



# **BHARAT HEAVY ELECTRICAL LIMITED, BHOPAL**

## **SPECIFICATION CUM COMPLIANCE CERTIFICATE OF 800 kV OIL-SF6 CONDENSER BUSHING**

**NAME & ADDRESS OF THE SUPPLIER :**

**SCOPE: SUPPLY OF 800 kV, 2500A, CTL - 600mm OIL-SF6 CONDENSER BUSHINGS COMPLYING WITH THE SPECIFICATIONS AS BELOW :**

**Spec No. : BCE/PS/800/46, Rev00**  
**Date : 13-09-2022**

S.NO.	DESCRIPTION OF BHEL REQUIREMENT	SPECIFIED / TO BE CONFIRMED BY	REMARKS
<b>1.0</b>	<b>WORKPIECE MATERIAL</b>		
1.1	Item : Oil Impregnated Paper (OIP) Condenser Bushing with porcelain /composite polymer housing <b>OR</b> RIP (Resin Impregnated Paper) condenser type bushing with composite polymer insulator (housing) <b>OR</b> RIS (Resin Impregnated Synthetic) condenser type bushing with composite polymer insulator (housing)	Vendor to confirm	
<b>2.0</b>	<b>SPECIFICATION :</b>		
2.1	The electrical and mechanical characteristics of bushings shall be in accordance with latest revisions of IEC: 60137:2017 & IEC 62271-211.	Vendor to confirm	
2.1	The bushing shall be suitable for connection with GIS SF6/ Oil Interface as per IEC 62271-211.	Vendor to confirm	
2.2	Valid type test reports as per IEC:60137 (2017) for similar 800 kV OIP/RIP/RIS Oil-SF6 bushings , conducted <b>within last 7(seven) years prior to the date of bid opening</b> shall be submitted alongwith the bid.	Vendor to confirm and submit the test reports alongwith the bid	
2.2.1	The type tests conducted should have either been conducted in accredited laboratory (accredited based on ISO/ IEC Guide 25/ 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by client / third party.	Vendor to confirm	
2.2.2	Type Tests reports should include the following tests also, (i) Seismic Test	Vendor to confirm	



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2.2.3	In case valid type test report as mentioned under Sr. Nos. 2.2.2.2.1 & 2.2.2.2 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. All arrangements including airfare, lodging & boarding, local conveyance shall be arranged by the vendor.	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	Bushings shall be manufactured and tested in accordance with IS:2099 & IEC-60137. Hollow column insulator shall be manufactured and tested in accordance with IEC-62155 / IS:5621. The insulators shall also conform to IEC 60815 as	Vendor to confirm		
2.3.2	Insulators shall be manufactured and conform to type tests and shall be subjected to routine tests in accordance with IS: 2099 & 2544,5621 & IEC-62155, as applicable.	Vendor to confirm		
2.3.3	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		
2.3.4	The bushing shall be of porcelain and have adequate current capacity to use the equipment to its maximum overload capacity.	Vendor to confirm		
2.3.5	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	Vendor to confirm		
2.3.6	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		





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2.3.7	Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service.	Vendor to confirm	
2.3.8	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	
2.3.9	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	
2.3.10	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	
2.3.11	Bottom stress shield with bolted fixing arrangement is preferable.	Vendor to confirm	
2.3.12	Bottom stress shield insulated with 5mm pressboard is preferable. It shall be duly packed in moisture proof condition and supplied alongwith bushing.	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	





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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	
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 technique being followed with detailed procedure and sampling shall be finalized during finalization of MQP.	Vendor to confirm	
2.4.11	The weather sheds of the insulators shall be of alternate shed profile as per IEC 60815 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	
2.4.12	The vulcanization for extrusion process shall be at high temperature and for injection moulding shall be at high temperature & high pressure.	Vendor to confirm	
2.4.13	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	





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2.4.14	The track resistance of housing and shed material shall be class 1A4.5 according to IEC 60587.	Vendor to confirm	
2.4.15	The strength of the weather shed to sheath interface shall be greater than the tearing strength of the polymer.	Vendor to confirm	
2.4.16	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	
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	Spare Bushing shall be specially packed suitable for long storage with non-returnable.	Vendor to confirm	
2.12	Bushings of identical current and voltage ratings must be interchangeable.	Vendor to confirm	
2.13	Supplier to submit their Quality Plan for review by BHEL.	Vendor to confirm	





