

नॉर्थ ईस्टर्न इलेक्ट्रिक पावर कॉर्पोरेशन लिमिटेड

NORTH EASTERN ELECTRIC POWER CORPORATION LIMITED



भारत सरकार का उद्यम: A Govt. of India Enterprise

मिनीरत्न : श्रेणी-I: Miniratna : Category-I

एनटीपीसी लिमिटेड की पूर्ण स्वामित्व वाली सहायक कंपनी

A Wholly owned subsidiary of NTPC Ltd



OFFICE OF THE EXECUTIVE DIRECTOR (CONTRACT & PROCUREMENT)

CORRIGENDUM No.17 Dated 17.09.2025

To

NIB No. 477 Dated: 26/02/2025

For

EPC execution of Electro-Mechanical Works for the 240 MW Heo HEP

The corrigenda to the Bid document is hereby issued:

Sl. No.	Bid Stipulation	Amendment
1	Particular Technical Specifications-Electrical, Volume II Section-II; E-6, Distribution Transformer.	Particular Technical Specifications-Electrical, Volume II Section-II; E-6, Distribution Transformer is revised and attached as Annexure I of this Corrigendum.
2	Particular Technical Specifications-Electrical, Volume II Section-II; E-2, Generator Transformer Clause No. 2.6.40 (GUARANTEES).	Particular Technical Specifications-Electrical, Volume II Section-II; E-2, Generator Transformer Clause No. 2.6.40 (GUARANTEES) is amended and attached as Annexure 2 of this Corrigendum.
3	Vol-I, Sec-II(b): Instruction to Bidders, Clause No.23.3 Stage 2: Evaluation and comparison of price bids (Sealed Cover 2) Sub Clause No. 23.3.2: The Price Schedules shall be filled up and uploaded. The evaluation of Price Bids will be done based on the Grand Total Price as per Price Schedule-I (BOQ) inclusive of all taxes and duties. The Total evaluated price shall be as under: Total Evaluated price = A + B, where A = Total price as per Price Schedule-I (BOQ) B = Loading for capitalization of losses as per Cl. 2.6.40 (Vol-II, Sec-II: E2). The Bidders may note that the prices quoted for Recommended spares in the price schedule will	Vol-I, Sec-II(b): Instruction to Bidders, Clause No.23.3 Stage 2: Evaluation and comparison of price bids (Sealed Cover 2) Sub Clause No. 23.3.2: The Price Schedules shall be filled up and uploaded. The evaluation of Price Bids will be done based on the Grand Total Price as per Price Schedule-I (BOQ) inclusive of all taxes and duties. The Total evaluated price shall be as under: Total Evaluated price = A + B+C, where A = Total price as per Price Schedule-I (BOQ) B = Loading for capitalization of losses as per revised Cl. 2.6.40 (Vol-II, Sec-II: E2) for Generator Transformer. Revised Cl. 2.6.40 (Vol-II, Sec-II: E2) for Generator Transformer is attached as

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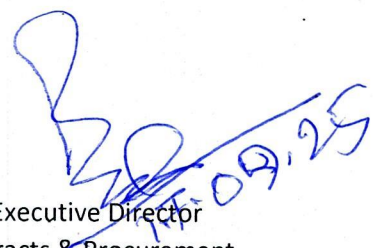
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	not be considered for Price Bid Evaluation. Any suo moto discounts and rebates after the opening of bids (Techno-commercial or price) shall not be considered for the purpose of ranking the offer, but if such a firm does become L1 at its original offer, such suo moto rebates shall be incorporated in the contract.	Annexure 2 of this Corrigendum. C= Loading for capitalization of losses as per revised Cl. 6.13 (Vol-II, Sec-II: E6: Revised Distribution Transformer) for 5MVA SST. Revised PTS (Vol-II, Sec-II: E6: Revised Distribution Transformer) is attached as Annexure 1 of this corrigendum. The Bidders may note that the prices quoted for Recommended spares in the price schedule will not be considered for Price Bid Evaluation. Any suo moto discounts and rebates after the opening of bids (Techno-commercial or price) shall not be considered for the purpose of ranking the offer, but if such a firm does become L1 at its original offer, such suo moto rebates shall be incorporated in the contract.
4	Vol-II, Sec-IV, TDS-11: Generator Transformer	Vol-II, Sec-IV, TDS-11: Generator Transformer is revised and attached as Annexure 3 of this corrigendum.
5	Vol-II, Sec-IV, TDS-12: Distribution Transformer	Vol-II, Sec-IV, TDS-12: Distribution Transformer is revised and attached as Annexure 4 of this corrigendum.

All other terms and conditions of the Bid Document shall remain unchanged.



Executive Director
Contracts & Procurement
NEEPCO, Shillong.

TABLE OF CONTENTS

SECTION-E6	3
6.0 DISTRIBUTION TRANSFORMERS.....	3
6.1 GENERAL.....	3
6.2 SCOPE.....	3
6.3 OPERATING CONDITIONS	4
6.4 APPLICABLE STANDARDS AND CODES	4
6.5 SPECIFICATION FOR DRY TYPE TRANSFORMERS.....	5
6.5.1 ENCLOSURE FOR DRY TYPE TRANSFORMER	5
6.5.2 CORE AND COILS.....	5
6.5.3 TAPPING	6
6.5.4 OFF-CIRCUIT TAP CHANGER.....	6
6.5.5 SUPPORT INSULATOR.....	6
6.5.6 MARSHALLING BOX.....	7
6.5.7 FITTING AND ACCESSORIES OF EACH TRANSFORMER.....	7
6.5.8 EARTHING DETAILS.....	7
6.5.9 CONTROL WIRING	7
6.6 SPECIFICATION FOR OIL TYPE TRANSFORMER.....	8
6.6.1 CORE MATERIAL	8
6.6.2 CORE CONSTRUCTION.....	8
6.6.3 CORE OIL DUCTS	9
6.6.4 CORE INSULATION.....	9
6.6.5 CORE EARTHING	10
6.6.6 CORE FLUX DENSITY	10
6.6.7 WINDING CONDUCTOR MATERIAL	11
6.6.8 WINDING CLAMPING AND BRACING	12
6.6.9 WINDING INSULATION.....	12
6.6.10 WINDING CONNECTIONS AND NEUTRAL EARTHING.....	13
6.6.11 TANK CONSTRUCTION	13
6.6.12 PRESSURE RELIEF DEVICE.....	14
6.6.13 TANK LIFTING AND HAULAGE	15
6.6.14 TANK COVERS	16
6.6.15 EARTHING OF TANK	17
6.6.16 BONDING	17
6.6.17 BUSHINGS	17
6.7 TERMINAL ARRANGMENT (BUS BAR AND CABLE CONNECTION)	17

6.7.1	BUS DUCT CONNECTION (HT SIDE)	17
6.7.2	BUS BAR CONNECTIONS (LT SIDE).....	18
6.8	BOLTS AND NUTS	18
6.9	LABELS AND PLATES.....	18
6.10	TECHNICAL PARAMETERS OF DRY TYPE TRANSFORMER.....	18
6.11	TECHNICAL PARAMETERS OF OIL TYPE TRANSFORMER	21
6.12	GUARANTEES FOR 1500KVA (SAT), 630KVA (UAT) AND 160KVA DISTRIBUTION TRANSFORMERS:..	24
6.13	GUARANTEES FOR 5MVA, 220/33KV STATION SERVICE TRANSFORMER:	25
6.14	DRAWINGS, DATA, MANUALS AND GUARANTEED PARTICULARS	26
6.15	SPARE PARTS.....	27
6.16	TESTING OF TRANSFORMER	27
6.16.1	TYPE TESTS.....	28
6.16.2	ROUTINE TESTS.....	28
6.16.3	SPECIAL TESTS:	28
6.16.4	TESTS ON ASSOCIATED EQUIPMENTS:	29
6.17	SHOP INSPECTION.....	30
6.18	ERECTION, TESTING AND COMMISSIONING	30
6.19	OBLIGATIONS OF THE PURCHASER.....	30
6.20	QUALITY ASSURANCE PROGRAM.....	31

SECTION-E6

6.0 Distribution Transformers

6.1 General

This Section covers the criteria for design, manufacturing, testing, supply, transportation up to site, handling and storage at site, erection, site-testing and commissioning of three numbers of 630 kVA Unit Auxiliary Transformers (UATs), 1500 kVA Station Auxiliary Transformers (SAT) , 5000 kVA Station service Transformer (SSTs) and 160 kVA Distribution Transformer along with its accessories. The transformers shall be of core/shell type and suitable in every way for operation on the system and under the conditions specified in this specification.

The transformers shall be designed, manufactured and tested in conformity with the latest issue of Indian Standards, IEC 76 / BS 171. The transformer and associated auxiliaries and equipment's shall be designed to facilitate operation, maintenance and repairs. All apparatus shall be so designed to ensure satisfactory operation under such sudden variations of load and voltage as may be met with under operating conditions on the system, including those due to short circuit.

All marshalling Box and other required auxiliaries, as required are included in this contract.

6.2 SCOPE

- (i) Three (3) Nos., 630 KVA; 11 kV/ 0.433 kV, Dyn11, 3 phase, 50 Hz., Dry type Unit Auxiliary Transformer (UATs) with "off-circuit" taps in steps of 2.5 % (2 steps for each direction, +5 to -5 range) of the rated voltage on H.V. side, complete with accessories and fittings, as specified and suitable for indoor mounting.
- (ii) Two (2) No., 1500 kVA, 33/0.433kV, three phase, cast resin, Dry type Station Auxiliary Transformers (SAT) with "off-circuit" taps in steps of 2.5% (2 steps for each direction, +5 to -5 range) of the rated voltage on H.V. side, complete with accessories and fittings as specified and suitable for indoor mounting.
- (iii) One (1) No. 5 MVA; 220 / 33 kV, 3 phase, 50 Hz, Oil type Station service Transformer (SST) with "off-circuit" taps in steps of 2.5% (2 steps for each direction, +5 to -5 range), complete with accessories and fittings and suitable for indoor mounting.

- (iv) Two (2) No. 160 kVA, 33 / 0.433 kV, three phases, pole mounted, oil type Transformers, with "off-circuit" taps in steps of 2.5% (2 steps for each direction, +5 to -5 range), one for Barrage site and one Penstock valve house complete with accessories and fittings as specified and suitable for outdoor mounting.
- (v) All accessories required for successful operation, control, monitoring of Transformer and mandatory spare as per requirement.

6.3 Operating Conditions

Transformers are going to be used for indoor/outdoor Installation where ambient temperature will be 40°C.

