Saudi Electricity Company	الشركة السعودية للكهرباء

SEC DISTRIBUTION MATERIALS SPECIFICATION	53-SDMS-01
	DATE: 26-02-2013G

53-SDMS-01

SPECIFICATIONS FOR

POWER TRANSFORMERS FOR PRIMARY DISTRIBUTION SYSTEM

TABLE OF CONTENTS

1.0 SCOPE

2.0 CROSS REFERENCES

3.0 APPLICABLE CODES AND STANDARDS

4.0 BASIC REQUIREMENTS AND GUIDELINES

5.0 DESIGN AND CONSTRUCTION REQUIREMENTS

5.1 General
5.2 Performance Characteristics and Ratings
5.3. Construction
5.4. Tap Changer
5.5 Temperature Control Devices
5.6 Outdoor Control Cabinet
5.7 Buchholz Relay
5.8 Pressure Relief Device
5.9 Outdoor Bushings (Oil/Air)
5.10 Radiator
5.11 Fans
5.12 Oil Preservation System
5.13 Breather
5.14 Drain, Filter and Sampling Valves
5.15 Inspection Facilities
5.16 Lifting, Moving and Jacking Facilities
5.17 Ladder
5.18 Grounding
5.19 External Terminal Markings and Location
5.20 Transformer Oil
5.21 Bushing Current Transformers
5.22 Terminations
5.23 Surge Arresters
5.24 On line monitoring
5.25 Nameplate

6.0 SHIPPING

6.1 Packing
6.2 Impact Recorder

7.0 TESTS

7.1 Type (Design) Tests
7.2 Routine Tests
7.3 Special Tests

8.0 DATA SCHEDULE

1.0 SCOPE

This SEC Distribution Materials Specification (SDMS) specifies the minimum technical requirements for design, engineering, manufacture, inspection, testing and performance of outdoor, three phase, mineral oil immersed Power Transformers, intended to be used in the system of the Saudi Electricity Company, Saudi Arabia.

This SDMS does not cover Generator Transformers and associated auxiliary transformers.

2.0 CROSS REFERENCES

This Material Standard Specification shall always be read in conjunction with latest SEC General Specification No. 01-SDMS-01, titled "General Requirements for All Equipment/Materials", which shall be considered as an integral part of this SDMS.

This SDMS shall also be read in conjunction with SEC Purchase Order or Contract Schedules for project, as applicable.

3.0 APPLICABLE CODES AND STANDARDS

The latest revision/amendments of the following Codes and Standards shall be applicable for the equipment/material covered in this SDMS. In case of conflict, the vendor/manufacturer may propose equipment/material conforming to one group of Industry Codes and Standards quoted hereunder without jeopardizing the requirements of this SDMS.

3.1	IEC 61869-1	Instrument Transformers, Part 1: Current Transformers
3.2	IEC 61869-6	Instrument Transformers, Requirements for Protective Current Transformers for Transient Performance
3.3	IEC 60076	Power Transformers
3.4	IEC 60137	Insulated Bushings for Alternating Voltages above 1000V
3.5	IEC 60214-1	Tap Changers Part 1: Performance Requirements and Test Methods
3.6	IEC 60214-2	Tap Changers Part 2 : Application Guide
3.7	IEC 60507	Artificial Pollution Tests on High Voltage Insulators to be used on AC systems

3.8	IEC 60529	Degrees of Protection Provided by Enclosures (IP Code)
3.9	IEC TR60616	Terminal and Tapping Markings for Power Transformers
3.10	IEC 60076-7	Loading Guide for Oil-Immersed Power Transformers
3.11	IEEE C57.12.00	General Requirments for Liquid-Immeresed Distriution, Power and Regulating Transformers.
3.12	IEEE C57.12.10	Requirements for Transformers, 230kV and below, 833/958 through 8333/10417 kVA, Single Phase; and 750/862 through 60 000/80 000/100 000 kVA, 3-Phase without Load Tap Changing: and 3750/4687 through 60000/80000/100000 kVA with Load Tap Changing – Safety Requirement
3.13	IEEE C57.12.70	Terminal Markings and Connections for Distribution and Power Transformers
3.14	IEEE C57.12.90	Test Code for Liquid Immersed Distribution, Power and Regulating Transformers and Guide for Short Circuit Testing of Distribution and Power Transformers
3.15	IEEE C57.109	Guide for Liquid-Immersed Transformer Through-Fault-Current Duration
3.16	IEEE C57.13	Requirements for Instrument Transformers
3.17	NFPA 70	National Electrical Code
3.18	IEEE C57.19.00	General Requirements and Test Procedure for Outdoor Power Apparatus Bushings
3.19	IEEE C57.91	IEEE Loading Guide for Loading Mineral-Oil-Immersed Transformers.
3.20	NEMA-TR-1	Transformers, Regulators and Reactors.
3.21	Cigre Brochure	Mechanical Condition Assesment of Transformer # 342 (April 2008) Windings using Frequency Response Analysis

3.22 SASO/SSA 421 Testing Methods for Power Transformers

3.23 SASO/SSA 422 Power Transformers

3.24 54-TMSS-01 Mineral Insulating Oil for Electrical Apparatus

3.25 50-TMSS-01 Current Transformer (CT) up to 380kV

3.26 53-TMSS-03 Online Gas Analyzer

3.27 31-TMSS-06 Terminal Blocks

4.0 BASIC REQUIREMENTS AND GUIDELINES

4.1 General

a) All equipments shall be compact, simple for operation with highly secured performance.

b) Transformer shall be suitable to operate at ambient temperature varying from 55 °C to – 5 °C, under dusty, dry climate out door conditions as given in 01-SDMS-01.

c) All equipments shall comply to the Specifications of SEC and relevant IEC Standards.

4.2 Bid Proposal

The Manufacturer shall provide the following along with his bid proposal, in addition to the requirements stipulated in the Purchase Order or Contract documents:

(a) Scope of Equipment Supply.

(b) Data Schedule for all SEC Materials Standard Specifications (SDMS, TMSS and SMSS) as given in this SDMS shall be duly filled-in.

(c) Technical literature, brochures and list of users in the electric utility sector.

(d) Complete type test reports/certificates of all major equipment of the Power Transformers.

(e) A declaration from the Manufacturer that the bid proposal is in accordance with the technical Specifications and associated SEC, material Standard Specifications. Otherwise the Manufacturer must state clearly any exception or deviation items from SEC Standards, these guideline Specifications and drawing plans and the reasons for exceptions or deviations.

(f) All documentation relating to this project shall be in English.

4.3 Base Design Phase

The base design phase is a period of 4-6 weeks of preliminary design following the issue of Purchase Order or award of Contract.

Six (6) sets of the base design package shall be submitted to SEC for review and comments at the base design review meeting which will be held by the SEC four (4) weeks after the receipt of the base design package.

The base design document shall consist of :

a. Detailed list of equipment to be supplied.

b. Following design drawings, as a minimum, but not limited to:

- Drawing Control Sheet.
- One-Line Diagram (Main one-line diagram, AC and DC auxiliary one-line diagram, etc.)
- General arrangement of the transformer (giving details of various components)

c. Literature (specifications, manuals, brochures, drawingsand completed Data Schedules) of the following materials, as a minimum, but not limited to:

1) Power transformer with On Laod Tap Changer (Maintenance Free On load Tap Changer)
2) Relays
3) Instruments
4) Control Panels
5) CTs/PTs.

d. Following calculations and specifications, as a minimum, but not limited to:

1) Power Transformer rating with and without cooling.
2) CT and PT Sizing, including auxiliary CTs.
3) AC and DC auxiliary supply design with sizing of auxiliary transformer, batteries, chargers, etc.
4) Grounding Conductor Sizing.

e. Details of site commissioning tests to be carried out.

4.4 Design Review Drawings

Following the base design phase, other detailed/manufacturer drawings shall be submitted by the Manufacturer for approval by SEC. The list of detailed drawings to be submitted for approval shall be mutually agreed to between the Manufacturer and SEC.

4.5 Manufacturer Progress Reporting

The Manufacturer shall submit to the SEC, a monthly progress report on the manufacture of the Power Transformers.

The progress report shall include among other items:

a. Design.

b. Procurement of Components.

c. Testing and Commissioning.

d. Overall Completion.

The format shall be mutually agreed to between the Manufacturer and SEC.

4.6 Test and Inspection

All equipment and materials shall be subject to inspection and tests as required in relevant SEC Materials Standard Specification, QA/QC Procedures and applicable industry standards or as may be decided by the SEC.

All design (type) and production (routine) tests prescribed in this SDMS and relevant SEC Materials Standard Specifications shall be performed in accordance with the applicable industry standards. In lieu of actual design (type) tests, the Manufacturer

may submit complete certificate reports or tests performed previously on identical units to the SEC for review and approval during the bidding stage.

a. The Manufacturer shall submit for all major equipment a detailed testing and Inspection program of respective manufacturers to the SEC for review, at least three (3) months before the commencement of manufacturing.

b. The Manufacturer shall employ a reputable independent vendor inspection agency to witness factory tests and inspect the equipment and materials that will be purchased for the manufacture of this transformer. The Manufacturer shall submit pre-qualification documents for his proposed vendor inspection agency for approval of SEC. The Manufacturer shall provide all technical specifications to the independent vendor inspection agency. The entire test inspection report shall be submitted for acceptance by the SEC.

c. SEC will also send its employees or its inspectors to witness the factory tests and Manufacturer will bear all the expenses involved.

d. Four (4) initial sets of all factory tests reports shall be submitted by the Independent inspection agency to the SEC for review and approval. The equipment shall not be shipped ex-factory unless the test reports have been accepted, and shipping clearance is given by SEC.

e. It shall be the vendor's responsibility to obtain all the necessary Certificates of Conformity and/or other documentation required for import and/or registration of the unit.

f. The unit shall undergo the vendor's mandatory Pre-Delivery Inspection (PDI). Prior to the delivery, the PDI documents shall be forwarded to SEC for approval.

4.7 Commissioning and Site Tests

The guidelines for Commissioning Tests and Checks as per SEC Standards and Specifications witnessed by SEC personnel:

The Manufacturer shall develop detailed commissioning and equipment site tests based on the requirements of SEC Standard to be performed at a SEC station.

