram –Gankar –Raghunathganj) road at a distance of 20km from National Highway 34 . Nearest railway station is Manigram adjacent to the site on Bandel-Barhawara branch line and 6.5km from Sagardighi railway station on Sainthia-Azimhunj line of eastern railway. Nearest Airport –Kolkata. Nearest Seaport-Kolkata/Haldia
e)	Altitude	34 m above MSL
f)	Transport Facilities	Road/Rail
g)	Postal Address	To follow
SITE CONDITIONS		
a)	Maximum Design ambient dry bulb temperature	50°C
b)	Minimum Design ambient dry bulb temperature	5°C
c)	Average Relative humidity (for design)	73 %
d)	Maximum relative humidity	84%
e)	Pollution Severity	Heavily Polluted
f)	Seismic zone	III

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g)	Wind velocity	47m/sec.
h)	Wind pressure	150kg/sq.mts
i)	Terrain category	2
j)	Risk coefficient (K1)	1.07
k)		
l)	Average rainfall	1389mm

SYSTEM PARAMETERS

Nominal system voltage	400 kV
Highest system voltage	420 kV
System voltage variation	-5% to +5%
Basic Impulse level(dry /wet)	1425kVp
Power frequency withstand voltage dry/wet	630kVrms
Switching Impulse withstand voltage (Phase to Earth)	1050kVp
Switching Impulse withstand voltage (Phase to Phase)	1575kVp
Lightning impulse withstand voltage (kVp between live terminals and earth.)	1425kVp
Lightning impulse withstand voltage (kVp impulse on one terminal and other terminal earthed) (across isolating distance).	1665kVp
Maximum radio interference voltage at 320kV rms phase to ground voltage	1000 micro volts for frequency between 0.5 MHz and 2.0 MHz
Rated short time current	50 kA for 1 sec
Frequency	50 Hz, +3% to -5%
Creepage distance	31 mm/kV
System Earthing	Effectively earthed

AUXILIARY POWER SUPPLY

3 phase A.C power supply	415V \pm 10%, 50 Hz \pm 5%, 3-phase 4 wire,50kA, solidly earthed, combined voltage and frequency variation \pm 10%
1 phase A.C power supply	240V \pm 10%, 50 Hz +3% to -5%, 1-phase AC supply
D.C. power supply	220V +10% to -15%, 2-wire , ungrounded 48V \pm 10%, 2 wire system positively earthed

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3.2 GENERAL TECHNICAL REQUIREMENT

3.2.1 TYPE TESTS

All equipment/systems to be supplied shall conform to type tests as per relevant standards and proven type. The Bidder / Contractor shall furnish the reports of all the type tests carried out in within last **five years from date of bid opening i.e. 18.03.2018.** as listed in relevant clauses in respective electrical specification and relevant standards for all components / equipment / systems. These reports should be for the tests conducted on identical/similar components/equipment/systems to those offered/proposed to be supplied under this contract.

Type tests done in an independent government laboratory or in the presence of representative of State Electricity Board or other reputed public undertakings, the type test reports of the same shall be submitted for scrutiny /approval. If these are found suitable and technically acceptable, conducting of type tests shall be waived off.

In case Contractor is not able to submit report of type test(s) conducted in last five years, or in case type test report(s) are not found to be meeting the specification/relevant standard requirements, then all such tests shall be conducted under this contract by the Bidder free of cost to Employer/Purchaser, and reports shall be submitted for approval. No charges shall be paid under this contract. All acceptance and routine tests as per relevant standards and specification shall be deemed to be included in the bid price.

3.2.2 CODES AND STANDARDS

All materials and equipment shall generally comply in all respect with the latest edition of relevant international electro-technical commission (IEC) or any other internationally accepted standard which ensure equal or better quality or relevant Indian standard(IS) mentioned against each equipment and this specification.

3.3 MATERIAL/WORKMANSHIP

3.3.1 General Requirements

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

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

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

All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practices will be accepted. Installation shall be constructed as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, leveling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances and instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacture's limits suitable guards shall be provided for the protection of personal on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purpose. The spare equipment(s) shall be installed at designated locations and tested for healthiness. The Contractor 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 Contractor shall apply all operational lubricants to the equipment installed by him. All oil, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the Contractor has any special requirement for the specific application of a type of oil or grease not available in India. In such is the case he shall declare in the proposal, where such oil or grease is available. He shall help purchaser in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

3.3.2 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 favorable to the growth of fungi and mildew. The indoor equipments located in non-air conditioned areas shall also be of same type.