- 1 The Transformer shall be capable of operating continuously at rated output at all the taps under following conditions:
 - Voltage variation at particular tap : ± 10 % at rated voltage
 - Frequency variation : ± 5 % of nominal frequency
 - Combined voltage and frequency variations : ± 10 %
- 2 The Transformer shall be capable of withstanding the short circuit stress due to a terminal fault on any one winding with full voltage maintained on the other winding for minimum period of (3) seconds.
- 3 The dry type of transformer shall be completely encapsulated cast resin type. naturally cooled (AN) non-inflammable and moisture proof. The flux density of all transformer shall not be more than 1.65 Tesla at the rated voltage and frequency. Current density of H.V. and L.V. winding of all transformers shall be free from annoying hum or vibration. The design shall be such as not to cause any undesirable interference with radio and communication circuit.
- 4 Transformer secondary is to be connected to respective LT panel through LT cables. The cables shall be in the scope of the bidder. The cable entry/exit shall be top/bottom as per layout requirement.
- 5 Altitude of Transformers installation is more than 1000m above MSL. Necessary altitude correction factor shall be applied for finalization of design parameters during detailed design.

6.4 APPLICABLE STANDARDS AND CODES

The equipment and materials covered by this specification shall conform to the latest edition of following Indian Standards or equivalent IEC standards except where specified otherwise in this specification:

Power Transformer	IS: 2026 (Part I to IV)/IEC 76
Specification for Dry Type transformer	IEC 60076 -11, ECBC 2017
Dry Type transformer	IEEE: C57.12.01-1988

Transformer, accessories, etc. meeting any other authoritative standard, which ensures equal or better quality than the Standards mentioned above, shall also be acceptable. However, where the equipment offered conforms to any other standards, the salient points of difference between standards adopted and provision of this specification and standards referred above shall be clearly brought out in the Bid. Copies of such standards in English language or fair English Translation shall be attached with the Bid.

6.5 SPECIFICATION FOR DRY TYPE TRANSFORMERS

6.5.1 Enclosure for Dry Type Transformer

The transformer shall be housed in IP23 enclosure fabricated from sheet steel of minimum 2 mm thickness. The screen shall be perforated sheet steel or wire mesh type. The enclosure shall be adequately reinforced to ensure rigidity so as to permit transportation of transformer within enclosure.

Double leaf access doors shall be provided with concealed hinge and neoprene gaskets for easy access to H.V. links and also for withdrawal of core and coil assembly, if required. Enclosure shall be provided with lifting lugs and grounding terminals; and the enclosure door shall have provision of pad locking in door close position.

Each Transformer shall be provided suitable mounting and fixing arrangement (nut bolt assembly). Jacking Pads, lifting eyes and pulling lugs shall be provided to facilitate movement of the transformer. All heavy removal Parts shall be provided with eye bolts for ease of handling.

6.5.2 Core and Coils

The transformer shall be of either core type or shell type. The core shall be built up with high grade, non-aging, low loss, high permeability grain oriented cold-rolled silicon steel laminations especially suitable for core material. The laminations shall also be free of all burrs and sharp projection.

The coils shall be manufactured from electrolytic copper conductor and fully insulated for rated voltage. Both HV and LV windings shall be completely encapsulated.

Insulating material shall be of proven design. Coils shall be so insulated that

impulse and power frequency voltage stresses are minimum and to withstand even extreme of temperature fluctuations. The insulating material shall be glass fiber reinforced with epoxy resin conforming to class 'H'. Separate encapsulation for HV and LV winding shall be provided and winding temperature rise is restricted to class B (70°C).

All leads from the windings to the terminal board and supporting insulator shall be rigidly supported to prevent injury from vibration or short circuit stresses. Guide tube shall be used where practicable.

The core and coil assembly shall be securely fixed in position so that no shifting or deformation occurs during movement of transformer or under short circuit stresses. Core coil assembly shall be provided with locking arrangements, lifting lugs, and earthing terminals.

The insulating structure for the core to bolts, core to clamp plates and core to structural steel works shall be such as to withstand voltage of 2 KV A.C for one minute. No strip conductor wound on edge shall have a width exceeding six times its thickness. Winding shall not contain sharp bends which might damage insulation and produce high dielectric stresses.

The Voltage level for power frequency and Basic impulse is to be considered as per altitude of transformer installation. (Altitude more than 1000m above MSL)

6.5.3 Tapping

Off-circuit taps at step of 2.5% (2 steps for each direction, +5 to -5 range) shall be provided on the high voltage winding. The transformer shall be capable of operation at its rated KVA on any tap provided the voltage does not vary by more than +/- 10% of the rated voltage corresponding to the tap. The winding including the tapping arrangement shall be designed to maintain electromagnetic balance between HV and LV windings at all voltage ratios.

6.5.4 Off-Circuit Tap Changer

The off-circuit tap changing shall be affected by 3-phase by change of links for dry type transformers. All contacts shall be silver plated and held in position under strong contact pressure to ensure low contact drop and avoid pitting. The design of tap changing link shall be such to ensure that same tap is set on all the three phases at a time.

6.5.5 Support Insulator

Support insulator shall be resin molded type of appropriate voltage class.

6.5.6 Marshalling Box

A sheet steel, weatherproof, IP54, marshalling box shall be provided containing all auxiliary devices such as winding temperature indicators etc.

All terminal blocks for connection shall be located in this box. The terminal blocks shall be 10sq.mm. The marshalling box shall be provided with cubicle lamp with door switch. Space heater of 240 volt (AC) with thermostat & switches and removable cable gland plate. For isolation for incoming supply switch MCCB's shall be provided.

6.5.7 Fitting and Accessories of Each Transformer:

The transformer will be equipped with fittings and accessories as listed below:

- i) Maximum winding temp. monitoring device with electrically separate sets of contacts for trip and alarm along with temperature sensing element embedded in L.V. winding of all three phases.
- ii) Jacking pad for core coil assembly
- iii) IP 54 marshalling box
- iv) Ground bus
- v) Door handle safety limit switch 1NO+1NC contact
- vi) Inspection Cover for cable end box
- vii) Handling and lifting lugs for core coil assembly.
- viii) Rating and terminal marking plates.

6.5.8 Earthing Details

A ground bus of 50x6 mm G.S. flat shall be run all along the transformer enclosure. Grounding pad shall have clean buffed surface with two tapped holes, M10 G.S. bolts and spring washers for connection to 50 x 6 mm G.S. flats.

The core coil assembly shall be directly connected to this ground bus by removable bolted link for effective grounding. Ground terminals shall also be provided on cable end box and marshalling box to ensure its effective earthing.

6.5.9 Control Wiring

All control alarm and indication devices provided with the transformer shall be wired up to the terminal blocks.

Wiring shall be done with PVC wires with FRLS in conduit of PVC. Minimum wire

size shall be 2.5 sq. mm. copper. Not more than two wires shall be connected to a terminal. 10% spare terminals shall be provided.

All devices and terminal blocks within the marshalling box shall be identified by symbols corresponding to those used in applicable schematic or wiring diagram.

6.6 SPECIFICATION FOR OIL TYPE TRANSFORMER

6.6.1 Core Material

All transformer cores shall be fabricated from high grade non-ageing, high permeability, cold-rolled super grain oriented silicon steel lamination known as HI-B steels grade 23 MOH having low-loss characteristics and preferably leading to low noise levels. The thickness of the sheet shall be 0.23 mm or less. However, the bidder shall indicate the thickness of the sheet in the Bid Document.

6.6.2 Core Construction

The magnetic circuit shall be of core construction designed to avoid static discharges and the development of short circuit paths within itself or to the earthed clamping structure and the production of flux component at right angles to the plane of lamination, which may cause local heating. After shearing, the laminations shall be treated to remove all burrs and remove residual stresses so that the laminations are flat and the finally assembled core is free from distortion. Laminations shall be coated with a durable baked enamel insulation coating, which shall be inert to the action of hot transformer oil. Paper and varnish insulation will not be accepted. The nature of insulation shall be stated in the bid. Mitered joints between cores and yokes shall be employed on all sizes of transformers for which this technique is practicable. The mitered joints in the core shall be interleaved. On no account 'butt' joints be offered.

All parts of the core shall be of robust design which are capable of withstanding mechanical shocks during normal lifting, transportation and handling of the transformer, and bracing of the core and winding assembly must be adequate to prevent any movement of core and winding relative to the tank during the conditions mentioned above. The clamping structure shall be so constructed that eddy currents are minimized.

Particular care shall be given to the design and construction of the corner joints between columns and yokes to avoid concentration of mechanical and magnetic stresses whilst allowing an easy dismantling of the joint for maintenance at site.

Adequate metallic bridges shall be provided between the core lamination packets in order to keep all portions of the core assembly at the same potential.

All structure members of the assembled cores shall be of steel except where conventional core-bolt clamping is replaced by taping or banded-clamping or epoxy fiber technique.

Adequate fitments, eyes and lugs, shall be provided for lifting the completed core and windings, and suitable accommodation, attached to each transformer, shall be provided for the storage of any removable parts of the lifting gear.

All castings shall be fettled, and structural steel shall be adequately painted before being built into the structure. Any non-magnetic or high-resistance alloy included in the design shall be subject to approval. All painting designed to be under oil or in contact with oil shall be to the Engineers approval.

The supporting framework of the core shall be designed to avoid the presence of pockets which would prevent complete emptying of the tank through the drain valve, cause the trapping of air during filling, or cause the trapping of gases which evolve during in-service faults. All steel sections used for supporting the core shall be thoroughly sand blasted or shot blasted after cutting, drilling and welding.

6.6.3 Core Oil Ducts

Suitable axial oil ducts shall be provided where necessary to ensure adequate cooling by free circulation of oil. The ducts shall be so dimensioned that the maximum temperature at any point remains within the admissible limits. The winding structure and main insulation shall not obstruct the free flow of oil through such ducts. Where the magnetic circuit is separated by more than 0.25 mm by cooling ducts parallel to the plane of the laminations or by insulating material, tinned copper strip bridging pieces shall be inserted to maintain continuity. Alternatively, resistance wire connections may be used if approved by the Engineer where this is part of the manufacturers standard design.

Where oil ducts or insulating barriers parallel to the plane of the laminations divide the magnetic circuit into two or more electrically divided pain, the ducts or barriers shall be bridged as stated previously and the magnetic circuit shall not be regarded as being of sectional construction.

6.6.4 Core Insulation

Individual laminations shall be insulated with material, which will not deteriorate due to the action of pressure and hot oil.

The magnetic circuit shall be earthed in accordance with IEC standard. With the earthing removed, the magnetic circuit shall be insulated from the clamping and supporting structure and all structural parts, and insulation of core to bolts and core to clamp plates shall withstand a test voltage of 2 kV RMS at 50 Hz for one minute.

The class and type of insulation and the method of applying it on the core bolts and under nuts and side plates shall be stated in the Schedules.

6.6.5 Core Earthing

All metal parts of the transformer except individual core laminations, core bolts and side-clamping plates shall be maintained at earth potential.

The magnetic circuit shall be earthed to the clamping structure through one removable core-insulation-test link only, placed in an accessible position beneath the inspection opening in the main-tank cover. The connection to the link shall be on the same side of the core as the main clamping-structure earth connections to the tank and shall be taken from the extreme edge of the top yoke.