During or after commissioning, training shall be given to operations staff covering the Operations and Maintenance of the complete unit.

A list giving full details of the site tests, tools and equipment to be used shall be

submitted by the Manufacturer for review and acceptance by SEC, six (6) months prior to the scheduled date of tests. Scheduled dates of all field/site tests shall be submitted to SEC two (2) months prior to arrange for the REPRESENTATIVES of SEC to witness the tests.

The commissioning and equipment site testing shall be done in strict compliance with the normal work schedule of SEC i.e. 8 hours per day, 5 days per week.

4.8 Record Books

Upon completion of the manufacture, the Manufacturer shall submit eight (8) sets of record books containing the following documents as a minimum:

a) Approved design and manufacturer drawings.

b) All calculation sheets.

c) Brief technical specification of all components.

d) Operation and maintenance manual consisting of:

- Manufacturer's instructions manual applicable to each component or material.
- Manufacturer's set-up procedures, including mechanical tolerances for maintenance or repair purposes.
- Complete set of Manufacturer's drawings and catalogs with identified parts for each device and other essential information for SEC cataloging and ordering replenishment parts.

Note: All documents in item (d) shall be originals.

4.9 Spare Parts

Manufacturer shall provide recommended spare parts list required for O&M of power transformers without including as part of bid.

4.10 Warranty

A minimum warranty of twenty four (24) months shall be granted with effect from the final acceptance/commissioning date by SEC. The limits shall be those submitted with the bid and accepted by SEC.

5.0 DESIGN AND CONSTRUCTION REQUIREMENTS

5.1 General

5.1.1 The transformer shall be core type.

5.1.2 Vector group designation shall be per IEC60076.

5.1.3 The transformer shall be suitable for outdoor service.

5.2 Performance Characteristics and Ratings

5.2.1 Rating

a. Unless otherwise specified in project SOW/TS, standard power transformer capacities (MVA) and vector groups for substations shall be one of the values as given in the below table:

Substation Nominal Voltage Rating, kV	Transformer Capacity ONAN/ONAF (MVA)	Vector Group
69/13.8	20/25, 30/40	Dyn1
33/13.8 or 34.5/13.8	10, 13/20, 20/25, 25/30	Dyn1, Dyn11 YNyn0

b. The transformer shall be capable of delivering its rated power continuously with rated voltage on the secondary winding under the ambient temperature specified in 01-SDMS-01, including requirements for the higher altitude as applicable.

5.2.2 Overloading Capability

a) The power transformer shall be designed to meet the overloading requirements of the relevant IEC or IEEE Industry Standards adjusted to ambient conditions specified in 01-SDMS-01.

b) All transformer accessories (tap changer, bushings, CTs, etc.) shall be rated to carry 120% of the transformer current with tap changer on the extreme minus tap.

5.2.3 Paralleling

The transformer shall meet the requirements for parallel operation.

5.2.4 Losses

The manufacturer shall state the guaranteed transformer losses as part of the proposal for natural cooling including tolerance per IEC or IEEE standards. The guaranteed total losses shall not exceed 0.5% (Max.) of ONAN rating. The factory measured total loss values shall not exceed guaranteed values. Otherwise penalty shall be imposed per Purchase Order or Contract Schedules for loss values up to 5% above guaranteed value including tolerance. If the actual losses exceed 5% above guaranteed value, SEC shall have the right to reject the transformer.

5.2.5 Operation at Higher than Rated Voltage/Frequency

a. The transformer shall be designed for the following overfluxing requirements on any tap while carrying the rated current for that tap without exceeding the temperature rise associated with temperature rise test:

Continuous	110% of rated volts/Hz
1 minute	125% of rated volts/Hz
10 seconds	140% of rated volts/Hz

b. Over excitation curve for the transformer showing volts/Hz versus time shall be submitted.

5.2.6 Short Circuit Withstand

a. The transformer shall be designed and constructed to withstand on any tapping without damage, the thermal and mechanical effects of short-circuit in accordance with IEC 60076 or IEEE C57.12.90.

b. Evidence regarding the thermal and dynamic withstand capability shall be demonstrated either by type test reports of short circuit for transformer with same rating or by type test reports for short circuit of similar transfomer and calculations and other documents per IEC 60076-5.

5.2.7 Tertiary Winding (if applicable)

Tertiary winding shall be delta or star connected as specified in data schedule. Delta connected winding shall meet the following requirements:

a. Tertiary winding rating shall be determined by the manufacturer with alculation based on dynamic short circuit withstand capability. The rating shall be guaranteed by the manufacturer and prove the same with temperature rise test if specified in data schedule. The delta- connected winding shall have at least a short time fault power rating equal to one-third of the power rating of the secondary winding.

b. The tertiary winding shall be connected internally and all ends of the windings shall be brought outside through three fully rated bushings for connection to external circuit. The insulation level of the bushings shall match with that of the winding. Series current limiting reactor shall not be used in the tertiary winding.

c. The manufacturer shall investigate the transferred over voltage phenomenon from the HV winding to the tertiary winding and furnish calculations for sizing of the tertiary surge arresters.
As all construction factors influencing the magnitude of transferred voltage are difficult to calculate, transferred voltage shall be proved with tests if stated in the data schedule.

d. Grounding of tertiary winding shall be per clause 4.19.3.

5.2.8 Cooling

a. The transformer shall be equipped with ONAN, ONAF etc., cooling system as specified in data schedule.

b. Loss of 25% of forced air-cooling capacity shall not affect the Continuous Maximum Rating of the transformer. Heat run test shall be performed without 25% redundant cooling.

c. The start and stop impulses for fans shall be from winding temperature indicator. Sufficient temperature difference between start and stop signals shall be kept and frequent start/stop operation for small temperature differences shall be avoided.

d. Control shall be suitable for both manual and automatic operation for each group of fans and changeover from automatic to manual control shall be possible.

e. Each fan motor shall be protected by a separate MCB (up to 32A) or MCCB (above 32A) provided with thermal over load and short circuit protection. Thermal over-load protection shall be hand reset type.

f. The failure of any individual fan or failure of a pump or fan motor MCCB/MCB in off position shall initiate an alarm.

5.2.9 Noise Level and Vibration

a. Unless otherwise specified in data schedule, noise level, when measured in accordance with IEC 60076-10 or IEEE C57.12.90, shall not exceed the limits specified in NEMA TR-1.

Noise level shall be furnished for each stage of cooling. Positive tolerance on noise level is not acceptable.

b. The design and clamping of the core and windings shall be such that excessive vibrations shall not be transmitted from the magnetic circuits to the tank and accessories. The maximum limit of vibration shall be 100µm.

5.2.10 Inrush Current

Inrush harmonic contents and the duration of inrush currents for worst energization criteria shall be provided on current versus time curve for odd and even harmonics. All relevant factors such as source impedance, remanence, damping, switching instant, existence of already energized parallel transformer shall be considered.

5.3 Construction

5.3.1. Tank

a. The tank shall be of conservator type construction.

b. The tank shall be made of formed and electrically welded high strength steel-alloy plate. It shall be suitably braced to provide sufficient strength for support of internal parts and to prevent damage or distortion under

service conditions or during transport or when the complete transformer assembly filled with oil is lifted by crane or jacks.

c. The tank and accessories shall be designed to withstand:

   1. 25% higher than the maximum operating pressure i.e. pressure from the oil preservation system comprising of oil in the tank and conservator.

   2. Full vacuum.

d. If the tap changer diverter switch enclosure is inside the main tank, it shall be so designed that, in the event of full vacuum being applied in the main tank, no oil can leak from diverter switch enclosure.

e. The base of the transformer shall have adequate strength to withstand moving, shipping, handling of the transformer and supporting the weight of the transformer on a concrete foundation in service.

f. Base structural members shall be so located that the center of gravity shall not fall outside the points of support for 15 degrees tilt from the horizontal, with or without oil in the transformer.

g. Surfaces forming part of gasketted joints shall be machine finished and provided with gasket retainers and metal stops to ensure even pressure and avoid overstressing the gasket. The gasket material shall be Nitryle rubber or equivalent. The main cover design shall be such that it will prevent the accumulation of water.

h. Core and coil assembly shall not be an integral part of the main cover.

i. Transformer tank and accessories shall be designed without pockets where in gas may collect. Where pockets cannot be avoided, pipes shall be provided to vent the gas into main expansion pipe. The vent pipes shall have a minimum inside diameter of 20mm and shall be protected against mechanical damage.

j. Provision for equalizing the main tank and OLTC shall be provided by an equalizer pipe with valve. The equalizer pipe shall be tapped from the pipe of main tank just before Buchholz relay or on the top cover and connected to OLTC chamber.

k. The cover of main tank shall be welded on the top (upper part), flange type, leak free and provided with:

1. At least one hand hole for core bushing connecting

2. At least one hand hole each on the neutral bushing

3. At least one inspection manhole for tap selector side.

4. Atleast one manhole for inspection purpose of the active part (core & winding). If round, the minimum diameter of the manhole shall be 60 cm and for a rectangular manhole a minimum of 40 cm x 60cm.

5. All necessary hand holes to service the bushing connections.

6. All necessary hand holes to service the HV and LV bushing connections.

5.3.2 Core

a. Core shall be manufactured from non-aging cold rolled silicon steel laminations of high-permeability super oriented/laser-etched or high-permeability normal oriented steels.

b. Each lamination shall be covered with insulating film. Cutting of lamination shall be done in such a way that magnetic field is applied in the direction of rolling.

c. The core and its mechanical parts shall be designed to withstand forces produced during normal transportation, short-circuits and earth quakes. The design shall avoid mechanical resonances at or near multiples of the frequency of the network (60Hz).

d. Maximum flux density at 110% rated voltage shall be at least 10% below saturation flux density and the core shall be designed to exhibit linear magnetization characteristics up to 120% rated voltage.

e. The core earthing shall be brought out of the tank through insulated bushing and shall have disconnecting link with protective cover. As a second point of earth, yoke channel shall be grounded with similar construction.

f. Shall comply with requirements of IEC 60404-8-7 or equvalent standard.

5.3.3. Windings

a. The minimum winding insulation requirements shall be as per 01-SDMS-01.

b. Winding shall be Copper without microscopic burrs. Conductors shall have rounded corners and insulated with thermally upgraded paper. Clamping arrangement of windings shall not impede free circulation of oil. Windings shall be designed to reduce out of balance forces.

c. Winding conductor shall be of high conductivity, soft drawn, annealed electrolytic copper and enameled type.

