Bharat Heavy Electricals Limited
)A Govt of India Undertaking(
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(SCHEDULE-VI)

ANNEXURE'A'

Enq Item no.	WO NO.	Transformer rating	Customer	Nomencleature	Qty	kV	CT Length	Amps	LI	SI	AC kV	SCT 3 Sec	Crrepage mm	Prefered mounting PCD
1	72586	160MVA,220/66kV	GETCO	HV	72	245	300	1250	1050	850	505	40 KA	7595	400mm, 12xDia20
2	72586	160MVA,220/66kV	GETCO	LV+HVN+LVN	90	72.5	300	2000	350	NA	155	25 KA	2250	290mm, 12xDia15
3	72587	150MVA Auto	GETCO	HV	4	245	300	1250	1050	850	505	40 KA	7595	400mm, 12xDia20
4	72587	150MVA Auto	GETCO	IV	4	145	300	1250	650	540	305	40 KA	4495	290mm, 12xDia15
5	72587	150MVA Auto	GETCO	N	2	36	300	2000	170	NA	70	25 KA	744	185mm, 6xDia15
6	72588	125MVA,220/33	GETCO	HV	24	245	300	1250	1050	850	505	40 KA	7595	400mm, 12xDia20
7	72588	125MVA,220/33	GETCO	LV +LVN	30	72.5	300	2000	350	NA	155	25 KA	2250	290mm, 12xDia15
8	72588	125MVA,220/33	GETCO	HVN	12	36	300	3150	170	NA	75	25 KA	1120	290mm, 12xDia15
9	72566	200MVA AUTO	PGCIL	HV	6	245	300	1250	1050	850	505	40 KA	7595	400mm, 12xDia20
10	72566	200MVA AUTO	PGCIL	IV	6	145	300	1250	650	NA	305	40 KA	4495	290mm, 12xDia15
11	72567	200MVA AUTO	PGCIL	HV	6	245	300	1250	1050	850	505	40 KA	7595	400mm, 12xDia20
12	72567	200MVA AUTO	PGCIL	IV	6	145	300	1250	650	NA	305	40 KA	4495	290mm, 12xDia15

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(SCHEDULE-VII)

ANNEXURE 'B'

GETCO

GETCO/E/TS – 2XMER01power/ *R12 Jun'19*

QUALIFYING REQUIREMENT for RIP/ RIF/ RIS bushings

1. The bidder shall be Original Equipment Manufacturer (OEM). The offered equipment has to be designed, manufactured and tested as per relevant IS/IEC with latest amendments.
2. Equipment proposed shall be of similar or higher rating and in service for a minimum period of THREE (3) years and satisfactory performance certificate* in respect of this is to be available and submitted.
3. Equipment offered shall have Type Test Certificates from 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), as per IEC / IS / technical specification. The type test reports shall not be older than FIVE years and shall be valid up to expiry of validity of offer.
4. If offered RIP/ RIF/ RIS bushings are offered from foreign OEM (Original Equipment Manufacturer) & supplied from their foreign works, type test reports & satisfactory performance certificate* from their offered country will be considered as valid.
5. If offered RIP/ RIF/ RIS bushings are to be supplied from Indian manufacturing unit under technical collaboration with foreign OEM, then type test reports & satisfactory performance certificate* from their offered country works of foreign OEM shall be considered valid for BID evaluation. However, in event of order, following type test reports to be submitted by Indian manufacturing unit having technical collaboration of foreign OEM, before commencement of supply, without affective delivery schedule, free of cost to GETCO.
   a. Dielectric Test as per IEC 60137 (Latest Edition)
   b. Temperature Rise Test as per IEC 60137 (Latest Edition)

Sign and Seal of Bidder

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(SCHEDULE-VIII)

ANNEXURE-'C' PGCIL 10 1/6

iv) Vacuum level of degassing chamber not more than 0.15 torr/0.2 mbar at rated flow and at final stage. Machine shall have minimum of two degassing chambers and these should have sufficient surface areas to achieve the final parameters.
v) Filter shall be capable of removing particle size more than 0.5 micron in the filtered oil.
vi) Processing temperature shall be automatically controlled and have an adjustable range from 40°C to 80°C.

