



**BHARAT HEAVY ELECTRICAL LIMITED, BHOPAL**

**SPECIFICATION CUM COMPLIANCE CERTIFICATE OF 420 kV OIP CONDENSER BUSHING**

NAME & ADDRESS OF THE SUPPLIER :

SCOPE: SUPPLY OF 420 kV, 2500A, CTL - 600mm OIP CONDENSER BUSHINGS COMPLYING WITH THE SPECIFICATIONS AS BELOW :

		Spec No. : BCE/PS/420/38, Rev02 Date : 05-11-2024	
S.NO.	DESCRIPTION OF BHEL REQUIREMENT	SPECIFIED / TO BE CONFIRMED BY	REMARKS
1.0	WORKPIECE MATERIAL		
1.1	Item :		
	Oil Impregnated Paper (OIP) Condenser Bushing with porcelain insulator /composite polymer housing as per IEC 60137 (2017), <u>suitable for operating in Seismic Zone No I-III in India as per IS 1893 (Part-1).</u>	Vendor to note	
2.0	SPECIFICATION :		
2.1.1	The electrical and mechanical characteristics of bushings shall be in accordance with IEC: 60137:2017 /DIN 42530	Vendor to confirm	
2.1.2	Bushings shall be robust and designed for adequate cantilever strength to meet the requirement of seismic condition, substation layout and movement along with the spare transformer with bushing erected and provided with proper support from one foundation to another foundation within the substation area.		
2.2	Valid type test reports as per IEC:60137 (2017) for similar 420 kV OIP bushings , conducted <u>within last 7(seven) years prior to the date of bid opening</u> shall be submitted alongwith the bid.	Vendor to confirm and submit the test reports alongwith the bid	
2.2.1	The type tests conducted earlier should have either been conducted in an 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 client / third party.	Vendor to confirm	
2.2.2	Type Tests reports should include Seismic Test.(in line with Sr. No. 1.1)	Vendor to confirm	

695627/2024/HEP-BCM21201

Spec No. : BCE/PS/420/38, Rev02

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2.2.3	In case valid type test report as mentioned under Sr. Nos. 2.2,2.2.1 & 2.2.2 above is not available, then vendor has to conduct type test in presence of BHEL / Customer representative before delivery of first lot , at no extra cost to BHEL.	Vendor to confirm	
2.3	The porcelain bushings must be shipped in crates to prevent them from breaking. The bushings can be packed in a slanted position on their own support so that the bushing insulation is always covered with oil. Each bushing must be lying on a solid base and protected by adequate filling material to avoid free-movement during transportation. If the manufacturer deems it necessary, the bushings can be strapped with nylon belts to block them in place.	Vendor to confirm	
2.3.1	Hollow column insulator shall be manufactured and tested in accordance with IEC-62155 / IS:5621. The insulators shall also conform to IEC 60815 as applicable.	Vendor to confirm	
2.3.2	Bushings insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.	Vendor to confirm	
2.3.3	All the porcelain shall have adequate physical properties and glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.	Vendor to confirm	
2.3.4	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.	Vendor to confirm	
2.3.5	Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service.	Vendor to confirm	
2.3.6	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.	Vendor to confirm	

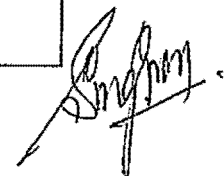


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2.3.7	All portions of the assembled porcelain enclosures and support insulators other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.	Vendor to confirm	
2.3.8	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. All load bearing surfaces shall be smooth and uniform so as to distribute the loading stresses uniformly. Insulator/bushing design shall be such as to ensure a uniform compressive pressure on the joints.	Vendor to confirm	
2.3.9	Bottom stress shield with bolted fixing arrangement shall be supplied.	Vendor to confirm	
2.4	The bidder may also offer composite silicon rubber insulator, conforming to IEC- 61462.	Vendor to confirm	
2.4.1	The hollow silicone composite insulators shall comply with the requirements of the IEC publications IEC 61462 and the relevant parts of IEC 62217.	Vendor to confirm	
2.4.2	The design of the composite insulators shall be tested and verified according to IEC 61462 (Type & Routine test).	Vendor to confirm	
2.4.3	Polymer / composite insulator shall be seamless sheath of a silicone rubber compound.	Vendor to confirm	
2.4.4	The housing & weather sheds should have silicon content of minimum 30% by weight.	Vendor to confirm	
2.4.5	It should protect the bushing against environmental influences, external pollution and humidity.	Vendor to confirm	
2.4.6	It shall be extruded or directly moulded on the core.	Vendor to confirm	
2.4.7	The interface between the housing and the core must be uniform and without voids.	Vendor to confirm	