5.4 Tap Changer

5.4.1 General

a. Unless otherwise specified in data schedule Tap-changer shall be operated by an AC motor driven mechanism.

b. Unless otherwise specified, the transformer shall be equipped with an On-Load Tap Changer located in the high voltage windings. The tapping power at each tap shall be equal to the rated power.

c. The step voltage for on-load tap changer shall be 1.25% unless otherwise specified in data schedule. Total number of taps and the number of positive steps and negative steps shall be as specified in data schedule.

d. The On-Load Tap Changer (OLTC) shall be in accordance with IEC 60214 or IEEE C57.12.10 with Vacuum type high speed resistor switch.

e. In conventional OLTC, diverter switch shall be housed in its own oil-tight vacuum proof compartment supplied with oil from a separate section of the main conservator tank, or from a separate conservator tank.

Complete diverter switch and tap selectors shall be capable of being withdrawn without removing upper tank cover of transformer.

f. The OLTC shall be suitable for continuous operation in conjunction with an automatic voltage regulating relay.

g. The OLTC diverter switch compartment shall be provided with the following safety features:

1. Automatically self-resetting type pressure relief device with two sets of alarm/trip contacts.

2. Oil/gas surge (pressure) relay located in the pipe leading from diverter switch oil compartment to OLTC conservator with a set of tripping contacts.

h. The OLTC Diverter Switch Oil compartment shall be fitted with two filtration valves together with the facility for sampling the oil from ground level.

i. Oil filter unit on OLTC shall be provided.

5.4.2 OLTC Control and Indication Features

OLTC shall be provided with the following control and indication:

a. Local/Remote selector switch. When the switch is put in remote position control shall be passed to remote tap changer panel. Alarm contacts shall be provided when the switch is in local position.

b. A crank for emergency hand operation of the drive mechanism.

c. Facilities for electrical “raise” and “lower” operation by control switch with intermediate off position or push buttons.

d. Mechanical tap position indictor. This shall be visible through the window of the enclosure.

e. Non-resettable operation counter to register the accumulated number of tap changing operations performed.

f. For parallel operation with similar transformer, if specified in the Data Schedule.

5.4.3 OLTC Drive mechanism and Safety Features

a. Tap changer shall be driven by a motor operated mechanism incorporating a stored energy device, which shall ensure that once a change of tap begins, it is completed and so shall ensure that the mechanism does not fail in an intermediate on loss of supply voltage to motor. The motor drive control shall follow the step by step principle to prevent runaway due to possible malfunction.

b. The emergency manual drive mechanism shall be electrically interlocked to prevent electrical operation of the motor while the hand crank is engaged.

c. Mechanically operated limit switches and mechanical stops shall be provided in the driving mechanism to prevent over-travel beyond the maximum raise and lower positions.

d. Overcurrent blocking at maximum current rating of the tap changer.

e. Electrical protection of motor and control circuits.

f. Alarm for loss of AC supply.

5.4.4 Enclosure

The control equipment and the drive mechanism shall be housed in corrosion proof cabinet made of 2mm sheet steel with hinged door with provision for padlocking. The enclosure shall be mounted on the transformer tank using anti-vibration mountings. The degree of protection shall be per 01-SDMS-01. Individual identification label on each equipment shall be provided.

5.5 Temperature Control Devices

5.5.1 Oil Temperature Indicator

a. The transformer shall be provided with dial type oil temperature indicator (O.T.I) to indicate the top oil temperature.

b. The O.T.I. shall have a dark face dial with light markings, a light colored indicating pointer and a hand resettable maximum indicating pointer. The dial marking shall be 20 to 160°C with ± 0.5% accuracy.

c. Four (4) individually adjustable sets of micro switch type contacts shall be provided for alarm and trip functions.

d. The words "Oil Temperature" shall be marked on the dial or on a suitable nameplate mounted adjacent to the indicator.

e. O.T.I shall be mounted in outdoor control cabinet, so that its dial shall be easily readable through a window by a person standing at the ground level.

5.5.2 Winding Temperature Indicator

a. Each winding of the transformer shall be provided with one (1) dedicated winding temperature indicator (W.T.I.) for indicating the winding temperature. W.T.I sensing element shall be supplied by CTs installed on the central phase bushing of each winding.

b. The W.T.I. shall have a dark face dial with light markings, a light colored indicating pointer and a hand reset maximum indicating pointer. The dial marking shall be 20 to 160°C with ± 0.5% accuracy.

c. The words “Winding Temperature” shall be marked on the dial or on a suitable nameplate, mounted adjacent to the indicator.

d. The automatic control of fans (in one or two stages) and pumps shall be accomplished by winding temperature indicator.

e. Four (4) individually adjustable sets of micro switch type contacts shall be available for the control of fans/pumps, alarm and trip functions. The contacts for the control of fans and pumps shall be wired to available terminal points for future use.

f. W.T.I shall be mounted in outdoor control cabinet, so that its dial shall be easily readable through a window by a person standing at the ground level.

5.5.3 Optical Fiber Sensors

Optical fiber sensors for direct measurement of winding hot spot temperature shall be installed. Because of fragility of sensors and optical fiber cables mechanical stresses and vibration shall be avoided during manufacturing and

in operation. For two winding transformers number of sensors shall be per the following table:

Number and phases of installation				
On Central Phase		On each lateral phase		Total
HV	LV	HV	LV	
2	2	1	1	8

5.6. Outdoor Control Cabinet

5.6.1 Control cabinet shall be tank mounted using anti-vibration mountings. Cabinet mounting height shall be such that it is readily accessible from finished ground level and the mounting height is subject to SEC approval.

5.6.2 The cabinet shall be of the outdoor type. It shall be made from 2mm sheet steel or 4mm thick anodized Aluminum and shall offer degree of protection per 01-SDMS-01. It shall have a hinged door with provision for padlocking and door switch operated interior lights.

A thermostatically controlled anti-condensation heater with overriding manual control shall be provided within the cabinet. The cabinet shall be designed for bottom entry of the external control and protection cables.

5.6.3 The outdoor control cabinet shall accommodate the following:

a. Oil and winding temperature indicators.

b. Control, protective gear and indications for the cooling apparatus including push buttons for manual operation of cooling system and auto/manual selector switches for cooling equipment.

c. All terminal connections for CTs, alarm/trip contacts of accessories, AC/DC incoming and outgoing cables, etc.

d. A gang operated switch to disconnect trip impulse emanating from transformer buchholz relay. One contact of this relay shall be wired to alarm when the switch is open.

5.6.4 All relays, switches, terminal blocks and lamps shall be identified by permanent nameplates. Plates shall be laminated, bolted type. Adhesive labels are not acceptable.

5.6.5 The door of the outdoor cabinet shall be provided with a suitable glass window through which the temperature indicators can be easily observed.

5.6.6 Wiring and Capillaries

a. Electrical connection between accessories and control cabinet shall be enclosed in metal raceways or rigid galvanized steel conduits and safely fastened to transformer tank. Wires shall be of ample size (subject to SEC approval). Steel armouring of cables is not acceptable.

b. All raceways cable fills shall be per NFPA 70. When a shielded control cable enters a control cabinet, the cable shield shall be terminated immediately on the control cabinet enclosure. Cable with extruded copper shield is preferable.

c. All CT secondary circuit wiring, external to control cabinet, shall not be smaller than 4mm2. All potential transformer wiring, external to control cabinet, shall not be smaller than 2.5mm2 copper. All wiring shall be heat resistant and flame retardant, with maximum operating temperature of 90°C, and rated 600/1000V, stranded annealed copper conductor conforming to IEC 60502. All wires shall be adequately rated for thermal withstand of the short circuit currents in accordance with back-up tripping time.

d. All control and instrumentation cables shall be properly shielded. The cable shield shall preferably be grounded.

e. All circuit wiring terminations shall be identified by a permanent marking at each termination with non adhesive ferrule or plastic sleeve marker in accordance with the connection diagram. Each end of every wiring leaving a terminal block shall be identified indicating local termination point and distant termination point. Markers shall be of material that will not deform or deteriorate, and shall withstand the specified ambient temperatures. Trip circuits shall be provided with red ferrule at the terminal block.

f. All AC circuit terminals and DC power terminals shall be fitted with non-inflammable, transparent plastic covers to prevent accidental contact with live parts. Each incoming and outgoing conductor shall be connected to an individual terminal through size 1 hooked crimps or ring type terminals. Termination of more than one conductor at one terminal point is not acceptable.

g. All cable glands used for the attachment of cables shall be metallic and not plastic.

h. All cables shall be properly bundled, clamped, or otherwise supported and protected. Stainless steel ties with epoxy coverings, suitable to bear the specified weather conditions shall be provided for the exterior cablings.

i. Additional 20% spare terminals of each category/type shall be provided on the terminal blocks adjacent to used terminals to accommodate future requirements.

j. Rigid pocket for storing the concerned circuit diagram inside the cabinet shall be provided.

k. Color coding of the wires shall be as follows:

All DC circuits:	Generally gray unless otherwise specified (Trip circuit shall be provided with Red ferrule at the terminal block).
All CT circuits:	Generally Yellow unless otherwise specified.
All PT circuits:	Generally Red unless otherwise specified.
All alarm circuits:	Blue.
All grounding conductors:	Green or Green with Yellow stripes.

AC Power Circuit:

3-phase, 4-wire	Red, Yellow, Blue, Black (Neutral)
3-phase, 3-wire	Red, Yellow, Blue
2-phase, 3-wire	Red, Yellow or White, Black (Neutral)
1-phase	Red, Black (Neutral)

l. Terminal blocks shall be per 31-TMSS-06.

m. The terminal blocks for CT secondary wiring shall be of shorting type and clearly marked to indicate the CT's phase and ratio in use. CT's shorting type terminal blocks shall provide a ground connection when CT shorting is applied. All PT circuits shall be provided with sliding link type terminal blocks.

5.7 Buchholz Relay

5.7.1 General

A two stage Buchholz relay shall be provided for the main tank and located in the pipe (with a slope of pipe not less than 1 in 12) between the transformer and conservator. It shall be equipped with two contacts, one for alarm and the other for tripping with $125V_{dc}$ rating unless specified otherwise in Data Schedules.