The above oil treatment plant (Filtration unit) shall be arranged by the bidder at his own cost.

8.3.6. **Transportation of Oil**

The insulating oil for the Transformer shall be delivered at site generally not before 90 days from the date of commissioning, with prior information to the Employer, in view of risk involved in balk storage, pilferage and fire hazard. In case this oil is not filled in Transformer due to delay in commissioning, same oil shall be used only after testing and ensuring that oil parameters are well within the specified limits.

Insulating oil shall be delivered to the site in returnable oil drums / flexi bag / tanker. The oil drums / flexi bag / tanker shall be taken back without any extra cost to Employer within generally 45 days after utilisation of oil but in any case before contract closing. However, the spare oil shall be delivered in non-returnable drums.

9. Spare Transformer Units Connection Arrangement

Detail procedure for storage of spare transformer unit with and without **isolator switching arrangement** is enclosed at **Annexure-Q.**

10. Bushings

10.1. 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. The electrical and mechanical characteristics of bushings shall be in accordance with IEC: 60137/DIN 42530. All details of the bushing shall be submitted for approval and design review.

10.2. Bushing for voltage of 52 kV and above shall be RIP bushing with composite polymer insulator. 36 kV and below voltage class bushing shall be solid porcelain or oil communicating type.

10.3. RIP type bushing shall be provided with tap for capacitance and tan delta test. Test taps relying on pressure contacts against the outer earth layer of the bushing is not acceptable.

10.4. Where current transformers are specified, the bushings shall be removable without disturbing the current transformers.

10.5. Bushings of identical rating shall be interchangeable to optimise the requirement of spares. Mounting dimensions of bushing shall be as per drawing mentioned at **Annexure – D.**

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10.6. Porcelain used in bushing manufacture shall be homogenous, free from lamination, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture.

10.7. Polymer / composite insulator shall be seamless sheath of a silicone rubber compound. The housing & weather sheds should have silicon content of minimum 30% by weight. It should protect the bushing against environmental influences, external pollution and humidity. The interface between the housing and the core must be uniform and without voids. The strength of the bond shall be greater than the tearing strength of the polymer. The manufacturer shall follow non-destructive technique (N.D.T.) to check the quality of jointing of the housing interface with the core. The technique being followed with detailed procedure and sampling shall be finalized during finalization of MQP.

The weather sheds of the insulators shall be of alternate shed profile as per 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. The vulcanization for extrusion process shall be at high temperature and for injection moulding shall be at high temperature & high pressure. 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. The track resistance of housing and shed material shall be class 1A4.5 according to IEC60587. The strength of the weather shed to sheath interface shall be greater than the tearing strength of the polymer. The composite insulator shall be capable of high pressure washing.

End fittings shall be free from cracks, seams, shrinks, air holes and rough edges. End fittings should be effectively, sealed to prevent moisture ingress, effectiveness of sealing system must be supported by test documents. All surfaces of the metal parts shall be perfectly smooth with the projecting points or irregularities which may cause corona. All load bearing surfaces shall be smooth and uniform so as to distribute the loading stresses uniformly.

The hollow silicone composite insulators shall comply with the requirements of the IEC publications IEC 61462 and the relevant parts of IEC 62217. The design of the composite insulators shall be tested and verified according to IEC 61462 (Type & Routine test)

10.8. Clamps and fittings shall be of hot dip galvanised/stainless steel.

10.9. Bushing turrets shall be provided with vent pipes, to route any gas collection through the Buchholz relay.

10.10. No arcing horns shall be provided on the bushings.

10.11. RIP 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. 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 with suitable arrangement for taking care oil expansion due to temperature variations shall also be acceptable. Manufacturer shall submit drawing/ documents of packing for approval

(SCHEDULE-VIII)

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during detail engineering. Detail method for storage of bushing including accessories shall be brought out in the instruction manual.