3.4 PAINTING

The painting of equipment shall be as follows:

Epoxy based with suitable additives. The thickness of finish coat shall be minimum 80 microns (minimum total DFT shall be 100 microns). However in case electrostatic process of painting is offered for any electrical equipment, minimum paint thickness of 80 microns shall be

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acceptable for finish coat.

Painting process shall be of powder coating type. All surface shall be cleaned , phosphated and given two coats of rust –resistant primer followed by two coats of finish paints . The interior of all panels cabinets and enclosures shall be finished with gloss white enamel. Two final powder coats of synthetic enamel paint of light grey shade(631 of IS-5) shall be given to exterior surface of all the panels. Sufficient quantities of touch paint shall be furnished for application at site. All The indoor cubicles shall be of same colour scheme and for other miscellaneous items, **colour scheme will be approved by the purchaser.**

3.5 PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration 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, piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner. Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent entry of insects.

3.6 FUNGISTATIC VARNISH

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

3.7 SURFACE FINISH

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

All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling. All external painting shall be as per shade no. 631 of IS:5.

3.8 GALVANIZING

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All ferrous parts including all sizes of nuts, bolts, Plain and spring washers, support channels, structures, shall be hot dip galvanized conforming to latest version of IS:2629 or any other equivalent authoritative standard. However, hardware less than M12 size shall be electro-galvanized. Minimum weight of zinc coating shall be 610 gm/sq.m and minimum thickness of coating shall be 85 microns for all items thicker than 6mm. For items lower than 6 mm thickness, requirement of coating shall be as per relevant ASTM.

3.9 PACKING

The following details are to be clearly indicated in the material forwarding documents:

- a) Name and address of the consignee.
- b) Purchase order number.
- c) Name of supplier/s.
- d) Description of equipment / material.
- e) Net weight.
- f) Gross weight.

Each package shall be accompanied by a packing note (in weather proof paper).

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the purchaser, the Contractor shall also submit packing details/associated drawing for any equipment material under his scope of supply, to facilitate the purchaser to repack any equipment/ material at a later date, in case the need arises. Any material found short inside the packing cases shall be supplied by the supplier without any extra cost. The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbol i.e. fragile, handle with care, use no Hooks etc.

3.10 HANDLING, STORING AND INSTALLATION

Contractor may engage manufacturer's Engineers to supervise if required for unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the purchaser. Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.

Where assemblies are supplied in more than one section, contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning.

Contractor shall be responsible for examining all the shipment immediately of any damage, shortage, discrepancy etc. for the purpose of Purchaser's information only. Any demurrage, pilferage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. The Contractor shall be fully responsible, for the equipment/material until the

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same is handed over to the purchaser in an operating condition after commissioning.

The minimum phase to earth, phase to phase and section clearance along-with other technical parameters for the various switchyard voltage levels to be maintained shall be strictly as per the approved drawings.

The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances, the Contractor shall immediately proceed to correct the discrepancy at his risks and costs.

3.11 DEGREE OF PROTECTION

The enclosures to be installed shall be provided with 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 possibilities of entry of water is limited:IP-41
- e) For LT switchgear (AC & DC distribution Boards): IP-54
- f) 11kV & 3.3kV Switchgears: IP4X
- g) 415V MCC / DBs / Fuse Board IP52 for indoor and IP65 for outdoor.
- h) Motor (Indoor/Outdoor): IP55
- i) Motor Actuator: IP65
- j) Control and Relay Panel in AC area: IP3X
- k) Control and Relay Panel in normal area: IP42
- l) Pushbutton Station/Kiosk/Panel - Indoor IP55
- m) Pushbutton Station/Kiosk/Panel -Outdoor IP65
- n) Indoor Junction boxes for cables / wires: IP55
- o) Outdoor lighting fixtures: IPW65
- p) Battery Charger Panel: IP42

The degree of protection shall be in accordance with IS:13947, (Part-1)/IEC-947(Part-1). Type test report/or degree of protection test on each type of the box shall be submitted for approval.

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3.12 RATING PLATES, NAME PLATES AND LABELS

Type or serial number together with details of the loading conditions under which the item of the substation in question has designed to operate and such diagram plates as may require by the Purchaser. The rating plate of each equipment shall be according to IEC requirements.

All such nameplate instruction plates, rating plates shall be bilingual with Hindi inscription first followed by English. Alternately two separate plates one with Hindi and other with English inscriptions may be provided. All measurements shall be in M.K.S units.