5.7.2. Gas Sampling Device and Test Connection

The gas release connection from the Buchholz relay shall be brought down to a gas sampling device, which shall be accessible at ground level. Gas sampling valve at the top shall be with an outlet approximately 3mm diameter and shall be suitable to take rubber tube connection. The outlet shall have a captive screwed cap. A test connection from the Buchholz relay shall be brought to the gas sampling device or may be terminated beside it. Isolating valve shall be provided in the gas sampling and test connection accessible at ground level.

5.7.3. The Buchholz relay shall be provided with reed switches (not mercury switches) only. The relay shall be insensitive to vibrations and shocks with accelerations up to 0.5g.

5.7.4. The pipes connecting the Buchholz relay shall have slide valves on the conservator side to enable dismantling of the Buchholz relay without oil leakage.

5.7.5. Mechnical test push button shall be provided.

5.8 Pressure Relief Device

Self resetting type pressure relief device shall be provided for rapid release of over pressure within the transformer, with oil collecting guard in order to direct or disperse the oil only to ground level for personnel/equipment safety. The device shall operate at a pressure less than the designed withstand pressure of the tank. The pressure relief device shall be provided with two sets of alarm/trip contacts, $125V_{dc}$ unless specified otherwise in Data Schedules.

5.9 Outdoor Bushings (Oil/Air)

5.9.1 General

Outdoor bushings for overhead terminations shall be electrical grade wet-processed porcelain, with oil impregnated paper insulation, brown in color, in accordance with relevant IEC or equivalent ANSI/IEEE Standards. Bushing shall be fitted with oil level gauge, which can be easily read from ground level. Fittings made of steel shall be galvanized.

All outdoor bushings shall withstand a washing pressure of 3500 kPa without permitting water ingress into the bushing turret and secondary terminal box of the bushing CTs.

5.9.2 Creepage and ground clearances

Outdoor bushings shall be designed to have a minimum creepage distance per 01-SDMS-01. The minimum phase to ground clearances shall be as shown in Table II. The minimum insulation levels shall be per 01-SDMS-01.

Table – II Phase to Ground Clearance

Nominal System Voltage, (kV_{rms})	Minimum Phase To Ground Clearance In Air, (mm)
13.8	200
33	400
34.5	400
69	720

5.9.3 All phase bushings for system voltages 69kV shall have a test tap brought out to a separate terminal. Power frequency withstand voltage of the tap shall be minimum 2 kV_{ac}.

5.9.4 The dimensions of 69kV bushings shall be per Figure 1 as included in this SDMS.

5.9.5 Bushings for 34.5 kV and below

a. Unless otherwise specified in data schedule 34.5 kV and below phase bushings shall be housed in a weatherproof enclosure and shall be suitable for XLPE cable terminations onto bushings inside the enclosure. The cable box for tertiary bushings shall be designed to accommodate surge arresters, if specified.

b. The bushings shall have a minimum creepage distance per 01-SDMS-01.

c. The neutral bushing shall be installed outside the enclosure.

5.10 Radiators

5.10.1 The tank shall have detachable radiators with flanged shut off valves at each end.

5.10.2 The radiator fins shall be welded with stiffening rods (horizontally and diagonally). In addition suitable ironwork shall be fitted to the radiator groups to prevent vibration during operation of the transformers.

5.10.3 The design of the radiators shall be such that dust and sand cannot accumulate and block or restrict circulation of the air.

5.10.4 Each radiator shall be provided with an air release vent and drain plug.

5.10.5 The radiators shall withstand the pressure and vacuum conditions specified for the tank.

5.10.6 Radiator interior shall be with corrosion proof painting and outer surface shall be either hot-dip galvanized or painted per 01-SDMS-01.

5.10.7 For shipping purposes, the radiator valves shall be furnished with a gasketted blanking plate.

5.11 Fans

5.11.1 The fan blades shall be provided with galvanized wire mesh guards at top and bottom with a degree of protection IP20 per IEC 60529 or equivalent. All

moving shafts and couplings shall be guarded. It shall be possible to remove a fan unit without dismantling the radiators or the supporting structures.

5.11.2 Fans shall not over hang from coolers/radiator fins. They shall be mounted on suitable structure members using anti-vibration mounts or mounted independently.

5.11.3 The cooling fans and fan blades shall be made of noncorrosive material.

5.11.4 All motors shall have degree of protection per 01-SDMS-01. Fan motors shall be mounted sufficiently above ground level for air in-take and space for maintenance. Airflow shall be vertically upward and the direction shall be marked on the fans.

5.12 Oil Preservation System

5.12.1 Transformer shall be provided with a conservator having two separate compartments or two independent conservators for the main tank oil and the OLTC diverter switch oil.

5.12.2 The conservator shall have the following accessories:

a. Drain valve for the main conservator compartment.

b. Drain valve for the OLTC diverter switch conservator compartment.

c. Shut-off valves in the pipes leading to the conservator from the main tank and OLTC diverter switch compartment.

d. Oil level indicator.

1. Individual magnetic oil level indicators with micro switch alarm contacts (mercury switches not acceptable) shall be provided in the respective conservators or conservator compartments to indicate oil level in the main tank and OLTC diverter switch compartment respectively.

2. The indicators shall have a dark face dial with light markings, a light colored indicating pointer. The diameter of the dial shall be not less than 210mm. The dial markings shall show 25°C level as well as the high and low oil levels.

3. The words "Oil Level" shall be marked on the dial or on a suitable nameplate mounted adjacent to the indicator.

4. Shall be provided with low and high level alarm and trip contacts.

5.12.3 The main tank oil conservator shall be fitted with bellows or other suitable expansion devices. The material used for these devices shall be Nitryle Rubber or better material and shall have the same service life as of the transformer. The failure of the membrane (puncture etc.) shall initiate an alarm.

5.12.4 One end of the conservator shall be removable for cleaning purposes and the drain valve shall be so situated that the conservator can be emptied completely without dismantling.

5.13 Breather

Each section of the conservator or each conservator shall be vented to the atmosphere through a silica gel or desiccant type, dehydrating breather with an oil bath. Silica gel/desiccant with blue, orange or yellow color indicator is normally acceptable. The breather shall be of adequate size. The container shall be mounted approximately 1.5m above ground level and arranged so that the tinted crystals may be easily observed and replaced.

5.14 Drain, Filter and Sampling Valves

5.14.1 The transformer shall be fitted with the following valves:

a. One drain/filter valve.

b. One filter valve.

c. Two sampling valves.

5.14.2 The drain/filter valve shall be located such that the tank can be drained completely. The size of the valve shall be 50mm diameter.

5.14.3 The filter valve shall be of 50mm diameter, and located at the top of the tank diagonally opposite to the drain/filter valve.

5.14.4 Each oil drain and filter valve, shall be provided with the following SEC standard connection fittings:

a. Coupler brass Type D-150, 1-1/2" N.P.T., Female plug connection rated 300 Psi.
b. Dust plug for coupler with retention chain, Type D-150, 1-1/2" N.P.T., Brass plug connection rated 300 Psi.

5.14.5 The sampling valves shall have 20mm diameter each and shall be located at the bottom and top of the tank. The lower sampling valve may be integrated with the drain/filter valve. The valves shall be of petcock type complete with dust cover. The valves shall be readily accessible with the transformer in service.

5.14.6 Drain/filter valve and lower sampling valve shall be provided at a minimum height of one meter from the ground level, for easy access.

5.14.7 All valves shall be made of bronze or stainless steel materials. Means shall be provided for locking valves. Each valve shall be provided with an indicator clearly showing its position.

5.15 Inspection Facilities

5.15.1 Adequate space shall be provided for inspection, testing and carrying out minor repairs in the interior of the transformer.

5.15.2 The covers shall have adequate handles to facilitate lifting.

5.16 Lifting, Moving and Jacking Facilities

5.16.1 Lifting Facilities

a. Suitable lifting arrangements for the balanced lifting of the completely assembled transformers shall be provided. The bearing surfaces of the lifting facilities shall be free from sharp edges and shall be provided with suitable hole for guying purposes.

b. Adequate lifting lugs shall be provided for untanking the core and coil assembly. Lifting eyes shall be provided for lifting the cover.

5.16.2 Moving Facilities

Transformers shall be with skid base or wheels as indicated in data schedule.

a. Transformer with wheels shall meet the following:

1. The base of the transformer shall be suitably designed to permit rolling in the directions of both centerlines of the base segments. At the base of the transformer four sets of single flanged detachable wheels with locking arrangement shall be provided.

2. The road clearance of the wheels shall be minimum 150mm and the wheels shall be set at 1435mm, 1500mm, 2000mm, or 3000mm rail gauge in the transverse direction and at 2000mm, 1500mm or 1435mm rail gauge in the longitudinal direction. The rollers shall be capable of being rotated through 90°. Width of rail shall be 100mm.

b. For transformers with skid base a set of anti-vibration pads as approved by SEC shall be provided underneath the transformer tank.

5.16.3 Jacking Facilities

Jacking pads shall be provided at each of the four corners near the extreme ends of the main tank and approximately 400mm above the lowest part of the tank. These pads shall be designed to take the complete weight of transformer with oil. Each pad shall be designed to take 50% of the total weight.

5.16.4 Safety Factor

Ultimate stress of lifting and moving facilities shall be designed for a safety factor of 5.

5.17 Ladder

Ladder shall be fixed on the transformer.

5.18 Grounding

5.18.1 The transformer shall be provided with grounding provisions near the base on two diagonally opposite sides.

5.18.2 Porcelain insulators for supporting the external grounding lead(s) to the neutral bushing shall be mounted on suitable brackets on the transformer tank.

5.18.3 One corner of the tertiary delta winding shall be grounded externally per Appendix B, IEC 60076-3.

5.18.4 Other requirements shall be per clause 12.1 of TES-P-119.10.

5.19 External Terminal Markings and Location

5.19.1 Terminal markings for three phase transformer shall be per IEC TR60616 or IEEE C57.12.70 (as specified in the data schedule) as per the following Table:

Table – III Terminal Marking

Bushings	Marking per IEC TR 60616				
	R	Y	B	N	Common Neutral
HV	1U	1V	1W	1N	N
LV	2U	2V	2W	2N	-
Tertiary	3U	3V	3W		-

5.19.2 The 1U bushing shall be located on the right hand side of the transformer when facing the primary (HV) side. The 1U , 1V and 1W terminals shall be arranged in numerical order, reading from right to left. 1N/N terminal, if applicable, shall be located on the right of 1U terminal.