10.12. The terminal marking and their physical position shall be as per IEC: 60076.

10.13. 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) at Transformer manufacturing works as routine test before despatch and the result shall be compared at site during commissioning to verify the healthiness of the bushing.

10.14. If the bushing Tan delta goes beyond 0.005 or increase is more than 0.001 within the warrantee period w.r.t. pre-commissioning values, the contractor shall arrange to replace the defective bushing by new one. No temperature correction factor shall be applicable for tan delta.

11. Neutral Formation and Earthing Arrangement

11.1. For 3-Phase Unit

The neutral of the transformer shall be brought out through bushing. The neutral terminal of 3-phase transformer shall be brought to the ground level by a brass/tinned copper grounding bar, supported from the tank by using porcelain insulators. The end of the brass/tinned copper bar shall be brought to the bottom of the tank, at a convenient point, for making bolted connection to two (2) 75 x 12 mm galvanised steel flats connected to Employer's grounding mat.

11.2. For 1-Phase Unit (if specified in BPS)

The neutral of the transformer shall be brought out through bushing. The contractor shall connect the neutrals of 1-phase transformers by overhead connection using an overhead common brass/tinned copper/Aluminum pipe /ACSR conductor grounding bus, supported from the tank and fire walls by using porcelain insulators and wherever flexible jumper needs to be provided, same shall be through twin conductor. All material like Bus post insulator, Aluminium tube, conductor, clamps & connectors, earthing materials, support structure, hardware etc required for neutral formation and connection with neutral CT and earthing of neutral shall be provided by contractor. The neutral formation shall be such that neutral winding of single-phase spare transformer can be disconnected or connected to either of the three phase banks.

12. Delta Formation (applicable for 1-Phase Transformer) :(if specified in BPS)

The tertiary/LV winding terminals of the transformer shall be brought out through bushing. The contractor shall connect Tertiary/LV of 1-phase transformers in DELTA configuration by overhead connection to operate in 3-Phase Bank. The Delta shall be formed by approximate size of 3" IPS Al tube, which shall be insulated with heat shrinkage insulating sleeve or cable of suitable voltage class and adequate thickness and shall be supported by structure mounted bus post insulators at suitable intervals. Jumpers (twin) wherever provided shall also be insulated at site using suitable insulation tape or sleeve atleast 52kV class for 33kV Bus and atleast 36kV class for below 33kV voltage class Bus. The minimum phase to phase horizontal spacing for delta formation shall be 1.5 meter. Suitable cable shall be used for delta formation for below 33kV winding All associated materials like bus post insulators, Aluminium tube,

(SCHEDULE-VIII)

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Section-GTR and other individual sections, requirement of individual section shall prevail.

7.0 MANDATORY SPARES

The Mandatory Spares shall be included in the bid proposal by the bidder. The prices of these spares shall be given by the Bidder in the relevant schedule of BPS and shall be considered for evaluation of bid. It shall not be binding on the Employer to procure all of these mandatory spares.

The bidder is clarified that no mandatory spares shall be used during the commissioning of the equipment. Any spares required for commissioning purpose shall be arranged by the Contractor. The unutilized spares, if any, brought for commissioning purpose shall be taken back by the Contractor.

8.0 EXCLUSIONS:

The following items of work are specifically excluded from the scope of this specification:

i) Earthing works and Civil foundation works for Transformers, its fittings, fire protection walls, Nitrogen Injection type Fire Prevention & Extinguishing System.

ii) HVWS Fire protection system for Transformers.

iii) Auxiliary power and control cables from control room / Bay control room and RTCC panel to Marshalling box.

iv) Soil investigation

v) Terminal connectors for transformers.

vi) Cable trenches

9.0 SPECIFIC REQUIREMENT

9.1 Tan-delta value for RIP (Resin Impregnated Polymer) condenser bushings shall be 0.004 (max.) in the temperature range of 20°C to 90°C. The measured Tan-delta value at site should not exceed by 0.001 w.r.t. factory results (measured at approx. similar temperature conditions) during warrantee period.