3.13 EARTHING

Equipment shall be provided with two grounding pads suitable for connection to galvanized steel flat. Control panels, Relay panel, outdoor marshalling boxes, Junction boxes, lighting panels and distribution board shall be provided with two grounding pads, for connection to galvanized steel flat. The two pads shall be provided, one each at the middle of the two opposite sides of the bottom frame of the equipment. Earthing of hinged door shall be done by using a separate earth wire.

3.14 TERMINAL BLOCKS AND WIRING

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

Terminal blocks shall be 1100 V grade box –clamp type and have continuous rating to carry the maximum expected current on the terminals. Those shall be of molded 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 preferably the terminal blocks shall be non-disconnecting stud type equivalent to Elmex type CATM4, Phoenix cage clamp type of Wedge or equivalent. The Insulating material of terminal block shall be nylon 6.6 which shall be free of halogens, fluorocarbons etc.

Terminal block 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.

The terminal shall be 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. 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. The terminal blocks shall be of extensible design. The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

The terminal blocks shall be fully enclosed with removable covers of transparent, non

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deteriorating 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.

Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.

All circuits except CT circuits : Minimum of 2 nos. of 2.5 sq.mm, copper flexible.

All CT circuits : Minimum of 4 nos. of 2.5 sq.mm, copper flexible..

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. 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.

There shall be a minimum clearance of 250mm between the first bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm. The Supplier shall furnish all wire, conduits and terminals for the necessary inter-phase electrical connection (where applicable) as well as between phases and common terminal boxes or control cabinets.

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 supplier 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.

3.15 CONTROL CABINETS, JUNCTION BOXES, TERMINALS BOXES AND MARSHALLING BOXES FOR OUTDOOR EQUIPMENTS

All types of boxes, cabinets etc. shall generally conform to and be tested in accordance with IS-5039, IS-8623 or IEC-439, as applicable and the clause given below.

Control cabinet, Junction boxes, Marshalling boxes & Terminal boxes shall be made of **CRCA sheet** steel of minimum 2 mm thickness. The thickness of door s/covers shall not be less than 1.6 mm. 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. Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements.

Cabinet /boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of gaskets shall be such that it does not get damaged/cracked during the operation of the equipment.

All door, removable covers and plates shall be gasketed all around with suitably profiled

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Neoprene gaskets. The gasket shall be tested in accordance with approved quality plan. The quality of gasket shall be such that it does not get damaged /cracked during the years of the equipment or its major overhaul whichever is earlier. All gasketed surfaces shall be smooth, straight and reinforced if necessary to minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate projecting at least 150 mm above from 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. The gland shall project at least 25mm above gland plate to prevent entry of moisture in cable crutch. Gland plate shall have provision for some future glands to be provided later, if required.

3.16 SPACE HEATERS

The heater shall be suitable for continuous operation at 240 V AC supply voltage and shall be provided with on – off switch and fuse shall be provided for heater.

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

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

3.17 QUALITY

BHEL quality plan to be followed subject to TBEM / customer's approval.

3.18 DOCUMENTATION

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3.18.1 LIST OF DOCUMENTS

The bidder shall submit a detailed list of drawings / documents along with the bid proposal which he intends to submit to the Employer after award of the contract.

The supplier shall necessarily submit all the drawings / documents unless any thing is waived.

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

3.18.2 DRAWINGS

All drawings submitted by the Contractor including those submitted at the time of bid 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, the external connections, fixing arrangement required, the dimensions required for installation and interconnections with other equipment and materials, clearances and spaces required for installation and interconnection between various portions of equipment and any other information specifically requested in the specifications.

Each drawing submitted by the Contractor shall be clearly marked with the name of the Employer, name of consultant, the unit designation, contract no., and the name of the Project. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

Further work by the Contractor shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Employer if so required.

All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the Contractor's risk. The Contractor 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 Contractor's drawing or work by the Employer shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

3.18.3 APPROVAL PROCEDURE

The scheduled dates for the submission of these as well as for, any data/information to be furnished by the Employer would be discussed and finalized at the time of award. The supplier shall also submit required no. of copies as mentioned in this specification of all drawings/design documents/test reports for approval by the Employer. The following schedule shall be followed

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generally for approval.

i.	Initial submission of drawings and data sheet	Within 2 (two) weeks from PO date.
ii.	Approval/comments/by employer on Initial submission	Within 2 (two) weeks of receipt
iii.	Resubmission	Within 1 (one) weeks (whenever from date of comments required) Including both ways postal time.
iv.	Approval or comments	Within 1 week of receipt of resubmission
v.	Furnishing of distribution copies	1 week from the date of last approval.