The 2U terminal shall be located on the left hand side of the transformer when facing the secondary (LV) side. The 2U, 2Vand 2W terminals shall be arranged in numerical order, reading from left to right. The 2N terminal shall be located on the left of 2U terminal.

5.20 Transformer Oil

The transformer shall be filled with mineral insulating oil, which shall conform to the latest revision of 54-TMSS-01.

5.21 Bushing Current Transformers

5.21.1 Power Transformer shall be provided with Bushing type current transformers (BCTs) except one CT in series to each tertiary winding phase shall be

provided (i.e. within delta of tertiary winding). The short circuit withstand capability of BCT shall be equal to that of power transformer.

5.21.2 Secondary leads of all BCTs and tertiary deleta winding CTs shall be wired to terminal blocks with manual shorting facility in the control cabinet. The blocks shall be marked clearly to designate the BCT phase and tap number in use.

5.21.3 Magnetizing curve of each tap for all transformer CTs shall be furnished and CT parameters as per applicable standards shall be provided.

5.21.4 Bushing CTs shall be tested in situ i.e after full assembly to transformer tank to ascertain correct assembly and positioning.

5.22 Terminations

5.22.1 The terminations may be of the following types, as applicable per Data Schedule :

a. Air terminations for overhead, bus duct or XLPE cable connections with rated voltage 34.5kV and below.

b. Air/Oil/SF6 terminations for 69kV system

5.22.2 Cable Terminations

a. The cable entry shall be designed for bottom entry. Suitable metallic cable glands with shrouds shall be provided for sealing all cable entries at the enclosures.

b. Dry type cable enclosure shall be provided for rated voltage 34.5kV and below, suitable for termination of single core, copper/aluminum XLPE cable as specified in data schedule. For 69kV, cable termination shall be of air, oil or SF6 type.

c. Flexible link shall be provided between cable and bushings in LV cable box.

d. LV cable box shall be provided on the right side of transformer when facing HV GIS building. Medium voltage cable box shall be provided on the top or side of transformer as per data schedule.

e. Cable box shall be provided with pressure relief device.

5.22.3 GIS Terminations

SF_6 bushings shall be provided, if specified in Data Schedule, for GIS terminations.

5.23 Surge Arresters

If surge arresters are to be mounted on the transformer then the transformers shall be provided with mounting brackets before and adjacent to the HV outdoor air bushing connections.

5.24 Online Gas analyzer.

Online gas analyzer shall be provided per 53-TMSS-03.

5.25 Nameplate

5.25.1 The transformer shall bear a nameplate permanently and legibly marked by acid or laser etched in English per IEC 60076-1 or ANSI C57.12.00 along with the following additional information:

a. SEC Purchase Order No. or Contract No. or J.O. No.

b. 53-SDMS-01 (Latest Revision)

c. Volume of oil (liters).

d. Schematic diagram showing oil lines and valves.

e. Zero sequence impedances (HV-LV, HV-TV & LV-TV) as applicable.

5.25.2 The nameplate material shall be stainless steel and shall be firmly affixed to the tank by stainless steel screws or rivets.

5.25.3 Individual identification labels shall be provided for each equipment housed inside the OLTC enclosure.

5.25.4 Stainless steel chart plate indicating oil level versus oil temperature for main tank and OLTC shall be provided.

5.25.5 Transformer serial number shall be engraved on the body.

6.0 SHIPPING

6.1 Packing

Packing and shipping shall meet the requirements laid down in 01-SDMS-01.

6.2 Impact Recorder

6.2.1 All power transformer shall be provided with two number three dimensional Impact Recorders (one mechanical and one elctronic type) shall be provided during shipment which shall remain charged until the transformer is delivered to site.

6.2.2 The recorders shall be fixed on the top of transformer cover, shielded to prevent damage.

6.2.3 The recorder shall have a minimum time scale of 60 days. Duration of shock impulses recording shall be longer than 50 milli seconds.

The manufacturer shall state the safe limits of shock impact(s) with time duration which the transformer shall sustain without requiring any inspection against damage and furnish necessary instructions for interpretation of recorded data. In the event that the transformer is found to have been subjected to excessive shock in transit, such examination as is necessary shall be made in the presence of SEC.

6.2.4 In case Impact Recorder(s) are not installed on the transformer and/or not been functional up to the delivery to the site, or excessive acceleration above the manufacturer's guranteed value, SEC shall have the right to reject the transformer and SEC decision is final.

7.0 TESTS

All test results shall be provided for review and approval by SEC.

7.1 Type (Design) Tests

7.1.1 All type tests prescribed in the relevant IEC or equivalent ANSI standard shall be performed on the representative unit or on the first unit of every new design or rating to be supplied to SEC.

7.1.2 Temperature rise test shall be performed at each stage of cooling. Test at forced cooling rating(s) shall be carried out with 25% redundant cooling equipment not operating.

7.1.3 In lieu of actual type tests, certified test reports of type tests performed on an identical unit may be submitted to SEC for review and approval during bidding stage.

7.1.4 Low leakage flux tests shall be performed per IEC 61869-6 at all taps for class TPS CTs when the value of factor of construction $F_c \leq 1.1$.

7.1.5. Cable Boxes shall be arc proof tested for full short circuit current as specified.

7.2 Routine (Production) Tests

All routine tests prescribed in the relevant IEC or equivalent ANSI standard shall be performed on all transformers. Production tests shall be carried out against "Vendor Approved Drawings".

7.2.1 Measurment of winding resistance.

7.2.2 Maeasurment of voltage ratio and check of phase displacement.

7.2.3 Measurment of short-circuit imedance and load loss.

7.2.4 Measurment of no-load loss and current.

7.2.5 Impulse Tests

Lightning impulse test shall be carried out on all windings as a routine test on all transformers. For orders of identical type transformers with voltage rating lower than 230kV, this test shall be performed on at least one unit.

Switching impulse test shall be carried out on all transformers with a rated voltage of 300kV and above.

7.2.6 On Load Tap Changer.

All routine and type tests on on-load tap changer and drive mechanism shall be carried out in accordance with IEC 60214.

7.2.7 Check of the ratio and polarity of built in current transformers and other tests. as presecribed in IEC or ANSI/IEEE shall be carried out. The following additional tests shall be performed in accordance with IEC 61869-1/IEC661869-6 or equivalent at each tap for all CTs:

a. Turns ratio error

b. CT secondary resistance (R_{ct})

c. Excitation Characteristics

The following additional test shall be performed for CTs manufactured per IEEE/IEC:

d. Determination of knee point voltage (Vk) for class C or K CTs manufactured per IEEE C57.13.

e. Determination of excitation limiting secondary voltage (Ual) for all class TPS CTs manufactured per IEC 60044-6.

7.2.8 Check of core and frame insulation

7.2.9 Oil Leakage Test

Transformer tank and accessories shall with stand operating pressure due to oil preservation system i.e. oil in tank and conservator, plus an additional pressure of 35kPa for 24 hours. Oil leakage shall not be observed during this period. Operating pressure (kPa) due to oil preservation system shall be stated in the test report.

7.2.10 The following special tests shall be carried out on all power transformers:

a. Zero sequence impedance measurement test shall be carried out.

b. Determination of capacitances windings-to-earth and between windings.

c. Measurment of dissipation factor of the insulation system capacitances.

d. Measurment of insulation resistance tests and polarization index.

e. Measurment of dissolved gasses in dielectric lliqiud from each separate oil compartment except diverter switch compartment before and after heat run and dilectric tests.

f. Determination of transient voltage transfer characteristics (calculation only).

g. Frequency response analaysis shall be carried out both at factory and at site. Manufacturer shall submit report on the analysis for SEC review.

h. Pressure Deflection Test

Unless otherwise specified in IEC 60076-1 pressure delfection shall be carried out as follows:

Transformer tank and accessories shall withstand 25% higher than the maximum operating pressure due to oil preservation systemi.e. oil in tank and conservator, for 30 minutes. The permanent deflectionafter releasing pressure shall not exceed 0.3%.

Pressure deflection tests and deflection requirmentsupersedes the above when specified in IEC 60076-1.

i. Vacuum Deflection Test

Unless otherwise specified in IEC 60076-1 vacuum delfection shall be carried out as follows:

Completely assembled tank with its coolers, cable box, conservator and other accessories shall be subjected to full vacuum for 30 minutes. The permanent deflection, after releasing the vacuum, shall not exceed 0.3%.
Vacuum deflection tests and deflection requirment supersedes the above when specified in IEC 60076-1.