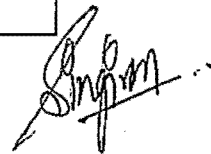


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2.4.8	The strength of the bond shall be greater than the tearing strength of the polymer.	Vendor to confirm	
2.4.9	The manufacturer shall follow non-destructive technique (N.D.T.) to check the quality of jointing of the housing interface with the core.	Vendor to confirm	
2.4.10	The weather sheds of the insulators shall be of alternate shed profile as per IS/ IEC 60815-3 The weather sheds shall be vulcanized to the sheath (extrusion process) or moulded as part of the sheath (injection moulding process) and free from imperfections.	Vendor to confirm	
2.4.11	The vulcanization for extrusion process shall be at high temperature and for injection moulding shall be at high temperature & high pressure.	Vendor to confirm	
2.4.12	Any seams / burrs protruding axially along the insulator, resulting from the injection moulding process shall be removed completely without causing any damage to the housing.	Vendor to confirm	
2.4.13	The track resistance of housing and shed material shall be class 1A4.5 according to IEC 60587.	Vendor to confirm	
2.4.14	The strength of the weather shed to sheath interface shall be greater than the tearing strength of the polymer.	Vendor to confirm	
2.4.15	The composite insulator shall be capable of high pressure washing.	Vendor to confirm	
2.5	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.	Vendor to confirm	
2.6	No radio interference shall be caused by the bushings when operating at the normal rated voltage. All surfaces of the metal parts shall be perfectly smooth with the projecting points or irregularities which may cause corona.	Vendor to confirm	



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2.7	End fittings shall be free from cracks, seams, shrinks, air holes and rough edges.	Vendor to confirm	
2.8	End fittings should be effectively, sealed to prevent moisture ingress, effectiveness of sealing system must be supported by test documents.	Vendor to confirm	
2.9	All load bearing surfaces shall be smooth and uniform so as to distribute the loading stresses uniformly.	Vendor to confirm	
2.10	Clamps and fittings shall be of hot dip galvanised/stainless steel.	Vendor to confirm	
2.11	Each bushing should be supplied with bushing handling and lifting tools.	Vendor to confirm and submit list with offer.	
2.12	Bushings of identical current and voltage ratings must be interchangeable.	Vendor to confirm	
2.13	Oil end dimensions to match as per drg. no. <u>BCE-4-1491</u> attached at <u>Annexure-I</u> .	Vendor to confirm	
2.14	Supplier to submit their Quality Plan for review by BHEL.	Vendor to confirm	
2.15	Bushing shall be specially packed to avoid any damage during transit and suitable for long storage, with non-returnable packing wooden boxes with hinged type cover. Without any gap between wooden planks. Packing Box opening cover with nails/screws type packing arrangement shall not be acceptable.	Vendor to Confirm	
2.16	Detail method for storage of bushing including accessories shall be brought out in the instruction manual.	Vendor to Confirm	
2.17	Tan delta measurement at variable frequency (in the range of 20 Hz to 350 Hz in the multiple of 17Hz with applied voltage 2KV-5KV) shall be carried out on each bushing at bushing manufacturing works as routine test before dispatch and the result shall be compared at site during commissioning to verify the healthiness of the bushing. No temperature correction factor shall be applicable for tan delta.	Vendor to Confirm	



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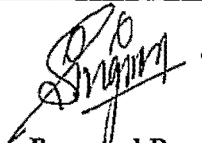
S.NO.	DESCRIPTION OF BHEL REQUIREMENT		SPECIFIED / TO BE CONFIRMED BY	REMARKS
2.18	Tan delta value of OIP condenser bushing shall be 0.004 (max) measured at ambient temperature. The measured tan delta value at site of in service bushing should not exceed by 0.001 w.r.t factory results during warranty period.		Vendor to Confirm	
2.19	If within the warrantee period the bushing Tan delta goes beyond 0.004 or increase is more than 0.001 in case of in service bushing at site, the supplier shall arrange to replace the defective bushing by new one free of cost.		Vendor to Confirm	
3.0	<b>Technical Parameters</b>			
3.1	Rated Voltage	420 kV	Vendor to Confirm	
3.2	Rated Current (Min.)	2500 A	Vendor to Confirm	
3.3	Lightning impulse withstand voltage	1425 kVp	Vendor to Confirm	
3.4	Switching impulse withstand voltage	1050 kVp	Vendor to Confirm	
3.5	One minute power frequency withstand voltage	695 kVrms	Vendor to Confirm	
3.6	Minimum total creepage distances	13020 mm (31 mm/kV)	Vendor to Confirm	
3.7	Tan delta of bushings	$\leq 0.004$	Vendor to Confirm	
3.8	Max partial discharge level at Um	$< 10$ pC	Vendor to Confirm	
3.9	Test tap voltage withstand level	2 kVrms	Vendor to Confirm	
3.10	Corona Extinction Voltage	508 kV rms	Vendor to Confirm	
3.11	Oil end length excluding bottom terminal & shield (mm)	1335mm	Vendor to Confirm	
3.12	Air End Terminal dia. & Length (mm)	Dia = 60mm, Length = 125mm	Vendor to Confirm	
3.13	Bottom porcelain max. dia. (mm)	350 mm	Vendor to Confirm	
3.14	Flange, PCD	8 holes, dia. 20 mm equally spaced on PCD 430 mm. Diameter 480mm	Vendor to Confirm	
3.15	CT space min.	600 mm	Vendor to Confirm	
3.16	Type of Lead	Solid Stem. Bottom connected	Vendor to Confirm	