Magnetic circuits having an insulated sectional construction shall be provided with a separate link for each individual section and the arrangement of the connections shall be subject to approval.

Where the magnetic circuit is separated by cooling ducts parallel to the plane of the laminations or by insulating material over 0.25 mm thickness, tinned copper strip bridging pieces shall be inserted to maintain continuity.

All earthing connections with the exception of those from the individual coil clamping rings shall have cross-sectional area of not less than 0.8 cm². Connections inserted between laminations of different sections of core shall have a cross-sectional area of not less than 0.2 cm².

Where clamping ring of coil are of metal at earth potential, each ring shall be connected to the adjacent core clamping structure on the same side of transformer main earth connections.

6.6.6 Core Flux Density

The maximum flux density in any part of the core and yokes at nominal ratio, frequency and voltage shall not exceed 1.65 Tesla. Lower flux densities will be preferred if these result in lower noise levels. Core placing shall be as magnetically balanced as possible. The bidder shall clearly indicate additional cost, if any, if low flux density is adopted.

The core shall be free from overfluxing liable to cause damage or to cause mal-operation of the protection equipment when the transformer is operating under the

continuous overvoltage condition specified. Under this steady overvoltage condition the maximum flux density must not exceed 1.9 Tesla and the magnetizing current must not exceed 5 percent of the rated load current at normal rated voltage.

6.6.7 Winding Conductor Material

The conductor of windings shall be of high-conductivity electrolytic grade copper free from scale and burns and transposed winding conductors shall be employed where appropriate. Windings of all 245 kV class transformers shall be made in dust free conditioned atmosphere.

The windings shall be designed to reduce to a minimum the out-of-balance electromagnetic forces in the transformer at all voltage ratings / tapings and the voltage between adjacent coils shall be kept as low as consistent with the good design.

The conductors shall be transposed at sufficient intervals to minimize eddy currents and equalize the current and temperature distribution along the winding. Coils shall be constructed to avoid abrasion of the insulation, (e.g. on transposed conductors), allowing for the expansion and contraction set up by the changes of temperature or the vibration encountered during normal operation.

Windings shall be so designed as to obtain an optimal value for series and shunt capacities in order to ensure a favourable distribution of the voltage for full impulse waves and chopped impulse waves.

Leads from winding to bushings shall be adequately supported to prevent damage from vibration and short-circuit forces.

All permanent current carrying joints in the windings and leads shall be brazed. The windings shall be designed to reduce to a minimum the out-of balance forces in the transformer at all ratios and special care shall be given to design and construction of tapped coils and connections.

The construction of the windings shall be such as to ensure uniform voltage and stress distribution on the windings in the event of high frequency impulses applied to the windings and the means adopted for the same shall be stated in the bid.

The windings shall be so designed that all coil assemblies of identical voltage rating shall be inter-changeable and field repairs to the windings can be made readily without special equipment. The coils shall be supported between adjacent sections by insulating spacers and barriers. The windings shall be dried by vapor phased system.

6.6.8 WINDING CLAMPING AND BRACING

The windings and connections shall be adequately braced to withstand mechanical shocks and electromagnetic impulsive force which may occur during handling, transportation and transient current surges. Bracings and other insulation used in the assembly of the windings shall be arranged to ensure free circulation of the oil and to reduce hot spots in the windings.

The stacks of windings shall receive adequate shrinkage treatment before final assembly so that any further shrinkage during service is not possible. However, adjustable devices shall be provided for taking up any shrinkage of coils in service.

The coil-clamping arrangement and the finished dimensions of any oil ducts shall be such as will not impede the free circulation of oil through the ducts.

Coil-clamping rings shall be of approved material (preferably steel) but axially laminated. Material other than bakelised paper shall not be used. Where such bakelised paper rings are reused it will only be approved as major insulation between the windings and earth if the creepage-voltage stress obtained by dividing the line voltage by the creepage distance to earth does not exceed 200 kV per meter. Metal clamping rings will be earthed. Clamping assemblies shall be arranged to prevent deterioration of the core characteristic.

Any metal pieces in contact with non-metallic clamping rings shall be so designed and secured that they do not weaken the electrical or the mechanical properties of the rings.

If the winding is built up of sections or disc coils, separated by spacers, the clamping arrangements shall ensure that equal pressure is applied to all columns of spacers. All such spacers shall be of approved material and shall receive adequate shrinkage treatment before assembly.

6.6.9 WINDING INSULATION

245 kV windings shall have graded insulation. Use of enamel as a sole conductor insulation is prohibited.

The insulation of windings and connections shall be free from insulating composition liable to soften, ooze out, shrink or collapse and be non-catalytic and chemically inert in transformer oil during service.

For oil immersed transformers the insulating media shall be of Class A material as defined in IEC 60085.

All neutral points of star windings shall be insulated for the voltages specified in the Schedules of Technical Requirements.

6.6.10 WINDING CONNECTIONS AND NEUTRAL EARTHING

The transformers should be connected in accordance with the IEC group of symbols.

The Wye connection of the distribution transformer shall be solidly grounded. The Bidder shall provide all the material and labour to realize the wye connection.

The neutral bushing shall be equipped with bushing type current transformers for each transformer respectively.

The Bidder shall solidly earthed the neutral bushing to the power house grounding grid located within the transformer gallery. The CT ratio is tentative and shall be subjected to configuration at the time of approval of drawings/manufacture.

The neutral bushing and ground connection shall be designed to withstand a momentary fault current of 50 kA without damaging insulation or conductors.

6.6.11 TANK CONSTRUCTION

Each oil immersed type transformer shall be enclosed in a suitably stiffened welded steel oil-tight tank of Bell type/ Conventional (preferred) construction. Tanks shall be of welded construction and fabricated from tested quality low carbon steel of adequate thickness. The weld procedure and performance shall be in line with ASME-BPV-IX. The thickness and bracing of the tank shall be such that the tank together with core and coil can be lifted and transported without damage or loss of oil tightness. All seams and those joints, not required to be opened at site, shall be factory welded and wherever possible they shall be double welded. All welding shall be stress relieved.

The base of tank shall be so designed that it shall be possible to move the complete transformer unit by skidding in any direction without injury when using rollers, plates or rails. The transformer tank shall be suitable for movement in both directions during shipment.

The main tank body including tap-changing compartment, conservators and coolers shall be capable of withstanding full vacuum.

Aluminium tanks shall not be considered.

Suitable guides shall be provided in the tank for positioning the core and coil assembly. The tanks shall be so designed that with the core and windings in position there shall be no possibility of formation of pockets where air or gas being

trapped when filling the tank with oil, and so that water shall not be trapped on the exterior of the tank. Where pockets cannot be avoided, pipes shall be provided to vent the gas into expansion pipe. The tanks shall be fitted with pockets for a thermometer and the bulbs of a winding temperature indicator and an oil-temperature indicator in maximum temperature zone and it shall be possible to remove the bulbs without lowering the oil in the tank. Protection shall be provided as necessary for the capillary tube. Tank stiffeners shall be provided for general rigidity and these shall be designed to prevent retention of water. Adequate space shall be provided at the bottom of the tank for collection of sediment. Tanks shall be designed to withstand mechanical shocks during transportation, vacuum filling of oil, continuous internal pressure of 100.66 kN/m² over normal hydrostatic pressure of oil and short circuit force.

The tank shields (if provided) shall be such that no magnetic field shall exist outside the tank. They shall be of magnetically permeable material. If required, impermeable shields shall be provided at the coil ends. Tank shield shall not resonate when excited at the natural frequency of the equipment. Bidder shall confirm use of tank shields in the additional information schedule.

Surface and flange temperature around the periphery of the transformers and any other part of the tank or ancillary equipment up to and including 2.0 m above the plinth shall not exceed 70°C at specified maximum ambient temperature at maximum continuous rating (MCR) on any tapping.

6.6.12 PRESSURE RELIEF DEVICE

Transformer tank shall be fitted with an approved pressure relief device designed to protect the tank from damage, and to control the explosion of oil under internal fault and may result in damage in the equipment. An extension pipe shall be fitted above the device such as to direct the major flow of ejected oil down wards and shall be fitted so as to permit its removal without disturbing the device or its flange fixings. The device shall be so located as not to interfere with the electrical clearances for any overhead connections. The device shall fully reseal after release of excess pressure.

The device shall operate at a static pressure, which shall be less than the hydraulic test pressure of transformer tank. Means shall be provided to prevent ingress of rain water.

One set of electrically insulated contact shall be provided for alarm / tripping.

A mechanical indicator, manually resettable type and clearly visible from a long distance shall be provided to indicate that the valve has operated.

For all transformers, the conventional diaphragm type of explosion vent shall also be provided and shall be situated above maximum oil level. An equalizer pipe shall be connected to pressure relief device from the conservator.

6.6.13 TANK LIFTING AND HAULAGE

Tank or enclosure shall be provided with the following handling facilities the first three of which must each be capable of lifting and/or moving the transformer complete and filled with oil.

- a) Lifting lugs or eyes of ample dimensions designed so that standard lifting shackles can be readily attached. The lifting eyes, lugs or hooks shall have a factor of safety of not less than 2 (two) to allow for possible unequal lifting forces.
- b) A minimum of four jacking pads shall be suitably located in accessible positions to make it possible to change the direction of wheels through 90°, when the transformer, complete with oil, is lifted on jacks to permit movement of the transformer both in longitudinal and transverse directions. A convenient track gauge (to be indicated in bid) in both longitudinal and transverse direction shall be chosen. Means shall be provided for locking the swivel movements in positions, parallel to and at right angles to the longitudinal axis of the tank. Suitable stoppers for the track wheels shall also be supplied. The pads shall be adequately braced and project a sufficient distance from the transformer side to enable a standard jack to be properly located. The minimum height of the lugs above the base shall be 500 mm excluding the under base dimensions, if detachable.
- c) Four anchor points shall be fitted to transformer tank or frame at not more than 760 mm from the base to enable the transformer complete (and filled with oil) to be slewed or hauled in any direction. Suitable haulage holes shall be provided for transformer wheeling in all four directions.
- d) Lifting handles on the tank-lid or enclosure hand-hold covers where the size and weight of such covers would make manhandling difficult.
- e) The transformer tank shall be supported on a strong structural steel base equipped with forged steel or cast steel single flanged bi-directional wheels suitable for moving the transformer completely filled with oil. The number and the spacing of wheels shall be specified in the Bid. The wheels shall be provided with grease nipples. Arrangement for clamping of the wheels with the rails, capable of being put on and off easily, shall also be provided. The structural steel supporting base shall be so designed that the centre of gravity of the transformer, with or without oil, will not fall outside the base support members for a tilt of the base of 15 degrees from the horizontal.

- f) The Bidder shall provide adequate number of hydraulic jacks for lifting the transformer for changing the plane of rotation of wheels.