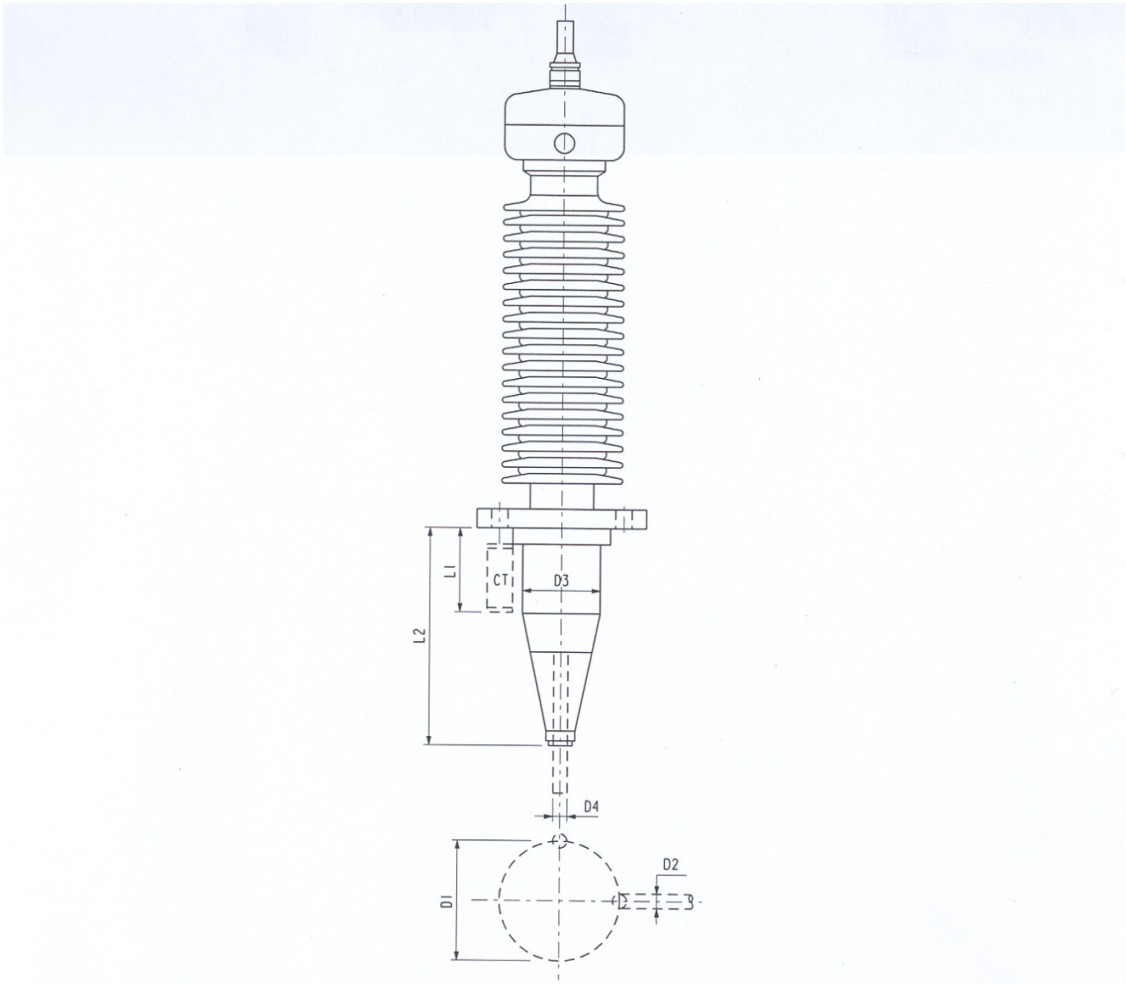
7.2.11 Special tests required per IEC/ANSI shall be carried out on one representative transformer, if specifiec in data schedule.

7.2.12 Tank Vibration Measurement

Tank vibration measurement shall be carried out on one of the transformers for each rating to be supplied to SEC. Measured vibration shall be less than 100µm.

7.3 Bushings

All routine and type tests on bushings shall be carried out in accordance with IEC 60137 or ANSI/IEEE standards.



D2 (No of Holes)	L1(max)	L2(max)	D1(max)	D3(max)	D4(max)
16 (12)	600	1000	290	200	40

Figure 1: 69kV Power Transformer Bushings

8.0 DATA SCHEDULE

POWER TRANSFORMERS FOR PRIMARY DISTRIBUTION SYSTEM

SEC Enquiry No. _____ Date: _____

SEC Purchase Order No. or Contract No. _____ Date: _____

SEC PTS No./Project Title with J.O. No. _____

REFERENCE SECTION NO.	DESCRIPTION	'A'	'B'	'C'
	Power Transformer Model No./Type No.	*		
	Type of System Grounding(Solidly grounded, resistance grounded, other)			
	HV			
	LV			
	TV (if applicable)			
3.0	Applicable Industry Standards	*		
5.0	DESIGN AND CONSTRUCTION REQUIREMENTS			
5.1	Design Ambient Temperature (ºC)	*		
	Number of Windings			
	Type of Cooling			
	Vector Group Designation			

A'- SEC SPECIFIED DATA/PARAMETER.
'B'- BIDDER/SUPPLIER/VENDOR/CONTRACTOR PROPOSED DATA/PARAMETERS.
'C'- REMARKS SUPPORTING THE PROPOSED DEVIATION IN COLUMN 'B'.
(*)- DATA/PARAMETER TO BE PROVIDED/PROPOSED BY THE BIDDER/SUPPLIER/ VENDOR/CONTRACTOR IN COLUMN 'B'.

REFERENCE

SECTION NO.	DESCRIPTION	'A'	'B'	'C'
5.2.1	Natural Cooling Rating HV/LV/TV (MVA)	/ /	/ /	/ /
	1st Stage Forced Cooling HV/LV/TV (MVA)	/ /	/ /	/ /
	2nd Stage Forced Cooling HV/LV/TV (MVA)	/ /	/ /	/ /
	Rated Voltage Transformation Ratio HV/LV/TV (kV)	/ /	/ /	/ /
	Temperature Rise Based on Ambient Temperature Conditions Specified in 01-SDMS-01			
	Winding °C	50		
	Oil °C	45		
	Winding maximum (hot spot) Temperature (°C)	98		
	Design X/R ratio			
	HV	*		
	LV	*		
	TV	*		
	Impedance Voltage at ONAN or ONAF base and reference temp. of 75°C (%) (Manufacturer shall indicate the value with applicable tolerance)			
	1. At Principal Tap (Guaranteed values) HV - LV			
	HV-TV (if applicable)	*		
	LV-TV (if applicable)	*		
	2. At Extreme Plus Tap HV - LV	*		
	HV-TV (if applicable)	*		
	LV-TV (if applicable)	*		

3. At Extreme Minus Tap			
HV - LV	*		
HV-TV (if applicable)	*		
LV-TV (if applicable)	*		
Zero-sequence impedance on ONAN base and reference temp. of 75°C (%)(Manufacturer shall indicate the value with applicable tolerance)			
1. At Principal Tap			
HV - LV	*		
HV-TV (if applicable)	*		
LV-TV (if applicable)	*		
2. At Extreme Plus Tap			
HV - LV	*		
HV-TV (if applicable)	*		
LV-TV (if applicable)	*		
3. At Extreme Minus Tap			
HV - LV	*		
HV-TV (if applicable)	*		
LV-TV (if applicable)	*		
Highest Design Operating Voltage for the tappings			
continuous operation (%)	105		
emergency operation (%)	110		
Maximum Design Flux Density			
at rated voltage (Tesla)	*		
at 110% rated voltage (Tesla)	*		
Saturation Voltage (%U_N)	*		
Current density at rated output			
Primary winding (Amp/mm^2)	*		
Secondary winding (Amp/mm^2)	*		
Tertiary winding (Amp/mm^2)	*		
No-load current when excited from LV side as			

% of full load current			
100% voltage (Guaranteed value)	*		
105% voltage	*		
110% voltage	*		
No-load current harmonics at 100% and 110% rated voltage (%)			
2nd Harmonics	*		
3rd Harmonics	*		
4th Harmonics	*		
5th Harmonics	*		
6th Harmonics	*		
7th Harmonics	*		
8th Harmonics	*		
9th Hamonics	*		
Basic Impulse Withstand Voltage (BIL)			
HV winding (kV_{peak})	*		
LV winding (kV_{peak})	*		
HV neutral end (kV_{peak})	*		
LV neutral end (kV_{peak})	*		
Common neutral for auto transformer winding (kV_{peak})	*		
Tertiary winding (kV_{peak})	*		
Tertiary neutral end (kV_{peak}) (if applicable)	*		
Switching Impulse Withstand Voltage (BSL) if applicable (kV_{peak})	*		
Separate Source Power Frequency Withstand Voltage			
HV winding (kV_{rms})	*		
LV winding (kV_{rms})	*		
HV neutral end (kV_{rms})	*		
LV neutral end (kV_{rms})	*		
Common neutral for auto transformer winding (kV_{rms})	*		

	Tertiary Winding (kVrms)	*		
	Tertiary neutral end (kV_{rms}) (if applicable)	*		
5.2.3	Requirement for parallel operation	Yes		
5.2.4	Guaranteed No-Load Losses at rated frequency (kW)			
	- at 100% rated voltage	*		
	No-Load Losses at rated frequency			
	- at 105% rated voltage	*		
	- at 110% rated voltage	*		
	Guaranteed Load Losses at 75°C at principal tappings (kW) for ONAN Rating			
	- HV to LV	*		
	Guaranteed Load Losses at 75°C at principal tappings (kW) for ONAN Rating			
	- LV to TV at TV rated power	*		
	- HV to TV at TV rated power	*		
	Guaranteed Load Losses at 75°C at principal tappings (kW) for Stage 1 Cooling Rating			
	- HV to LV	*		
	- LV to TV at TV rated power	*		
	- HV to TV at TV rated power	*		
	Guaranteed Load Losses at 75°C at principal tappings (kW) for Stage 2 Cooling Rating			
	- HV to LV	*		
	- LV to TV at TV rated power	*		

	- HV to TV at TV rated power	*		
	Load Losses at 75°C at tappings having highest losses (kW)			
	- Tap Position No.	*		
	- HV to LV	*		
	- HV to TV	*		
	Total losses of auxiliaries, pumps and fans in service at full load (kW)			
	at Stage 1 cooling	*		
	at Stage 2 cooling	*		
5.2.6	Maximum Symmetrical short circuit current for which windings are designed to thermally withstand			
	Duration (seconds)	*		
	HV winding (kA)	*		
	LV winding (kA)	*		
	TV winding (kA)	*		
	Maximum Asymmetrical short circuit current for which the windings are mechanically designed			
	HV winding (kA_{peak})	*		
	LV winding (kA_{peak})	*		
	TV winding (kA_{peak})	*		
	Thermal and mechanical damage curve per IEEE C57.109 enclosed	*	Yes/No	
5.2.7	Temperature rise test to prove tertiary winding rating required	Yes/No		
	Transferred overvoltage calculation for tertiary winding enclosed	*	Yes/No	
5.2.9	Noise level at rated voltage and			

	frequency (max)			
	- at Natural Cooling (dB)	73		
	- at Stage 1 Cooling (dB)	75		
	- at Stage 2 Cooling (dB)	75		
5.3	Construction			
5.3.1	Type of tank construction			
	Tank Cover	Welded		
	Min. thickness of tank steel (mm)			
	- Sides	*		
	- Base	*		
	- Cover	*		
	Min. Thickness of radiator plates (mm)	*		
	Maximum Positive Withstand Pressure * of Tank and Radiators (kPa)	*		
	Minimum Vacuum Withstand (milli bar)	*		
5.3.3	Winding Insulation			
	HV Winding	*	Uniform/ Graded	
	LV Winding	*	Uniform/ Graded	
	TV Winding	Uniform		
	Winding Leakage Reactance (ohm)	*		
5.4	Tap Changer	On load		
	Type	Vacuum		
	Manufacturer	*		
	Type Designation	*		
	Number of steps (17 or 12)			
	Step Voltage (1.25 or 1.43%)			
	Tapping Range (+5%/-15% or+5%/-15%)			