Note: The contractor may please note that all resubmissions must incorporate, all comments given in the submission by the Employer failing which the submission of documents is likely to be returned. Every revision shall be a revision number, date and subject, in a revision block provided in the drawing, clearly marking the changes incorporated.

The title block of drawings shall contain the following information incorporated in all contract drawings. Please refer enclosed sheet for details of Title block.

3.18.4 DOCUMENTS TO BE SUBMITTED ALONGWITH OFFER

- 1) Drawings
- 2) Guaranteed Technical Particulars
- 3) Type Test Reports
- 4) Manufacturing Quality Plan

3.18.5 DOCUMENTATION SCHEDULE

S. No.	DESCRIPTION	TENDER STAGE	CONTRACT STAGE FOR APPROVAL	FINAL DOCUMENTATION	
				Prints	CDs
1	Drawings and Data Sheets	1	6	7	4 nos of all drawings/ documents
2	Drawings "As Built "	-	-	7	
3	Type Test Reports	1	6	7	
4	Erection Manuals	-	6	7	
5	Operation and Maintenance Manuals	-	6	7	
6	Manufacturing Quality Plan	1	6	7	
7	Field Quality Plan	1	6	7	
8	Inspection Test Reports	-	-	7	

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O & M Manuals shall be submitted 3 months prior start of unit commissioning,
The manual shall be submitted as follows-

1. 1 soft copy + 12 sets of hard copy to WBPDC Sagardighi site.
2. 1 soft copy + 3 sets of hard copy to WBPDC Corporate office.

Soft copies of drawings at contract stage shall also be submitted in **PDF format**.

Drawings will also be submitted in mini cartridges in AUTOCAD Release -14 package or any other CAD package along with conversion files for all major items.

Final Documentation shall be submitted in bound volumes with Customer & Project etc. written on top.

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 Doc. No. TB-445-316-CAC01, Rev. No.-0, Clamps and connectors –

SECTION 4

GUARANTEED AND TECHNICAL PARTICULARS FOR CLAMPS AND CONNECTORS

- | | |
|-------------------------------------------------------------------------------------------------|----------|
| 1) Manufacture's name and address | 1)..... |
| 2) Applicable standards | 2)..... |
| 3) Application | 3)..... |
| 4) Type | 4)..... |
| 5) For connection to | 5)..... |
| a) Conductor size and arrangement | (a)..... |
| b) Equipment terminal and arrangement | (b)..... |
| 6) Material (state percentage - composition of constituents and impurities present) | 6) |
| a) Clamp body | (a)..... |
| b) Bolts and nuts | (b)..... |
| c) Spring washers | (c)..... |
| d) Liners, if any | (d)..... |
| 7) Rated current (A) | 7)..... |
| 8) Maximum temperature rise over reference ambient temperature when carrying rated current (°C) | 8)..... |
| 9) Rated terminal load and factor of safety (Kg) | 9)..... |
| 10) Minimum thickness of any part (mm) | 10)..... |
| 11) Weight of clamp complete with hardware (Kg) | 11)..... |
| 12) Machine accuracy for matching surface | 12)..... |
| 13) Service (Indoor/Outdoor) | 13)..... |

DEVIATION SCHEDULE

SCHEDULE OF TECHNICAL DEVIATIONS

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

S.No.	Page No.	Clause No.	Deviation	Reason / Justification
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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

ANNEXURE-TQR

TECHNICAL PRE- QUALIFICATION REQUIREMENT

Name of customer: WBDCL KOLKATA

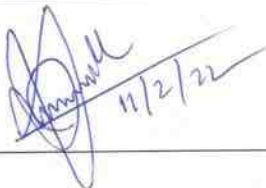
Name of consultant: DCPL KOLKATA

Name of Project: 1X660MW SAGARDIGHI UNITS PROJECT

Name of Item: Clamps and Connectors

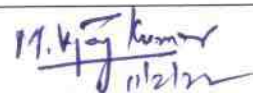
<u>PQR Sr. No</u>	<u>PQR Description</u>	<u>Supporting Document to be attached</u>
1.	The Bidder should have designed, manufactured and supplied 400kV Clamp and Connector during the last 5 years from the date of Notice to proceed(NTP) i.e. 01.07.2020.	a) Copy of Purchase Orders / LR / MDCC / DI/etc

Prepared By:
Naveen Kr Tripathi
(Dy. Mgr/TBEM)



11/2/22

Checked By:
M Vijay Kumar
(Sr Manager-TBEM)



11/2/22

Approved By:
Sh S K Shukla
(Sr. DGM-TBEM)



11/02/22