6.6.14 TANK COVERS

At least two adequately sized inspection openings of suitable design, one at each end of the tank, shall be provided on the tank cover. The openings shall be of sufficient size to afford easy access to internal connections of bushings, current transformers, winding connections and earth link for testing, etc. The design should be such that water shall not collect near the gasketed joints. Tank covers or enclosure panels shall be so constructed that they can be removed and replaced without sustaining damage. Inspection covers shall also be fitted and these shall not exceed 25 kg in weight.

The tank and cover shall be provided with sufficient and properly spaced bolts and gaskets with metal inserts.

All joint faces shall be machined or ground and arranged to prevent the ingress of water or leakage of oil with a minimum of gasket surface exposed to the action of air or oil. Oil resisting synthetic rubber gaskets are not permissible except where the synthetic rubber is used as a bonding medium for cork or similar material. Gaskets, of resilient material which will not deteriorate under the action of hot oil, are to be as thin as possible consistent with the provisions of a good seal and full details of all gasket sealing arrangements shall be shown on the plant drawings.

Enclosure covers and inspection panels shall be accurately fitted and robust to prevent distortion. Countersunk screws may be used for fixing. Gaskets shall be used to deaden vibration where necessary.

Bushings, turrets, covers of inspection openings, thermometer pockets, etc. shall be designed to prevent ingress of water into or leakage of oil from the tank. Turrets and other parts surrounding the conductors of individual phase shall be non-magnetic. Necessary provisions shall be provided to drain out leakage oil/water at the lowest points of the bushing flange wherever required. The same shall be properly sealed with dual stop cock arrangement.

The tank cover shall be fitted with thermometer pockets (on position of maximum oil temperature at MCR) for bulbs of oil and winding temperature indicators. The thermometer pocket shall be filled with a captive screw top to ingress of water. It shall be possible to remove these bulbs without lowering the oil in the tank.

6.6.15 EARTHING OF TANK

Two substantial earthing terminals / pads suitable for connecting 50X10 mm mild steel flat capable of carrying the maximum possible earth-fault current shall be provided at positions close to the two diagonally opposite bottom corners of tank. The terminals shall be designed to carry this current without damage for duration at least equal to the short circuit period for which the main windings are designed, in accordance with IEC 60076 or for 4 seconds the full LV short circuit current of Transformer. These grounding terminals shall be suitable for bolted connection. Two earthing terminals shall also be provided each on cooler, control panel, marshalling box and any other equipment mounted separately.

The Bidder shall provide the material and labor to bond each earthing terminal to the main grounding grid located within the transformer gallery. Earthing conductors shall be capable of withstanding 50 kA for 1 seconds.

6.6.16 BONDING

Substantial bonding-connection studs must be provided to permit the bonding of all transformer ancillary equipment and housings not forming an integral part of the main transformer tank. Bonding studs shall be connected to the grounding grid located within the transformer gallery.

6.6.17 BUSHINGS

All bushings shall have the current rating, voltage rating, basic insulation level, creepage distance etc. as indicated in the Schedule / IS:2099 / IEC 37. The standard dimensions shall be kept, in view so that transformer can accept any bushing of parameter and dimensions.

The 245 kV bushings shall be of oil to SF6 bushings shall be of Epoxy Resin Impregnated Paper (ERIP) or RIS. A tapping is to be brought out to a separate terminal for testing purposes. Any stress shield is to be considered an integral part of the bushing assembly. Permissible variation in the value of capacitance and maximum value of dielectric dissipation factor (tan delta) of bushing and test tap of transformer bushing shall be as per IEC 137 and IEEE Std. C57.152-2013.

6.7 TERMINAL ARRANGMENT (Bus bar and Cable Connection)

6.7.1 Bus Duct Connection (HT Side)

Tap-off shall be taken from the main Isolated phase bus duct for Unit Auxiliaries Transformers. The bidder shall give the provision for connecting the bus duct connections on HT side of UAT-1, UAT-2 and UAT-3. For SAT, the connection on HT side shall be made through HT cable. The connection for HT side of 5 MVA SST shall be through GIB and Oil to SF6 bushing.

6.7.2 Bus bar Connections (LT Side)

The bidder shall give the provision for cable connectivity with LT panel. The Contractor shall supply a non-magnetic blank gland plate suitable for drilling on site. A separate L.V. Neutral bushing shall be provided on tank for connection to 415 V neutral with solidly earthed.

6.8 BOLTS AND NUTS

Bolts and nuts shall conform to ASTM: A193, B-7 and ASTM – A194-2H. Steel bolts and nuts exposed to atmosphere with suitable finishes like cadmium plated or zinc plated passivity shall be used for diameter above 6 mm. All bolts, nuts and washers in contact with non-ferrous parts shall, which carry current shall be of phosphor bronze, where the transfer of current is through bolts. Suitable spanners shall be provided to reach the bolts where these have been located in inaccessible position.

6.9 LABELS AND PLATES

- 1 Labels shall be provided for all apparatus such as relays, switches, fuses etc. contained in any cubicle or marshalling kiosks.
- 2 Descriptive labels for mounting indoors or inside cubicles and kiosks shall be of material that will ensure permanence of numbering. A matt or satin finish shall be provided to avoid dazzle from reflected light. Labels mounted on dark background shall have white lettering. Danger notices shall have read letters on white background.

All labels shall be of in-corrodible material and shall be attached to the panels with brass screws, which have received rust preventive treatment. If required, labels can be stuck to the panels with suitable adhesive also.

6.10 TECHNICAL PARAMETERS OF DRY TYPE TRANSFORMER

The rating and electrical characteristics of the transformers shall be as follows:

1 General

- | | | | |
|------|-----------------------------|---|-------------------------------|
| i. | Service | : | UAT-1,2 & 3, SAT 1 & 2 |
| ii. | Installation | : | Dry Cast Resin Type |
| iii. | 3 Phase Unit / Single Phase | : | Three Phase |
| iv. | Cooling | : | Natural Cooling (AN) |
| v. | Quantity | : | Three (3 UATs) & Two (2 SATs) |

2 Rating

- i. KVA Rating : 630 kVA(UAT) & 1500 kVA(SAT)
- ii. No Load Voltages
- HV winding : 11kV(UAT)/33 kV (SAT)
- LV Winding : 0.415KV
- iii. Frequency : 50Hz
- iv. Maximum Ambient Temp. : 40°C
- v. Temperature rise by resistance of winding : 70°C
- vi. Winding Connection
- i High Voltage : Delta
- ii Low Voltage : Star

3 Vector Group Reference : Dyn11

4 Protection class : IP 23

5 Approximate Overall dimension : Vender to specify

6 Approximate Weight : Vender to specify

7 System Voltage

- HV Nominal / Highest : 11/12KV(UAT) & 33/36 kV(SAT)
- LT Nominal / Highest : 0.415/0.433KV(UAT and SATs)

8 System Neutral Earthing

- HV side : NA
- LV side : Solidly Earthed

9 Maximum Losses (Inclusive of all tolerance) :
As specified at Guarantee Clause 6.12 below

- No load losses at rated voltage :
- Load Losses at principal tap rated capacity :
- Total losses :

10 Over load capacity of Transformer while Transformer is in operation continuously on full load at 40°C ambient temperature, the transformer shall be capable of delivering twice every twenty four hours either

- One hundred fifty percent of full load for fifteen minutes, or
- Two hundred percent of full load for five minutes
- Two hundred fifty percent of full load for two and half minute.

11 Excitation current:

- At 100% of rated voltage : 1.5% of rated full load Current
- At 120 % of rated voltage : 3 % of rated full load

Current

- | | | | |
|----|--|---|--|
| 12 | Basic impulse level | | |
| | - Bushing | : | 95 kV(11 kV)/ 170 kV(33 kV) |
| | - Winding | : | 75 kV (11 kV)/ 170 kV(33 kV) |
| | - LV | : | N/A |
| 13 | Power Frequency level | | |
| | - Bushing | : | 38kV(11 kV)/95 kV(33 kV) |
| | - Winding | : | 28kV(11 kV)/77 kV(33 kV) |
| | | : | |
| 14 | Percentage Impedance at 75 deg.C | : | 4 % (UAT)/ 6 %(SAT) |
| 15 | Inrush Current | : | 7 to 8 times of rated current |
| 16 | Noise level (Full load transformer noise level at 1 m from transformer). | : | As per NEMA TR1 |
| 17 | Tap Changer | | |
| | - Tapping on winding HV/LV | : | HV |
| | - Weather ON load / Off load circuit | : | Off circuit |
| | - Tap ranges | : | 2.5% (2 steps for each direction, |
| | +5 to -5 range) | : | |
| | - Capacity (Full/Reduced) | : | Full |
| | - Type of Control | : | Manual |
| 18 | Current Transformer Electrical Detail | | |
| | - Type | : | Resin cast CT (2-core) |
| | - Turn ratio | : | As per Requirement |
| | - Protection | : | PS/5P20 |
| | - Metering | : | 0.2S |
| | - Burden | : | finalized during detail design |
| | - Number of secondary winding | : | One |
| | - Location of Installation | : | Neutral Flat of LV Side |
| 19 | Terminal Arrangement | | |
| | - High Voltage (Primary) | : | Bus Duct(UAT)/Cable (SAT) |
| | - Low Voltage (Secondary) | : | Cable |
| 20 | Alarm and tripping | : | Winding Temp. Scanner will be provided which should have potential free contacts |

for alarm and trip and also
local & remote display.