Rated Through Current (A)	*		
Short Circuit Current (kA)	*		
Dynamic short circuit current (kA_{peak})	*		
Location (In-tank type fitted inside transformer main tank/outside transformer main tank or External mounted type)	*		
Voltage Class (kV_{rms})	*		
BIL (kV_{peak})	*		
Type of transition impedance (high resistance)	*		
Time of transfer from one step to another			
- motor-operated (seconds)	*		
- manually operated (Number of revolution)	*		
Oil filter unit for OLTC	*		
Motor drive unit:			
Type	*		
Power	*		
Rated Voltage (V_{ac})/(V_{dc})			
Number of phases			
Control voltage (V_{ac} or V_{dc})			
Space heater (V_{ac})	400		
Heater Wattage (W)	*		
Provision of parallel operation along with Supervisory Equipment	Yes/No		
Oil/Gas Surge Relay for OLTC			
Manufacturer	*		
Type Designation	*		
Alarm Contact Current Rating at 125 or 48 V_{dc} (A)	*		

5.5.1	Oil Temperature Indicator			
	Manufacturer	*		
	Type Designation	*		
	Type of Liquid Sensing Element	*		
	Provision of maximum indicator	Yes		
	Adjustment Range of Alarm and trip contacts (From_to_°C)	20-160ºC		
	Adjustment Range of Forced cooling contacts (From_to_°C)	20-160ºC		
	Contact Current Rating at 125 or 48 V_{dc} (A)	*		
	Number of contacts	4		
5.5.2	Winding Temperature Indicator			
	Manufacturer	*		
	Type Designation	*		
	Type of Liquid Sensing Element	*		
	Provision of maximum indicator	Yes		
	Adjustment Range of Alarm and trip contacts (From_to_°C)	20-160ºC		
	Adjustment Range of Forced cooling contacts (From_to_°C)	20-160ºC		
	Contact Current Rating at 125 or 48 V_{dc} (A)	*		
	Number of contacts	4		
5.5.3	No. of sensors			
	HV Winding	4		
	LV Winding	4		
5.7	Buchholz Relay			
	Manufacturer	*		
	Type Designation	*		
	Alarm/Trip Contact Current Rating at 125 or 48 V_{dc} (A)	*		

5.8	Pressure Relief Device (Main Tank)			
	Manufacturer	*		
	Type Designation	*		
	Pressure Range for Operation (From_to_kPa)	*		
	Resealing Pressure (kPa)	*		
	Number of alarm/trip contacts	2		
	Alarm Contact Current Rating at 125 or 48 V_{dc} (A)	*		
5.9	Bushings			
	High Voltage Bushings			
	Manufacturer	*		
	Type designation	*		
	Material	*		
	Location (top, side, others)			
	Terminal take off angle (vertical, horizontal, angle)			
	Number			
	Rated Voltage (kV)			
	Rated Maximum Voltage (kV)			
	Rated current (A)	*		
	BIL (kV_{peak})	*		
	Switching Impulse Withstand Voltage, if applicable (kV_{peak})	*		
	Power Frequency Dry/Wet Withstand Voltage (kV_{rms})	*		
	Creepage distance (mm)	*		
	Cantilever strength (kN)	*		

Mounting details			
Hole circle diameter of the flange (mm)	*		
Number of bolts	*		
Hole diameter (mm)	*		
Terminal			
Type	*		
Size	*		
No. of holes, if applicable	*		
Low Voltage Bushing			
Manufacturer	*		
Type designation	*		
Material	*		
Location (top, side, others)			
Terminal take off angle (vertical, horizontal, angle)			
Number			
Rated Voltage (kV)			
Rated Maximum Voltage (kV)			
Rated current (A)	*		
BIL (kV_{peak})	*		
Power Frequency Dry/Wet Withstand Voltage (kV_{rms})	*		
Creepage distance (mm)	*		
Cantilever strength (kN)	*		
Mounting Details			
Hole circle diameter of the flange (mm)	*		
Number of bolts	*		
Hole circle diameter (mm)	*		
Terminal			
Type	*		
Size	*		
No. of holes, if applicable	*		

HV Neutral Bushing			
Manufacturer	*		
Type designation	*		
Material	*		
Location (top, side, others)			
Terminal take off angle (vertical, horizontal, angle)			
Rated Voltage (kV)	*		
Rated Maximum Voltage (kV)	*		
Rated current (A)	*		
BIL (kV_{peak})	*		
Power Frequency Dry/Wet Withstand Voltage (kV_{rms})	*		
Creepage distance (mm)	*		
Cantilever strength (kN)	*		
Mounting details			
Hole circle diameter of the flange (mm)	*		
Number of bolts	*		
Hole circle diameter (mm)	*		
Terminal			
Type	*		
Size	*		
No. of holes, if applicable	*		
LV Neutral Bushing/Common Neutral Bushing for Auto Transformer			
Manufacturer	*		
Type designation	*		
Material	*		
Location (top, side, others)			
Terminal take off angle (vertical, horizontal, angle)			
Rated Voltage (kV)	*		

Rated Maximum Voltage (kV)	*		
Rated current (A)	*		
BIL (kV_{peak})	*		
Power Frequency Dry/Wet Withstand Voltage (kV_{rms})	*		
Creepage distance (mm)	*		
Cantilever strength (kN)	*		
Mounting details			
Hole circle diameter of the flange (mm)	*		
Number of bolts	*		
Hole circle diameter (mm)	*		
Terminal			
Type	*		
Size	*		
No. of holes, if applicable	*		
Tertiary Bushing			
Manufacturer	*		
Type designation	*		
Material	*		
Location (top, side, others)			
Terminal take off angle (vertical, horizontal, angle)			
Rated Voltage (kV)			
Rated Maximum Voltage (kV)	*		
Rated current (A)	*		
BIL (kV_{peak})	*		
Power Frequency Dry/Wet Withstand Voltage (kV_{rms})	*		
Creepage distance (mm)	*		
Cantilever strength (kN)	*		
Mounting details			
Hole circle diameter of the flange (mm)	*		
Number of bolts	*		
Hole circle diameter (mm)	*		

	Terminal			
	Type	*		
	Size	*		
	No. of holes, if applicable	*		
5.11	Cooling Equipment			
	Fans			
	Number of cooling fans (main/spare)	*		
	Number of cooling fan groups	*		
	Power rating of each fan	*		
	Supply Voltage (V_{ac})	*		
	Number of phases	*		
	Number of wires	*		
	Total fan consumption at full load (kW)	*		
	Degree of protection for fan blades	*		
5.12.2	Oil Level Indicator for the Main Tank			
	Manufacturer	*		
	Type Designation	*		
	Alarm Contact Current Rating at 125 V_{dc} (A)	*		
	Oil level indicator for OLTC			
	Manufacturer	*		
	Type Designation	*		
	Alarm Contact Current rating at 125 V_{dc} (A)	*		
	Conservator Expansion Device Material	*		
5.14	Drain, Filter and Sampling Valves (attach drawing for each type of valve)			
	Type & Size of Oil Drain Valve (mm)	50		

	Type and Size of Filtration Valve (mm)	50		
	Size of Oil Sampling Valve/s (mm)	20		
	Type & Size of Radiator Valves (mm)	*		
5.16	Transformer Moving Facilities			
	Transformer Base Type	Skid/ Wheels		
	Wheel Details Wheels Center to Center Distance (1500 to 3000 transverse or 1500 to 2000mm longitudinal)	*		
5.17	Ladder	Yes		
5.19	Transformer Terminal Markings	clause 4.20/ IEC 60616		
5.20	Transformer Mineral Oil (Manufacturer shall fill up column "B' of 54-SDMS-01 Data Schedule)	*		
5.21	Bushing Current Transformer			
	High Voltage Bushing Current Transformers			
	Manufacturer	*		
	Type Designation	*		
	No. of CTs per phase			
	Continuous Thermal Current Rating Factor			
	Metering CT			
	Protection CT			
	Multi Ratio CTs (MRCT)			
	Single Ratio CTs			

Rated Short Time Withstand Current			
Thermal Ith (kA)	*		
Dynamic (kApeak)	$2.6xI_{th}$		
Short Time Thermal Current duration (sec.)			
Rated primary short circuit current I_{PSC} (kA)	*		
Temperature Rise (°C)	*		
Core No.	1 / 2 / 3	1 / 2 / 3	
Purpose (Relaying or Metering)	/ /	/ /	
Type of Protection (Back-up/differential/Distance/REF etc.)	/ /	/ /	
Current Ratio at specified tap	/ /	/ /	
Accuracy Class	/ /	/ /	
Burden (VA)/Resistive Burden-R_b (ohms)	/ /	/ /	
Secondary Winding Resistance at 20°C, R_{ct} (ohms)	/ /	/ /	
<u>For class TPS CTs per IEC</u>			
Rated symmetrical short circuit current factor -K_{SSC}	*/*/*	/ /	
Dimensioning parameter -K	*/*/*	/ /	
Excitation limiting secondary voltage -U_{al} (Volts)*	*/*/*	/ /	
Accuracy limiting secondary exciting current – I_{al} (mA)	*/*/*	/ /	
Secondary excitation current-I_{mag} at half excitation limiting secondary voltage (mA)	*/*/*	/ /	
<u>For class C or K CTs per IEEE / Class P CTs per IEC</u>			
Magnetizing current -I_{mag} (mA)	*/*/*	/ /	
Knee point voltage -V_k (Volts)/ /Secondary limiting e.m.f	*/*/*	/ /	