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3.17	No of holes,depth of bolt & hole diameter for oil end terminal	6 nos, depth = 20mm, hole dia = 12mm	Vendor to Confirm & Supply	
3.18	Oil End Shield diameter(max)	350mm	Vendor to Confirm & Supply	
3.19	Fixing hardware for transformer lead	Matching with the bushing bottom connector	Vendor to Confirm & Supply	
4.0	<b>DOCUMENTATION :</b> Following documents in English language should be submitted along with the bid for our evaluation.		Vendor to Confirm	
4.1	OGA Drawing		Vendor to submit	
4.2	Type test reports		Vendor to submit	
4.3	Instruction manual		Vendor to submit	
4.4	Quality Plan		Vendor to submit	
5.0	<b>ROUTINE TEST INSPECTION:</b>		Vendor to confirm	
5.1	Routine tests to be conducted on all bushings as per IEC 60137:2017. The routine tests may be witnessed by BHEL/customer/TPIA at supplier's works.		Vendor to confirm	

  
**Prepared By:**  
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**Manager (CIE)**

  
**Approved By:**  
**Kulamani Naik**  
**SDGM (BCE)**

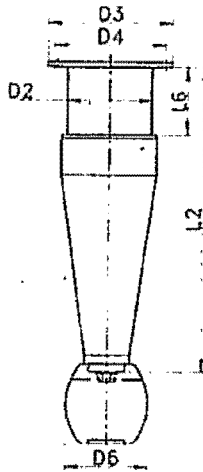
ANNEXURE - I

FIRST ANGLE PROJECTION

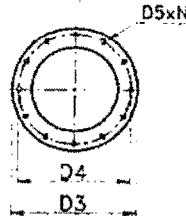
(ALL DIMENSION ARE IN. mm)

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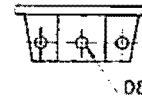
OIL END DETAILS



MOUNTING FLANGE DETAILS



BOTTOM CONNECTION DETAILS



DESCRIPTION	420kV	800kV
BIL kVp	1425 1550(for GT)	2100
Creepage Distance (mm) (min.)	13020	24800
Current Rating (A)	2500	2500
Type of lead	Solid Stem(SS)	Solid Stem(SS)

DIMENSION DETAILS:-

SYMBOL	DESCRIPTION	420kV	800kV
L2±5	Length between bottom seal of flange & bottom of the oil end shield/stress relieving electrode /oil end terminal whichever is the longest.	1335	1955
L6(min)	Length for accommodating bushing current transformer (BCT)	600	600
D2(max)	Maximum diameter of oil immersed end	350	528
D3±2	Outside diameter of fixing flange	480	780
D4±1(PCD)	Pitch circle diameter of fixing holes of flange	430	711
D5xN	Diameter of fixing hole & Number of fixing holes	20x8	32x12
D6(max)	Maximum diameter of oil end shield/stress relieving electrode	350	420
D8	Diameter of hole for oil end terminal	Ø12	Ø12
No. of holes and depth of bolt for Oil End Terminal		6,20	6,20
Diameter of Air End Terminal		Ø60	Ø60
Length of Air End Terminal		125	125

- NOTES:- 1. ALL DIMENSION ARE IN M.M.  
2. NO POSITIVE TOL. WHERE MAX. DIMENSION SPECIFIED AND NO NEG. TOL. WHERE MIN. DIMENSION IS SPECIFIED.



**BHARAT HEAVY ELECTRICALS LTD.**  
BHOPAL

	NAME	SING	DATE	NO OF VAR.
DRN.	PRADEEP	Sd/-	10.08.22	-
CKD.	BRM/SEK	Sd/-	10.08.22	-
APPD.	M.KURRE	Sd/-	10.08.22	-

DEPT.	CODE OF TOL. DIV. C/M/F	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	TEM NO.	NO. OF ITEMS
BCE	421	NTS	-	--	-	-
TITLE				DRAWING NO.	REV.	
STD. DIMN. FOR 420kV-2500A & 800kV-2500A OIP CONDENSER BUSHINGS (LOWER PORTION)				BCE-4-1491	00	
SHEET NO.		NO. OF SHEETS				
01		01				