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S.NO.	DESCRIPTION OF BHEL REQUIREMENT	SPECIFIED / TO BE CONFIRMED BY	REMARKS
2.14	Corona Shield to be provided at 800KV Bushing terminal (Air End) to minimise corona.	Vendor to confirm	
2.15	Bottom stress shield insulated with 5mm pressboard is preferrable. It shall be duly packed in moisture proof condition and supplied alongwith bushing.	Vendor to confirm	
2.16	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	
2.17	In case of RIP/RIS bushing with polymer housing, Bushing oil end portion shall be fitted with metal housing with positive dry air pressure and a suitable pressure monitoring device shall be fitted on the metal housing during storage to avoid direct contact with moisture with epoxy. Alternatively, oil filled metal housing / tank with suitable arrangement for taking care oil expansion due to temperature variations shall also be acceptable. Tank shall have necessary provision for oil filling, level gauge etc. Manufacturer shall submit drawing/ documents of packing for approval during detail engineering.	Vendor to Confirm	
2.18	Detail method for storage of bushing including accessories shall be brought out in the instruction manual.	Vendor to Confirm	
2.19	Tan delta measurement at variable frequency (in the range of 20 Hz to 350 Hz) shall be carried out on each condenser type bushing (OIP/RIP/RIS) at manufacturing works as routine test before despatch and the result shall be compared at site during commissioning to verify the healthiness of the bushing.	Vendor to Confirm	





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S.NO.	DESCRIPTION OF BHEL REQUIREMENT	SPECIFIED / TO BE CONFIRMED BY	REMARKS
2.20	<p>Tan delta value of RIP/RIS condenser bushing at site shall be 0.005 (max) in temperature range of 20 deg C to 90 deg C. The measured tan delta value at site of in-service bushing should not exceed by 0.001 w.r.t factory results (measured at approx. similar temperature conditions) during warranty period.</p> <p>Tan delta value of OIP condenser bushing at site shall be 0.004 (max) measured at ambient temperature. The measured tan delta value of in-service bushing should not exceed by 0.001 w.r.t factory results during warranty period.</p>	Vendor to Confirm	
2.21	If the bushing does not fulfill the criteria under Cl. No. 2.20 mentioned above, the supplier shall arrange to replace the defective bushing by new one ,within the warrantee period.	Vendor to Confirm	
3.0	<b>Technical Parameters</b>		
3.1	Rated Voltage	800 kV	Vendor to Confirm
3.2	Rated Current (Min.)	2500 A	Vendor to Confirm
3.3	Lightning impulse withstand voltage	2100 kVp	Vendor to Confirm
3.4	Switching impulse withstand voltage	1550 kVp	Vendor to Confirm
3.5	One minute power frequency withstand voltage	970 kVrms	Vendor to Confirm
3.6	Minimum total creepage distances	min 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 shield (mm)	1995mm	Vendor to Confirm
3.11	SF6 end length (mm)	$1798 \pm 5$ mm	Vendor to Confirm



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3.12	SF6 end Terminal details	Suitable for connection with GIS SF6 Interface as per IEC 62271-211	Vendor to Confirm	
3.12	Height of mounting flange (between SF6 side and oil side PCD areas)	390 mm	Vendor to Confirm	
3.13	Oil End Terminal details	Hexagonal shape 6 holes - dia.=12 mm/ depth=20mm	Vendor to Confirm	
3.14	Oil end side max. bushing dia. (mm)	528 mm	Vendor to Confirm	
3.15	Flange, PCD (fixing details)	12 holes, dia. 32 mm equally spaced on PCD 711 mm Dia of PCD area = 780mm	Vendor to Confirm	
3.16	CT space min.	600 mm	Vendor to Confirm	
3.17	Max. shield diameter	420 mm	Vendor to Confirm	
3.18	Type of Lead	Bottom connected	Vendor to Confirm	
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>GUARANTEE :</b>			
5.1	12 months from the date of commissioning of the transformer and 18 months from the date of supply, whichever is later.		Vendor to Confirm	
6.0	<b>ROUTINE TEST INSPECTION:</b>		Vendor to confirm	





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6.1	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	

  
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