6.11 TECHNICAL PARAMETERS OF OIL TYPE TRANSFORMER

6.11.1. Technical description of Station Service Transformer (5000 kVA) is as follows:

1	Rated Power	5000 KVA (3 Phase)
2	Voltage Ratio	220kV/33kV
3	Type of cooling	ONAN
4	No. of phases	3-phase
5	Frequency	50 Hz
6	No. of Windings	02 (Primary and Secondary)
7	Cooling medium	Mineral oil
8	Rated System voltage (Primary winding)	220 kV
9	Rated System voltage (Secondary winding)	33 kV
10	Highest system voltage	245 kV / 36 kV
11	Primary winding connection of transformer & system of earthing	Star connected with neutral, solidly earthed.
12	Secondary winding connection of transformer and system of earthing	Star connected with neutral, solidly earthed.
13	Connection Details	GIB connection on HV side
14	Vector Group	YNyn0
15	Temperature rise over designed ambient of 40°C	
	a) Top oil by thermometer	45°C
	b) Winding (Measured by resistance method)	50°C
16	Class of Insulation	A
17	Altitude	> 1100 m above msl.
18	Duty	Continuous
19	Insulation level	
	(i) Lightning impulse withstand voltage	• 1050 kV (HV) • 170 kV (LV)
	(ii) Power Frequency withstand voltage	• 505 KV (HV) • 77KV (LV)
20	Percentage Impedance voltage	7.0% with Tolerance as per IS/IEC
21	Tapping	Full capacity (rated MVA) taps shall be provided on Primary Winding to give a

		voltage variation of (+)5% to (-) 5% in equal steps of 2.5 % (2 steps for each direction, +5 to -5 range)
22	Type of tap changing gear on primary side gear	Off circuit Changing gear
23	Installation	Indoor installation
24	Details of Auxiliary supply	220 V DC. -15 & + 10%, and 3 phase 415 V $\pm$ 10%
25	Maximum / limiting losses for transformer (without any positive tolerance)	To be given by bidder
	➤ No load losses	
	➤ Load losses at 75°C	
26	Flux density (Tesla) at rated voltage and rated frequency	Less than 1.65
27	Type of rollers	Dismantlable flat / flanged bi-directional rollers
28	Type of Terminations	GIB at one end/Cable box at other end
29	Minimum phase to phase and phase to earth clearance in air	Not less than 2127 mm. (Altitude correction to be applied)

6.11.2. Technical description of Distribution Transformer for Penstock valve house & Barrage site is as follows:

1	Rated Power	160 KVA (3 Phase)
2	Voltage Ratio	33 kV/ 0.433kV
3	Type of cooling	ONAN
4	No. of phases	3-phase
5	Frequency	50 Hz
6	No. of Windings	02 (Primary and Secondary)
7	Cooling medium	Mineral oil
8	Rated System voltage (Primary winding)	33 kV
9	Rated System voltage (Secondary winding)	0.415 kV
10	Highest system voltage	36 kV (HV)
11	Primary winding connection of transformer & system of earthing	Delta connected (un-grounded).

12	Secondary winding connection of transformer and system of earthing	Star connected with neutral, solidly earthed.
13	Connection Details	HV: Through transformer bushing LV: 415V termination through cable
14	Vector Group	Dyn11
15	Temperature rise over designed ambient of 40°C	
	a) Top oil by thermometer	45°C
	b) Winding (Measured by resistance method)	50°C
16	Class of Insulation	A
17	Altitude	> 1100 m above msl.
18	Duty	Continuous
19	Insulation level	
	(iii) Lightning impulse withstand voltage	• 170 kV (HV) • NA (LV)
	(iv) Power Frequency withstand voltage	• 77 KV (HV) • 3.0 KV (LV)
20	Percentage Impedance voltage	4.0% with Tolerance as per IS/IEC
21	Short circuit level for 33KVSystem (Primary Delta Wdg.)	25KA
22	Tapping	Full capacity (rated MVA) taps shall be provided on Primary Winding to give a voltage variation of (+)5% to (-) 5% in equal steps of 2.5 % (2 steps for each direction, +5 to -5 range)
22	Type of tap changing gear on primary side gear	Off circuit Changing gear
23	Installation	Outdoor installation on two pole structure
24	Details of Auxiliary supply	220 V DC. -15 & + 10%, and 3 phase 415 V $\pm$ 10%
25	Maximum / limiting losses for transformer (without any positive tolerance)	As specified at Guarantee Clause 6.12 below
	➤ No load losses	
	➤ Load losses at 75°C	

6.12 GUARANTEES FOR 1500KVA (SAT), 630KVA (UAT) AND 160KVA DISTRIBUTION TRANSFORMERS:

The following parameters shall be guaranteed:

- No load losses in kilowatts at rated voltage and rated frequency without +ve tolerance.
- Load losses (Total losses minus no load losses) in kilowatts at rated output, rated voltage and rated frequency without +ve tolerance
- Maximum power in kW consumed by pumps/fans without +ve tolerance.

Maximum permissible losses for Distribution Transformers have been specified as below:

KVA	No Load Losses	Load Losses at Principal tap at 75°C	Total Losses
160KVA	0.28 kW(max.)	1.7 kW (max.)	2.38 kW (max.)
630KVA	2.0 kW(max.)	7.0 kW (max.)	9.0 kW (max.)
1500KVA	2.8 kW(max.)	14 kW (max.)	16.8 kW (max.)

Penalties shall be separately evaluated for:

- The excess of test figures of the no load losses in kilowatts over the corresponding guaranteed figures.
- The excess of the difference between the test values of the load losses in kilowatts over the corresponding guaranteed values. No tolerance shall be permitted over the test figures of the losses.
- The excess of power consumed by pumps/ fans in kW over the corresponding test values guaranteed by the Bidder

Following penalties shall be levied on the manufacturer/contractor (as the case may be) if losses measured during routine test are found to be within +2% tolerance of the losses specified above, beyond which the transformer shall be liable for rejection. No benefit shall be given for supply of transformer, with losses (measured during routine tests) less than the losses specified above.

Differential of specified losses vs Measured losses	Rate (in INR per KW) for Liquidated Damage
No load losses	Rs.10,00,000/KW
Load losses	Rs.8,00,000/KW
Auxiliary losses	Rs.8,00,000/KW

The penalties will be applied pro-rata for fraction of a kilowatt.

6.13 GUARANTEES FOR 5MVA, 220/33KV STATION SERVICE TRANSFORMER:

The following parameters shall be guaranteed:

- a) No load losses in kilowatts at rated voltage and rated frequency without +ve tolerance.
- b) Load losses (Total losses minus no load losses) in kilowatts at rated output, rated voltage and rated frequency without +ve tolerance.
- c) Maximum power in kW consumed by pumps/fans without +ve tolerance.

Penalties shall be separately evaluated for:

- a) The excess of test figures of the no load losses in kilowatts over the corresponding guaranteed figures.
- b) The excess of the difference between the test values of the load losses in kilowatts over the corresponding guaranteed values. No tolerance shall be permitted over the test figures of the losses.
- c) The excess of power consumed by pumps/fans in kW over the corresponding test values guaranteed by the Bidder.

Following penalties shall be levied on the manufacturer/contractor (as the case may be) if losses measured during routine test are found to be within +2% tolerance of the losses specified in Guaranteed Technical Particular (GTP) by the contractor, beyond which the transformer shall be liable for rejection. No benefit shall be given for supply of transformer/reactor, with losses (measured during routine tests) less than the losses specified in Guaranteed Technical Particular (GTP).

Differential of specified losses vs Measured losses	Rate (in INR per KW) for LD
No load losses	Rs.10,00,000/KW
Load losses	Rs.8,00,000/KW
Auxiliary losses	Rs.8,00,000/KW

The penalties will be applied pro-rata for fraction of a kilowatt.

For the purpose of comparison of bids, the quoted prices shall be equalized for the guaranteed transformer losses. Taking the lowest values of no-load and load losses and other losses indicated by any of the Bidders as the reference, the quoted prices of various Bidders will be loaded for excess losses (difference of guaranteed losses and the reference losses) at the half of the rate as given above for liquidated damages computation. All losses considered shall be without any +ve tolerance. For bid evaluation purpose, following table shall be considered.

Differential of specified losses vs Measured losses	Rate (in INR per KW) for loss capitalisation
No load losses	Rs.5,00,000/KW
Load losses	Rs.4,00,000/KW
Auxiliary losses	Rs.4,00,000/KW

6.14 DRAWINGS, DATA, MANUALS AND GUARANTEED PARTICULARS

6.14.1 Drawings, data and guaranteed particulars to be furnished with the Bid.

The following drawings and test reports for each item are to be supplied as part of the contract along with the Bid Document:

- (a) General outline dimensional drawings showing front and side elevation and plan of transformer and all accessories and external features, spacing of mounting, net weight and shipping weight, center of gravity. The drawing should indicate location of LV and HV terminals with respect to centre line and ground.
- (b) Foundation plan showing load details.
- (c) Detailed dimensioned drawing showing clearances.
- (d) Assembly drawings and weights of main component parts.
- (e) Shipping drawings showing dimensions and weights of each package. Arrangement for inert gas retention and monitoring and other protective arrangements during transportation. Drawings giving the design loads for foundations.
- (f) Tap changing and nameplate diagrams.
- (g) Descriptive brochures for all auxiliary equipment.
- (h) A complete Bill of Material for the equipment.
- (i) Type tests and special test reports conducted on similar transformer.

The Bidder shall submit the dimension and clearance drawings in a soft copy also. Any Bid lacking complete information in this respect is likely to be rejected.

6.14.2 Drawings, data manuals, etc. and documentation to be furnished by the Supplier after award of contract:

After award of contract, the Supplier shall supply five (5) copies of the following drawings, for approval as per agreed time schedule and shall subsequently provide ten (10) complete sets of final drawings, one of which shall be auto-positive suitable for re-production:

- (a) General outline drawing showing front and side elevation and plan of the transformer and all accessories and extreme features with details of dimensions, net and shipping weights, crane lift for un-tanking, size of lifting lugs and eyes, clearance between HV and LV terminals and ground, etc.
- (b) Foundation plan showing loading details.
- (c) Details of each type terminal connections.
- (d) Bus bar trucking details.
- (e) Name plate drawing with terminal marking and connection diagram.
- (f) Transportation dimension drawing.

- (g) Magnetizing characteristic curves of current transformers.
- (h) Efficiency Curve.
- (i) Schematic and control wiring diagram for all accessories and auxiliary equipment.
- (j) Over-fluxing withstand time characteristics of transformer.
- (k) Sectional view showing the general constructional features of the transformers, core, winding, tap changer etc.
- (l) Quality Assurance Plan
- (m) Large-scale drawings of high and low tension windings of the transformers, showing the nature and arrangement of insulation and terminal connections.
- (n) Typical Operation and Maintenance Manual supplied of the Equipment supplied by the Supplier for a Project.

Operation, maintenance and erection manuals (10 copies) shall be supplied by the manufacturer one month prior to the shipment of the transformer. The manuals shall contain all the drawings and information required for erection, operation and maintenance of the transformer. Any other drawing & document which is considered necessary by the purchaser shall also be supplied by the contractor.

Descriptive literature and data on transformers, windings, tap changing gear, temperature detector, instruments and controls, etc. shall also be supplied by the manufacturer along with the instruction manuals.

6.15 SPARE PARTS

The transformers shall be supplied with –

- (a) A full outfit of tools, spanners, jacks, special tools for assembling and dismantling the transformer, with a rack for holding them. All spanners shall be single ended and case hardened.
- (b) Spare-parts as listed in schedule of requirement and normally recommended by the manufacturer, for normal operating life of the transformers, along with their item wise prices. The manufacturer shall designate those spares, which he recommends for the first five years of operation.

6.16 TESTING OF TRANSFORMER

Each transformer shall be completely assembled and tested at the factory. Tests shall be performed in the presence of Purchaser's representative. Tests shall be performed in compliance with latest edition of IS: 11171/ IEC: 60076-11/ IS:2026-1/ IEC: 60076-1. No material shall be shipped until the test reports are duly approved by the Purchaser or his representative.

The following electrical and mechanical tests shall be carried out on the transformer unless otherwise stated in the schedule of requirements.