9.2 Size of valves for UHF sensor shall be minimum 50NB.

9.3 For foundation of cooler bank of 400kV, 500 MVA Transformer, fixing of cooler support shall be provided through Anchor Fastener with chemical grouting and no pockets for bolting shall be provided.

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9.4 Regarding cooler pipe supports, Buchholz pipe (if required) and fire-fighting pipe supports, no concrete block shall be made for pipe support as locations of all the blocks are different for different manufacturers. Pre-fabricated metallic support from pit shall be provided for cooler pipe & Pylon support which shall be fixed through Anchor Fastener with chemical grouting. Further cooler pipe & Pylon support shall be encased with concrete to prevent rusting.

9.5 The Contractor shall be responsible for safety of human and equipment during the working. It will be the responsibility of the Contractor to co-ordinate and obtain necessary clearance before commissioning. Any additional items, modification due to observation of such statutory authorities shall be provided by the Contractor at no extra cost to the Employer.

9.6 The system fault levels at Meerut & Simbhaoli GIS S/s are as mentioned below:

S. No.	Substation	765kV	400kV	220kV	132kV
1.	Meerut	50kA for 1sec	63kA for 1sec	50kA for 1sec	NA
2.	Simbhaoli	NA	50kA for 1sec	40kA for 3sec	40kA for 3sec

9.7 Any other items not specifically mentioned in the specification but which is required for erection, testing and commissioning and satisfactory operation of equipment covered in this specification are deemed to be included in the scope of specification unless specifically excluded.

9.8 Employer has standardized its technical specification for various equipment and works for different voltage levels. Items, which are not applicable for the scope of this package as per schedule of quantities described in BPS, the technical specification for such items should not be referred to.

9.9 The creepage distance for transformer bushings shall be 31mm/KV.

9.10 **Tap Changer Tap Range & No. of steps of 200MVA, 3-Ph 220/132/11kV Auto transformers:** -5% to +15% of IV variation in the step of 1.25%, 16 steps & 17 tap position on 132kV side of series winding

9.11 The Technical Parameters of 200MVA, 220/132/11kV Auto-Transformer is enclosed at **Annexure-I.**

9.12 In Section-GTR and other technical specifications, the term 'Employer and/or 'Purchaser may be read as Employer.

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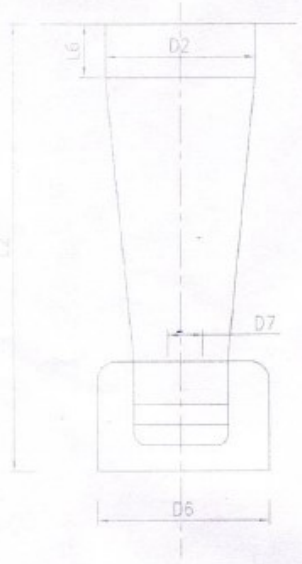
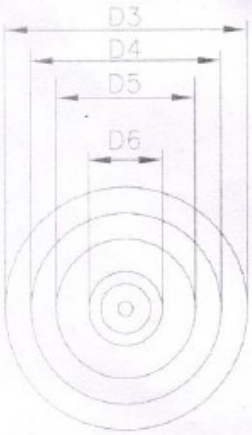


VOLTAGE RATING KV	420	245	145	72.5	52
BIL (kV_p)	1425	1050	650	325	250
CREEPAGE (MM) (Min.)	~~10580~~	~~6130~~	~~3625~~	~~1810~~	~~1300~~
CURRENT RATING (A) (Min.)	800 1250	1250 2000	800	800	3150
L2±5 (FOR DIFF. VALUES OF L6)	1640	1130 1230	600#/800	695	475
L6 (MIN.)	400	300	100#/300	300	100
D2 (Max.)	350	270	165	115	165
D3±2	720	450	335	225	335
D4±1	660	400	290	185	290
D5xN	24x12	20x12	15x12	15x6	15x12
D6 (MAX)	350	270	165	115	115
D7 (Min)	60	48 –	38	—	—



NOTE:

1. ALL DIMENSIONS ARE IN MM
2. NO POSITIVE TOL. WHERE MAX. DIMENSION SPECIFIED AND NO NEG. TOL. WHERE MIN. DIMENSION IS SPECIFIED

APPLICABLE FOR SHUNT REACTOR

WO 72566/72567

PREPARED BY	CHECKED BY	APPROVED BY	TITLE	DRG NO
			STD. DIMN. FOR RIP CONDENSER BUSHINGS (LOWER PORTION)	000-T-E-A-[illegible]

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(SCHEDULE-IX)

Annexure –D

Reference Drawings

The list of drawings indicated below forms a part of this specification.

Sr. No	Drawing Description	Drawing No.
i)	Standard Foundation Drawing (315MVA & 500MVA, 400/220/33kV Auto Transformer)	STD/FDN/500MVA/400KV
ii)	Standard dimensions for RIP Condenser bushings (Lower portion)	0000-T-E-A-001 R02
iii)	Typical arrangement of transformer with regulating winding at the end of the series winding.	000S3-YE4-014
iv)	Conceptual drawing for optical fiber sensor	C/ENGG/STD/ optical fiber sensor/AT-SR, REV 0
v)	Conceptual drawing for showing power and control cable connection for operation with spare unit – 1 Ph Transformer	C/ENGG/TR/SPARE/CABLE/STD REV02
vi)	Conceptual drawing for showing power and control cable for operation of 3-Ph Transformer	C/ENGG/STD/CABLE/TR REV01

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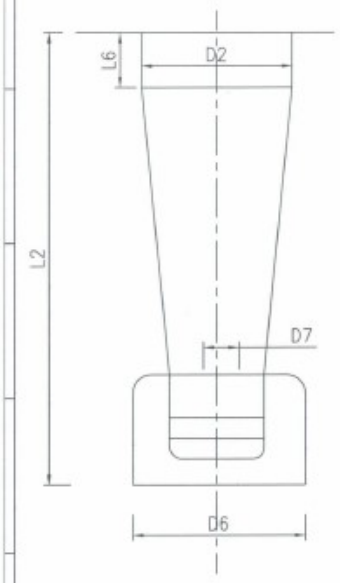
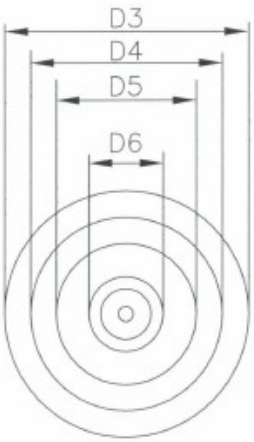
(SCHEDULE-IX)



VOLTAGE RATING KV	420	245	145	72.5	52
BIL (kVp)	1425	1050	650	325	250
CREEPAGE (MM) (Min.)	10500	6125	3625	1810	1300
CURRENT RATING (A) (Min.)	800 1250	1250 2000	800	800	3150
L2±5 (FOR DIFF. VALUES OF L6)	1640	1130 1230	600#/800	695	475
L6 (MIN.)	400	300	100#/300	300	100
D2 (Max.)	350	270	165	115	165
D3±2	720	450	335	225	335
D4±1	660	400	290	185	290
D5xN	24x12	20x12	15x12	15x6	15x12
D6 (MAX)	350	270	165	115	115
D7 (Min)	60	48 –	38	—	—



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APPLICABLE FOR SHUNT REACTOR

PREPARED BY	CHECKED BY	APPROVED BY	TITLE	DRG NO
			STD. DIMN. FOR RIP CONDENSER BUSHINGS (LOWER PORTION)	000-T-E-A-001-R02