6.16.1 Type Tests

Transformer type tests shall include tests stated in latest issue of IS: 11171/ IEC: 60076-11/ IS:2026-1/ IEC: 60076-1. These tests shall include but may not be limited to the following:

- a) Measurement of winding resistance
- b) Voltage ratio on each tapping and check of voltage vector relationship
- c) Impedance voltage at principal tapping, short-circuit impedance and Load losses
- d) No load losses and no load current
- e) Separate-source voltage withstand
- f) Induced over voltage withstand test
- g) Lightning impulse test
- h) Temperature rise test

6.16.2 Routine tests

- 1) Transformer routine tests shall include tests stated in latest issue of IS: 11171/ IEC: 60076-11/ IS:2026-1/ IEC: 60076-1. These tests shall include but may not be limited to the following:

- a) Measurement of winding resistance
- b) Voltage ratio on each tapping and check of voltage vector relationship
- c) Impedance voltage at principal tapping, short-circuit impedance and Load losses
- d) No load losses and no load current
- e) Separate-source voltage withstand
- f) Induced over voltage withstand test

- 2) In addition to the routine tests specified above, the following routine tests shall also be made on each of the transformers:

- a) Measurement of exciting current at 100% of rated voltage.
- b) Measurement of exciting current at 120% of rated voltage.
- a) Regulation at rated load and at unity power factor, 0.8 lagging power factor and 0.8 leading power factor.

6.16.3 Special tests:

Special tests as specified in IS: 11171/ IEC: 60076-11/ IS:2026-1/ IEC: 60076-1 and mutually agreed shall also be carried out. The Bidder shall clearly state the testing facilities available with them for conducting short circuit, measurement of acoustic level, and Partial discharge and other special tests as per the standards.

Detailed test schedule and procedures shall be formulated by the vendor and submitted for purchaser's approval. Vendor shall specify the maximum allowable

tolerance against each test parameters in line with applicable standards. All the tests shall be witnessed by purchaser. Necessary modifications or corrections shall be made by the vendor in case if equipment fails to meet any requirements of the specifications.

6.16.4 Tests on associated equipments:

The test certification of associated equipments shall be provided by the manufacturer at time of the testing.

Test reports:

- i) After all tests have been completed, six certified copies of each test report shall be furnished. Each report shall supply the following information:
 - a) Complete identification data including serial number of the transformer/equipment tested. Calibrated oscillographs of impulse test shall form part of the test report.
 - b) Method of application, where applied, duration and interpretation of results for each test. Quantities corrected to 75°C shall be given.
 - c) Temperature and pressure data including ambient temperature and atmospheric pressure.
- ii) Routine test reports shall also furnish the following information:
 - a) Calculated value of regulation at unity, 0.8 lagging and 0.8 leading power factors.
 - b) Calculated values of efficiency of transformer at 50, 75 and 100 percent of rated capacity with unity and 0.8 power factor.
- iii) The Bidder shall state in his proposal the testing facilities available at his works. In case full capacity testing facilities are not available, the Bidder shall state the method proposed to be adopted so as to ascertain the transformer characteristics corresponding to full capacity testing. The Bidder shall also indicate tests recommended to be carried out at site during installation and commissioning. These tests shall be carried out by the Supplier during erection supervision.
- iv) The Purchaser and/or his representative including a third party inspection agency appointed by the Purchaser shall have the right to witness any or all tests.
- v) The Purchaser reserves the right to reject the transformer, if losses exceed the declared losses beyond tolerance limits as per IS/IEC or temperature rise in oil and of winding exceed the value specified.

6.17 SHOP INSPECTION

No equipment or material shall be dispatched to the site prior to its inspection at manufacturer's works by the **Purchaser** or his authorized representative. The **Purchaser's** representative shall have access and facilities for un-restricted inspection of manufacturer's works.

6.18 ERECTION, TESTING AND COMMISSIONING

The LT Dry Type transformers are to be installed at the location as shown in relevant drawing. The installation of the transformers includes but not limited to the following:

- Transport and unloading of the transformers from the trailer to the respective bases of the transformers..
- Welding, jointing and clamping, soldering, brazing as per drawings and as per engineering practices and Quality Assurance Plan.
- Field tests comprising Commissioning, operational or other tests as per technical provisions and/or applicable standards, whether specifically mentioned or not.
- Performance/Final acceptance tests as applicable in accordance with provisions of technical specifications.
- Corrections (if any) in erection or during assembly for the transformers shall be done as per approved drawings.
- Any other activities/services not specially mentioned in technical provisions but necessary for completeness of the Equipment, its commissioning, performance testing or sustained operation/ maintenance.
- Implementation of quality assurance plan and control of quality.

The erection agency shall be responsible to arrange all the tools and tackles necessary for the erection, testing and commissioning of the transformer. The Supplier shall submit the foundation design for the same to the Purchaser for approval.

The Contractor shall maintain at his site office up-to-date copies of all drawings. He shall also maintain continuous record of all stages of erection, test data and changes made in the drawings and supply one corrected copy to Purchaser.

6.19 OBLIGATIONS OF THE PURCHASER

The Purchaser shall not provide any lifting facility for the transformer., it shall be the responsibility of the Contractor of distribution of the circuit as per its requirement. The Purchaser shall bill the Contractor on the energy consumed by it based on the meter reading taken on the circuit provided by the Purchaser at the rate prevailing at the time of the execution of the contract.

The Purchaser shall not provide any accommodation to the Supplier or Contractor or any of its employees. However, the Purchaser shall render full assistance to them in this regard.

6.20 QUALITY ASSURANCE PROGRAM

A quality assurance program detailing specific control procedure proposed to be adopted for controlling the quality characteristics relevant to each item of equipment shall be furnished. This shall include, but not be limited to the following to ensure conformance of equipment specification and relevant Codes/Standards:

1. Inspection of incoming raw materials.
2. Tests to Verify chemical and physical properties of all materials including test certificates of bought-out items like motors, contactors, circuit breakers, instruments / gauges etc. as per relevant Indian Standards.
3. Tests during manufacture / assembly of transformer, its fittings and accessories including customer hold points etc.

Other tests shall be as part of manufacturer's standard quality assurance plan.

Annexure-2

REVISED GUARANTEE CLAUSE FOR GENERATOR TRANSFORMER (Clause no. 2.6.40 of Original PTS)

The following parameters shall be guaranteed:

- a) No load losses in kilowatts at rated voltage and rated frequency without +ve tolerance.
- b) Load losses in kilowatts at rated output, rated voltage and rated frequency without +ve tolerance.
- c) Maximum power in kW consumed by pumps/ fans (Auxiliary losses) without +ve tolerance.

Penalties shall be separately evaluated for:

- a) The excess of test figures of the no load losses in kilowatts over the corresponding guaranteed figures.
- b) The excess of the difference between the test values of the load losses in kilowatts over the corresponding guaranteed values. No tolerance shall be permitted over the test figures of the losses.
- c) The excess of power consumed by pumps/fans in kW (Auxiliary losses) over the corresponding test values guaranteed by the Bidder.

Following penalties shall be levied on the manufacturer/contractor (as the case may be) if losses measured during routine test are found to be within +2% tolerance of the losses specified in Guaranteed Technical Particular (GTP) by the contractor, beyond which the transformer shall be liable for rejection. No benefit shall be given for supply of transformer/reactor, with losses (measured during routine tests) less than the losses specified in Guaranteed Technical Particular (GTP).

Differential of specified losses vs Measured losses	Rate (in INR per KW) for LD
No load losses	Rs.10,00,000/KW
Load losses	Rs.8,00,000/KW
Auxiliary losses	Rs.8,00,000/KW

The penalties will be applied pro-rata for fraction of a kilowatt.

For the purpose of comparison of bids, the quoted prices shall be equalized for the guaranteed transformer losses. Taking the lowest values of no-load and load losses and other losses indicated by any of the Bidders as the reference, the quoted prices of various Bidders will be loaded for excess losses (difference of guaranteed losses and the reference losses) at the half rate as given above for liquidated damages computation. All losses considered shall be without any +ve tolerance.

For **bid loading** amount will be half of penalty for non-performance.

Differential of specified losses vs Measured losses	Rate (in INR per KW) for loss Capitalization
No load losses	Rs.5,00,000/KW
Load losses	Rs.4,00,000/KW
Auxiliary losses	Rs.4,00,000/KW

North Eastern Electric Power Corporation Ltd.
3X80MW Heo Hydro Electric Project
Package Electro-Mechanical Equipment

Revised Technical Data Sheet
Volume II Section-IV ; TDS-11
Generator Transformer

NORTH EASTERN ELECTRIC POWER CORPORATION LIMITED

(A Govt. of India Enterprise)

**HEO HYDROELECTRIC PROJECT (240 MW)
IN SHI YOMI DISTRICT, ARUNACHAL PRADESH**



ISO: 9001, 14001 & 45001

**TENDER DOCUMENT
(Domestic Competitive Bidding)**

**BID DOCUMENTS
FOR
TURNKEY EXECUTION**

VOLUME-II

SECTION -IV-TECHNICAL DATA SHEETS

Guaranteed and Other Technical Particulars

TDS-11 : GENERATOR TRANSFORMER

01. GENERATOR TRANSFORMER

A. Guaranteed Technical Particulars

Item No.	Parameter	Units	Contractor's Data
A.01	Generator Transformers		
1	Name of Manufacturer		
2	Applicable standards		
3	Application (Indoor/Outdoor)		
4	Type of construction		
4.A	(I) Reference ambient temperature		
	a) Maximum (°C)		
	b) Minimum (°C)		
4.B	a) Winding Hot Spot Temperature (°C)		
	b) Temperature rise in core by calculation (°C)		
5	Temp. gradient between windings and oil (°C)		
6.A	Rated Power, MVA (OFWF)		
6.B	i) Rated Voltage (HV)		
	ii) Rated Voltage (LV)		
	iii) Rated Frequency (Hz)		
	iv) Rated Load Current (A)		
7	Phases (Single/Three)		
8	Type of Cooling		
9	No load current at rated frequency		
	a) At 90% rated voltage (A)		
	b) At 100% rated voltage (A)		
	c) At 110% rated voltage (A)		
10	Magnetizing in-rush current (A)		
11	Power factor of No-load current at normal voltage, ratio and frequency		
12	Losses		
	i) Guaranteed No load loss at rated voltage and frequency	kW	
	ii) Guaranteed I ² R Loss/Cu Loss at rated current & frequency (at 75°C) at principal tap	kW	
	iv) Load Loss (Cu Loss/I ² R + Stray Loss) at rated current & frequency (at 75°C) at principal tap	kW	
	v) Guaranteed Auxiliary loss at rated voltage and frequency	kW	
	Total Losses (No load loss + Load loss+ Aux. loss) at rated load, rated voltage and rated frequency on principal tap	kW	
13	Regulation at full load at 75 °C winding temperature at:		
	a) upf		
	b) 0.8pf		

Item No.	Parameter	Units	Contractor's Data
14	Efficiency: At 100% load upf 0.8 lead 0.8 lag At 75% load upf 0.8 lead 0.8 lag At 50% load upf 0.8 lead 0.8 lag	%	
15	Load at maximum efficiency	%	
16	Fault level of system (in kA) and its duration (in sec)	kA (sec)	;
17	Calculated short Circuit current (in kA) withstand capability for 3 seconds without exceeding temperature limit (i.e. Thermal ability to withstand SC current)	kA	
18	Test current (in kA) and duration (in ms) for short Circuit current test (i.e Dynamic ability to withstand SC)	kA & msec	
19	Maximum flux density in core and yoke		
	a) At 90% Voltage (Tesla)		
	b) At 100% Voltage (Tesla)		
	c) At 110% Voltage (Tesla)		
20	Capacitance between windings and		
	a) HV Winding to earth (PF)		
	b) LV Winding to earth (PF)		
21	Power and Energy Consumption of oil pumping equipment at -if applicable		
	a) Power consumption (kW)		
	b) Energy consumed at rated load (kWh)		
	c) Energy consumed at 75% rated load(kWh)		
	d) Energy consumed at 50% rated load(kWh)		
22.	Resistance per phase at rated current and at 75 Deg C		
	a) HV Winding (ohm)		
	b) LV Winding (ohm)		
23.	Percentage Impedance voltage at 75 Deg C, at nominal tap		
24	Thermal time constant		
25	Core		
	a) Type of core (Core or Shell)		
	b) Net core area (mm ²)		
	c) Type of joint between core & yoke		
	d) Material of core laminations & grade (built or interleaved)		
	e) Thickness of stampings (mm)		
	f) Hot rolled or cold rolled sheets		
	i) % silicon contents		
	ii) Specific loss w/kg at ... °C		
	iii) BIS certified (Yes/No)		
	g) Details of oil ducts in cores		
	i) Whether in the plane or at right angles to the plane of windings		

Item No.	Parameter	Units	Contractor's Data
	ii) Across the plane of laminations		
	h) Core assembly		
	i) Whether core construction is with or without core bolts		
	ii) Insulation of core bolt		
	iii) Insulation of core bolt washers		
	iv) Insulation between core laminations		
	v) Core bolt insulation withstand voltage for 1 minute (kV r.m.s)		
	vi) Are the core bolts grounded. If so, how.		
	i) Material, thickness & Insulation of core clamping plate		
	j) Describe location/method of core grounding		
	k) Max flux density in core at rated frequency at (Wb / m ²)		
	a) 90% Voltage		
	b) 100% Voltage		
	c) 120% Voltage		
26	Winding		
	i) Type and Material		
	a) H.V.		
	b) L.V.		
	ii) Current density at rated load & conductor area		
	a) H.V.		
	i) Current density (A/mm ²)		
	ii) Conductor area (mm ²)		
	b) L.V.		
	i) Current density (A/mm ²)		
	ii) Conductor area (mm ²)		
	iii) Maximum current density under short circuit	A/mm ²	
	a) H.V.		
	b) L.V.		
	iv) Insulation graded or ungraded		
	a) H.V. winding		
	b) L.V. winding		
	v) Type of Joints in winding		
	a) H.V. winding		
	b) L.V. winding		
	vi) Type of axial coil support		
	a) H.V. winding		
	b) L.V. winding		
	vii) Type of radial coil supports		
	a) H.V. winding		
	b) L.V. winding		
	viii) Maximum allowable torque on coil clamping bolts		
	ix) a) Whether HV winding are interleaved		
	b) Whether windings are pre-shrunk		
	c) Whether adjustable coil clamps are provided for HV and LV winding		

Item No.	Parameter	Units	Contractor's Data
	d) Whether steel rings used for the windings, if so, whether they are split		
	e) Whether electro-static shields are provided to obtain uniform voltage distribution in the HV windings.		
	x) Inter turn insulation		
	a) Extreme end turn reinforcement		
	b) End turns reinforcement		
	c) Reinforcement of turns adjacent tappings		
	xi) Whether windings are varnish impregnated or merely dried under vacuum and flooded with hot dry oil		
	xii) Whether impregnated before assembly or after		
	xiii) Size of cooling ducts		
	xiv) Insulating material		
	a) Turn insulation of HV winding		
	b) Turn insulation of LV winding		
	c) Between core and lower voltage winding		
	d) Between higher and lower voltage winding		
	xv) No load current at frequency and at		
	a) 90 % Voltage		
	b) 100% Voltage		
	c) 120% Voltage		
	xvi) Magnetizing Current (A)		
	a) HV Winding		
	i) At 90% rated voltage		
	ii) At 100% rated voltage		
	iii) At 110% rated voltage		
	b) LV Winding		
	i) At 100% rated voltage		
	xvii) Leakage Reactance		
	a) HV Winding		
	b) LV Winding		
27	Press Board: i) Make ii) Type		
28	Conductor Insulating Paper i) Kraft paper ii) Thermally upgraded Kraft paper iii) Nomex		
29	Impulse volt-time characteristics of the transformer		
30	Off-circuit tap changer details		
	i) Manufacturer's name / make		
	ii) Type		
	iii) Rated Voltage		
	iv) Rated Current		
	v) No. of taps _____ ($\pm$ range)		
	vi) Step Voltage		
31	Details of Bushings		

Item No.	Parameter	Units	Contractor's Data
	a) Manufacturer,		
	i) Type,		
	ii) rated current and		
	iii) rated voltage		
	b) Name of bushing manufacturer		
	c) Standards applicable		
	d) Visible power frequency discharge voltage kV (rms)		
	e) One minute dry/wet power frequency withstand test voltage kV (rms)		
	f) Lightning impulse withstand voltage kV (peak)		
	g) Switching impulse withstand voltage kV (peak)		
	h) Noise level (db)		
	i) Radio interference voltage for each bushing (micro volt)		
	j) Partial discharge level (pc)		
	k) Creepage distance (mm)		
	l) Weight of assembled single phase bushing (kg)		
	m) Spacing between bushings on the tank (mm)		
	n) Rated short time current (kA)		
	o) Duration of short time current (Sec)		
	p) Insulation material		
	i) Solid material		
	ii) Liquid volume (l)		
	iii) Gas volume (l)		
	r) Dimensional drawing (attached)		
32	Neutral Current transformers		
	a) Name of manufacturer		
	b) Type & location		
	c) Standard to which it conforms		
	d) Frequency (Hz)		
	e) i) Rated primary current (A)		
	ii) Rated Secondary current (A)		
	f) Insulation level		
	g) Turns ratio		
	h) Number of identical core		
	i) Rated output (VA) of the core		
	j) Class of Accuracy / Protection class		
	k) Knee point voltage		
	l) Magnetizing current at knee point voltage		
	m) Secondary resistance		
33	Phase Current Transformers		HV
	a) Name of Manufacturer		
	b) Type & Location		
	c) Standard to which it conforms		
	d) Frequency (Hz)		
	e) i) Rated Primary Current		
	ii) Rated Secondary Current		
	f) Insulation level		

Item No.	Parameter	Units	Contractor's Data
	g) Turns Ratio		
	h) Number of identical cores		
	i) Rated output (VA) of the cores		
	j) Class of accuracy / Protection class		
	k) Knee point voltage		
	l) Magnetizing current at knee point voltage		
	m) Secondary resistance		
34	HV Connection Box and SF6 Insulated Transformer Termination-if applicable		
	a) Name of Manufacturer		
	b) Type		
	c) Standards to which it conforms		
	d) Frequency (Hz)		
	e) Maximum voltage (kV)		
	f) Rated current (A)		
	g) Short circuit withstand (kA-1 s)		
	h) Impulse level (kV)		
	i) SF6 concentration		
	j) SF6 pressure at 40°C (kPA)		
	k) Conductor size (mm ²)		
	l) Cable diameter range (mm)		
	m) Technical brochure		
35	Coolers / Heat exchanger-if applicable		
	a) Type and Make (Double tube/ Single tube)		
	b) Number of coolers for each transformer and capacity (kW)		
	c) Material of oil-to-water heat exchanger tubes		
	d) Total cooler losses with transformer operating at full load rating		
	e) Cooling water requirement		
	i) Flow rate at max. temperature of 30°C (L/min)		
	ii) Pressure (kPA)		
	iii) Pressure regulating arrangement		
	iv) Features offered for prevention of water ingress in oil in case of cooling tube leakage		
	v) Attach schematic drawing		
	f) Oil Pump		
	i) Capacity pump in L/min		
	ii) Rated voltage		
	iii) Speed (rpm)		
	iv) Normal load kW		
	v) Locked rotor current (A)		
	vi) Efficiency of motor at full load (%)		
	vii) Temperature rise of motor at full load (°C)		
	viii) BHP of driven motor		
	ix) Whether pumps are suitable for continuous operation at 85% of their rated voltage		
	x) Type of cooling Equipment Control		

Item No.	Parameter	Units	Contractor's Data
	xi) Temperature range over which control is adjustable		
	xii) Attach schematic drawing		
	g) Transformer loading capability in % with part of cooling tubes (at one bank) being out of circuit		
	i) 10% out circuit %		
	ii) 25% out circuit %		
	iii) 50% out of circuit %		
36	Pressure Relief device / Safety valve		
	a) Pressure at which safety valve will operate		
	b) Adjustable range for above		
	c) Opening time of valve and its characteristics		
	d) Pressure which transformer can safely withstand		
37	Temperature Indicators- Oil / Winding		
	a) Type and make		
	b) Indication range		
	c) Number of Indicators		
	d) Repeater for Control room		
	e) Setting range for alarm/trip		
	f) Pamphlets (to be attached)		
	g) Accuracy		
38	Oil / Water flow Indicators-if applicable		
	a) Type and make		
	b) Principle of operation		
	c) Flow Indication range		
	d) On/Off settings for control		
	e) Pamphlets		
39	Whether the following are designed for oil filling under full vacuum		
	a) Tank		
	b) Coolers		
	c) Conservators		
	d) Bushings		
40	Conservator		
	a) Type of conservator (attach details)		
	b) Volume between highest & lowest levels		
41	Total quantity of oil required for transformer		
	a) Including conservator and		
	b) Cooling system		
42	Quality of Oil		
	a) Governing standard		
	b) Resistivity		
	i) At 27°C (ohm-cm)		
	ii) At 90°C (ohm-cm)		
	c) Tan Delta values at 90°C		
	d) Water content threshold (ppm)		
	i) At the time of filling, sampled at room temp		

Item No.	Parameter	Units	Contractor's Data
	ii) In operation, sampled hot		
	e) Dielectric strength (Break-down voltage) kV/mm		
	f) pH Value		
42	Gas and Oil operated relay		
	a) Make and type (attach pamphlets)		
43	Type and rating of phase and neutral terminal connectors		
44	Clearances mm		
	(attach drawings showing the clearance)		
	a) L.V. Termination		
	i) Spacing of LV terminals in air		
	ii) Clearance between phases in oil		
	iii) Clearance between phase and earth in oil		
	b) HV Termination		
	i) Clearance between phases in oil		
	ii) Spacing of HV terminals in air		
	iii) Clearance between phases tank and earth in oil		
	c) Other Clearance		
	i) Clearance of neutral to earth in air		
	ii) Clearance of neutral to earth in oil		
	iii) Clearance between coils		
	iv) Clearance between core and coils		
45	Approximate weight (kg):		
	a) Core		
	b) H.V. Winding		
	c) L.V. Winding		
	d) Core and Winding		
	e) Tank and fittings with accessories		
	f) Oil required for first filling		
	g) Untanking weight (Heaviest piece)		
	h) Total weight with oil and fittings		
46	Approximate overall dimensions (mm)		
	a) Length (attach drawing)		
	b) Breadth		
	c) Height		
47	Details of tank		
	a) Type of Tank (Bell type or tank with cover)		
	b) Approximate thickness of sides mm		
	c) Approximate thickness of bottom		
	d) Approximate thickness of cover mm		
	e) Location of tank joints		
	f) Joints welded or bolted		
	g) Material of gaskets provided in tank		
	h) Vacuum pressure for which transformer is designed		
	i) Drawing Enclosed		

Item No.	Parameter	Units	Contractor's Data
48	Whether transformer is suitable for back-charge from HV side (Yes/No)		
49	Lifting Jack		
	i) Governing Standard		
	ii) No. of Jacks in one set		
	iii) Capacity (tonnes)		
	iv) Pitch (mm)		
	v) Lift (mm)		
	vi) Height in closed position (mm)		
	vii) Mean diameter of thread (mm)		
	viii) Jacks to be operated by common hydraulic package		
50	Control Cabinet		
	i) Make and type		
	ii) Class of protection		
	iii) Details of apparatus proposed to be housed in the Kiosk		
51	Marshalling Kiosk		
	i) Make and type		
	ii) Class of protection		
	iii) Details of apparatus proposed to be housed in the Kiosk		
52	Common Marshalling Box		
	i) Make and type		
	ii) Class of protection		
	iii) Details of apparatus proposed to be housed in the Box		
53	Details of anti-earthquake device provided		
54	Minimum clearance height for lifting core and winding from the tank (mm) / Minimum clearance height for lifting tank cover (mm) for bell type of transformer		
55	a) No. of. bi-directional wheels provided		
	b) Type of Flanged wheel		
	c) Spacing of wheels		
	i) Long axis mm (Gauge distance)		
	ii) Shorter axis mm (Gauge distance)		
	d) Whether grease nipples provided in the wheel		
56	Jack Support		
	Location of Jacks from C/L		
	a) Longer axis		
	b) Shorter axis		
57	Proposed method of Transportation (Detail planned route)		
58	Shipping details		
	a) Parts detached for transport		
	b) Weight of heaviest package to be transported Tons		
	c) Dimensions of largest package to be transported		
	i) Length mm		
	ii) Breadth mm		
	iii) Height mm		

Item No.	Parameter	Units	Contractor's Data
	d) Gross weight to be handled		
	e) Method of protecting transformer winding during transport		
59	Oil handling system		
	a) Make		
	b) Type		Before filtration
	c) Break-down voltage (kV)		
	d) Moisture content (PPM)		
	e) Gas content (% volume)		
	f) Acidity (mg of KOH/g of oil)		
	g) Pre-filter		
	i) Flow capacity (l/h)		
	ii) Rating (mm)		
	h) Oil inlet pump		
	i) Capacity (l/h)		
	ii) Operating pressure (bar)		
	iii) Suction (m)		
	i) Rotary oil sealed pump		
	i) Nominal pumping speed (l/m)		
	ii) Cooling		
	j) Roots pump		
	i) Nominal pumping speed (m3/h)		
	k) Attach all technical data sheets		

North Eastern Electric Power Corporation Ltd.
3X80MW Heo Hydro Electric Project
Package Electro-Mechanical Equipment

Revised Technical Data Sheet
Volume II Section-IV ; TDS-12
Distribution Transformers

NORTH EASTERN ELECTRIC POWER CORPORATION LIMITED

(A Govt. of India Enterprise)

**HEO HYDROELECTRIC PROJECT (240 MW)
IN SHI YOMI DISTRICT, ARUNACHAL PRADESH**



ISO: 9001, 14001 & 45001

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**BID DOCUMENTS
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**VOLUME-II
SECTION -IV-TECHNICAL DATA SHEETS**

Guaranteed and Other Technical Particulars

TDS-12 : DISTRIBUTION TRANSFORMERS

01. Distribution Transformers

A. (Guaranteed Technical Particulars)

Sl. No.	Description	Units	To be filled by the Tenderer			
A.01	Distribution Transformers		Dry (630 kVA)	Dry Type (1500 kVA)	Oil Type (160 kVA)	Oil Type (5 MVA)
A.	Guaranteed technical particulars					
i)	Rating	KVA				
ii)	Rated /No load voltage on principal tap	kV				
	· HV winding					
	· LV winding					
iii)	Maximum operating voltage at full load on principal tap	kV				
	· HV winding					
	· LV winding					
iv)	Voltage between phase to earth for which star point is insulated	V				
v)	Rated frequency	Hz				
vi)	No-load current at rated voltage and rated frequency at principal tap	A				
vii)	Maximum current density in winding at continuous maximum rating	A/cm ²				
	· HV winding					
	· LV winding					
viii)	Inrush current at normal voltage, frequency and power rating	A				
ix)	Maximum flux density in iron at normal voltage, frequency and power rating & 110% voltage	Weber/ Sq.m				
	· Core					
	· Yoke					
x)	Voltage regulation at full load & at	%				
	· Unity power factor					
	· 0.8 power factor (lagging)					
	· 0.8 power factor (leading)					
xi)	Percentage impedance voltage at rated power and rated voltage on	%				
	(a) Principal tap					
	(b) Min Tap(-10%)					
	(c) Max Tap (+10%)	%				
xii)	Zero sequence impedance at principal tap	Ω				

Sl. No.	Description	Units	To be filled by the Tenderer			
A.01	Distribution Transformers		Dry (630 kVA)	Dry Type (1500 kVA)	Oil Type (160 kVA)	Oil Type (5 MVA)
xiii)	X/R ratio when off-circuit tap link at rated position					
xiv)	No-load losses at rated voltages and rated frequency on principal tap	KW				
xv)	Load loss (Cu loss + Stray loss) at 75°C at principal tap rated capacity	KW				
xvi)	Auxiliary loss at 75°C at principal tap rated capacity	KW				
xvii)	Total losses (No load loss + Load loss + Aux. loss) at rated load , rated voltage and rated frequency on principal tap	KW				
xviii)	Efficiencies at rated voltage and rated frequency at tap position with maximum losses and unity power factor	%				
	a) at full load					
	b) at 75% of full load					
	c) at 50% of full load					
xix)	Over load capacity while Transformer shall be capable of operating continuously					
	· On full load at 40°C ambient temperature, the transformer shall be capable of delivering twice every twenty four hours either					
	· One hundred fifty percent of full load for fifteen minutes, or					
	· Two hundred percent of full load for five minutes					
	· Two hundred fifty percent of full load for two and half minute.					
xx)	Temperature Rise					
	· One hundred fifty percent of full load for fifteen minutes, or					
	· Two hundred percent of full load for five minutes, or					
	· Two hundred fifty percent of full load for two and half minute					
xxi)	Load at which maximum efficiency occurs	% of full load				
xxii)	Maximum efficiency	%				

Sl. No.	Description	Units	To be filled by the Tenderer			
A.01	Distribution Transformers		Dry (630 kVA)	Dry Type (1500 kVA)	Oil Type (160 kVA)	Oil Type (5 MVA)
xxiii)	Noise level at a distance of 1 metre at rated voltage on principal tap	dB				
xxiv)	Insulation class					
B.	Other technical particulars					
i)	Type of transformer					
ii)	Manufacturer					
iii)	Standards					
iv)	Number of windings					
v)	Number of phases					
vi)	Phase connections					
	· HV winding					
	· LV winding					
vii)	Vector group					
viii)	Method of neutral earthing for LV winding					
ix)	Type of cooling					
x)	Type of installation	Indoor				
2	WINDING					
A.	Guaranteed Technical Particulars					
i)	Resistance per phase at 75°C of	Ω				
	· HV winding					
	· LV winding					
ii)	Reactance per phase of	Ω				
	· HV winding					
	· LV winding					
B.	Other Technical Particulars					
i)	Type and material of windings					
	· HV winding					
	· LV winding					
ii)	Insulating materials used for					
	· HV winding					
	· LV winding					
iii)	Weight of copper required for complete transformer.	Kg				
3	Core					
	· Material for core laminations.					
	· Thickness of laminations.	mm				
	· Whether laminations are of grain oriented cold rolled silicon steel.					
	· Core joints, inter-leaved or butt joints.					

Sl. No.	Description	Units	To be filled by the Tenderer			
A.01	Distribution Transformers		Dry (630 kVA)	Dry Type (1500 kVA)	Oil Type (160 kVA)	Oil Type (5 MVA)
	· Weight of core.	Kg				
	· Insulation between core laminations.					
	· Insulation of core bolts.					
	· Insulation of core and plates.					
	· Number of limbs in the core.					
4	Enclosure					
	Material and thickness of plate for					
	i. Sides					
	ii. Bottom					
	iii. Top cover					
5	Impulse Level					
	HV	kV				
	Winding	kV				
	Support Insulator	kV				
6	Power Frequency level					
	HV	kV				
	Winding	kV				
	Support Insulator	kV				
7	Neutral CT					
	· Type					
	· Rated voltage	V				
	· Rated frequency	Hz				
	· One second dynamic short circuit current rating	kA _{peak}				
	· One second thermal short circuit current rating	kA _{peak}				
	· Number of cores					
	· Accuracy class					
	· Transformation ratio					
	· Rated output of each core at 0.8 Power factor	VA				
	· Accuracy limit factor					
	· Magnetising current					
	· Knee point voltage					
8	Tap-changer					
	· Type					
	· Location (HV side)					
	· Step voltage					
	· Number of steps					
9	Auxiliary Devices					
	· Type & manufacturer of winding temperature indicator					

Sl. No.	Description	Units	To be filled by the Tenderer			
A.01	Distribution Transformers		Dry (630 kVA)	Dry Type (1500 kVA)	Oil Type (160 kVA)	Oil Type (5 MVA)
10	Dimensions And Weight Of Transformer					
	· Transformer dimensions (complete assembly)					
	- Height (from track to highest top)					
	- Over all length					
	- Overall width					
	· Weight of complete transformer with fittings & accessories					
	· Shipping dimensions of transformer					
	- Height					
	- length					
	- width					
	· Shipping weight of transformer					