Low Voltage Bushing Current Transformers			
Manufacturer	*		
Type Designation	*		
No. of CTs per phase			
Continuous Thermal Current Rating Factor			
Metering CT			
Protection CT			
Multi Ratio CTs (MRCT)			
Single Ratio CTs			
Rated Short Time Withstand Current			
Thermal I_{th} (kA)	*		
Dynamic (kA_{peak})	$2.6xI_{th}$		
Short Time Thermal Current duration (sec.)			
Rated primary short circuit current			
I_{PSC} (kA)	*		
Temperature Rise (°C)	*		
Core No.	1 /2 /3	1 /2 /3	
Purpose (Relaying or Metering)	/ /	/ /	
Type of Protection (Back-up/differential/Distance/REF etc.)	/ /	/ /	
Current Ratio at specified tap	/ /	/ /	
Accuracy Class	/ /	/ /	
Burden (VA)/Resistive Burden-Rb (ohms)	/ /	/ /	
Secondary Winding Resistance at 20°C, Rct (ohms)	/ /	/ /	

For class TPS CTs per IEC			
Rated symmetrical short circuit current factor -K_{SSC}	*/ * /*	/ /	
Dimensioning parameter -K	*/ * /*	/ /	
Excitation limiting secondary voltage -U_{al} (Volts)*	*/ * /*	/ /	
Accuracy limiting secondary exciting current – I_{al} (mA)	*/ * /*	/ /	
Secondary excitation current-I_{mag} at half excitation limiting secondary voltage (mA)	*/ * /*	/ /	
For class C or K CTs per IEEE / Class P CTs per IEC		/ /	
Magnetizing current -I_{mag} (mA)	*/ * /*	/ /	
Knee point voltage -V_k (Volts)/ /Secondary limiting e.m.f	*/ * /*	/ /	
High Voltage Neutral Bushing Current Transformers			
Manufacturer	*		
Type Designation	*		
No. of CTs			
Continuous Thermal Current Rating Factor			
Protection CT			
Multi Ratio CTs (MRCT)			
Single Ratio CTs			
Rated Short Time Withstand Current			
Thermal I_{th} (kA)	*		
Dynamic (kA_{peak})	2.6xI_{th}		
Short Time Thermal Current duration (sec.)			
Rated primary short circuit current	*		

I_{PSC} (kA)			
Temperature Rise (°C)	*		
Core No.	1 / 2	1 / 2	
Type of Protection (differential/ REF etc.)	/	/	
Current Ratio at specified tap	/	/	
Accuracy Class	/	/	
Burden (VA)/Resistive Burden-R_b (ohms)	/	/	
Secondary Winding Resistance at 20°C, R_{ct} (ohms)	/	/	
<u>For class TPS CTs per IEC</u>			
Rated symmetrical short circuit current factor -K_{SSC}	*/*	/	
Dimensioning parameter -K	*/*	/	
Excitation limiting secondary voltage -U_{al} (Volts)*	*/*	/	
Accuracy limiting secondary exciting current – I_{al} (mA)	*/*	/	
Secondary excitation current-I_{mag} at half excitation limiting secondary voltage (mA)	*/*	/	
<u>For class C or K CTs per IEEE / Class P CTs per IEC</u>			
Magnetizing current -I_{mag} (mA)	*/*	/	
Knee point voltage -V_k (Volts)/ /Secondary limiting e.m.f	*/*		
Low Voltage Neutral/Common Neutral Bushing Current Transformers for Auto Transformer			
Manufacturer	*		
Type Designation	*		

No. of CTs			
Continuous Thermal Current Rating Factor			
Protection CT			
Multi Ratio CTs (MRCT)			
Single Ratio CTs			
Rated Short Time Withstand Current			
Thermal I_{th} (kA)	*		
Dynamic (kA_{peak})	$2.6xI_{th}$		
Short Time Thermal Current duration (sec.)			
Rated primary short circuit current I_{PSC} (kA)	*		
Temperature Rise (°C)	*		
Magnetizing curve enclosed	*	Yes/No	
Core No.	1 /2	1 / 2	
Type of Protection (differential/Distance/REF etc.)	/	/	
Current Ratio at specified tap	/	/	
Accuracy Class	/	/	
Burden (VA)/Resistive Burden-R_b (ohms)	/	/	
Secondary Winding Resistance at 20°C, R_{ct} (ohms)	/	/	
Temperature Rise (°C)	*		
<u>For class TPS CTs per IEC</u>			
Rated symmetrical short circuit current factor -K_{SSC}	*/*	/	
Dimensioning parameter -K	*/*	/	
Excitation limiting secondary voltage -U_{al} (Volts)*	*/*	/	

Accuracy limiting secondary exciting current – I_{al} (mA)	*/*	/	
Secondary excitation current-Imag at half excitation limiting secondary voltage (mA)	*/*	/	
For class C or K CTs per IEEE / Class P CTs per IEC			
Magnetizing current -I_{mag} (mA)	*/*	/	
Knee point voltage -V_k (Volts)/ /Secondary limiting e.m.f	*/*	/	
Tertiary Bushing Current Transformer			
Manufacturer	*		
Type Designation	*		
No. of CTs per phase			
Continuous Thermal Current Rating Factor			
Protection CT			
Multi Ratio CTs (MRCT)			
Single Ratio CTs			
Rated Short Time Withstand Current			
Thermal I_{th} (kA)	*		
Dynamic (kA_{peak})	2.6xI_{th}		
Short Time Thermal Current duration (sec.)			
Rated primary short circuit current I_{PSC} (kA)	*		
Temperature Rise (°C)	*		
Core No.	1 / 2	1 / 2	
Type of Protection (differential/ REF etc.)	/	/	
Current Ratio at specified tap	/	/	
Accuracy Class	/	/	

Burden (VA)/Resistive Burden-R_b (ohms)	/	/	
Secondary Winding Resistance at 20°C, R_{ct} (ohms)	/	/	
For class TPS CTs per IEC			
Rated symmetrical short circuit current factor -K_{SSC}	/	/	
Dimensioning parameter -K	/	/	
Excitation limiting secondary voltage -U_{al} (Volts)*	/	/	
Accuracy limiting secondary exciting current – I_{al} (mA)	/	/	
Secondary excitation current-I_{mag} at half excitation limiting secondary voltage (mA)	*/*	/	
For class C or K CTs per IEEE / Class P CTs per IEC			
Magnetizing current -I_{mag} (mA)	*/*	/	
Knee point voltage -V_k (Volts)/ /Secondary limiting e.m.f	*/*	/	
Bushing Current Transformers for W.T.I			
Manufacturer	*		
Type Designation	*		
Ratio			
HV	*		
LV	*		
TV	*		
Burden (VA)	*		
Accuracy Class	*		

5.22 Terminations

Termination for HV Winding

Open Bushings (oil/Air)	Yes/No		
Type of conductor			
Conductor material			

Conductor size (mm²)				
Cable Box				
Type of cable				
Cable size (mm²)				
Material				
Number of phase				
Method of termination (Pothead, stress cone, heat shrinkable)				
Number of terminations				
Terminal enclosure required	Yes/No			
Type (Air, Oil)				
Incoming cable take off method (Vertical, horizontal, Angle to horizontal)				
GIS (Oil/ SF_6) (For details refer to 32-TMSS-02 Data Schedule and attach relevant data)	Yes/No			
Bus Duct (If bus duct is required, full details will follow order Placement)	Yes/No			
Termination for LV winding				
Open Bushings (Air)	Yes			
Type of conductor				
Conductor material				
Conductor size (mm²)				
Cable Box				
Type of cable				
Cable size (mm²)				
Material				

	Number of phase			
	Method of termination (Pothead, stress cone, heat shrinkable)			
	Number of terminations			
	Terminal enclosure required	Yes		
	Type (Air)	Yes		
	Incoming cable take off method (Vertical, horizontal, Angle to horizontal)			
	Bus Duct (If bus duct is required, full details will follow order Placement)	Yes/No		
	Termination for Tertiary Windings			
	Open Bushings	Yes/No		
	Type of conductor			
	Conductor material			
	Conductor size (mm²)			
	Cable Box			
	Type of cable			
	Cable size (mm²)			
	Material			
	Number of phase			
	Method of termination (Pothead, stress cone, heat shrinkable)			
	Number of terminations			
	Terminal enclosure required	Yes/No		
	Type (Air, Oil)			
	Incoming cable take off method (Vertical, horizontal, Angle to horizontal)			
5.23	Surge Arresters			

	Provision for Surge Arresters mounting required (If surge arresters are required Data Schedule of 35-TMSS-03 shall be completed and attached by the specifying engineer)	Yes/No		
5.24	On line monitoring			
	On line gas analyzer	Yes		
	On line moisture analyzer	Yes		
	AUXILIARY SUPPLIES			
	Voltage for Motors and Controls (400 V_{ac}/125 or 48 V_{dc})			
	Number of phases	3		
	Number of wires	4		
	DC Voltage for Control and Protection.(125 or 48 V_{dc})			
6.0	WEIGHT AND DIMENSIONS			
	Weight of Core and Coil Assembly (kg)	*		
	Weight of Core (kg)	*		
	Weight of Copper (kg)	*		
	Weight of Oil (kg)	*		
	Total Weight (kg) with oil	*		
	without oil	*		
	Shipping Weight (kg)	*		

Volume of Oil - Main Tank (liters)	*		
Volume of Oil - Conservator (liters)	*		
Overall Dimensions of the Assembled Transformer			
Height (mm)	*		
Width (mm)	*		
Length (mm)	*		
Maximum Shipping Dimension of Transformer			
Height (mm)	*		
Width (mm)	*		
Length (mm)	*		
Shipping			
Maximum permissible acceleration during shipment in, (g)			
Lateral direction	*		
Longitudinal direction	*		
Vertical direction	*		
Maximum Guaranteed Permanent Deflection			
Under Pressure test. (mm)	*		
Under Vacuum test (mm)	*		
Transportation Limitations			
(If yes, specify the maximum			

	overall dimensions of the transformer or attach the route or profile)	*		
7.3	Special Tests List special tests that shall be required			

8.0 DATA SCHEDULE
POWER TRANSFORMERS FOR PRIMARY DISTRIBUTION SYSTEM

A. ADDITIONAL TECHNICAL INFORMATION OR FEATURES TO BE FURNISHED BY SEC:

B. ADDITIONAL SUPPLEMENTARY DATA OR FEATURES PROPOSED BY BIDDER/VENDOR/SUPPLIER/CONTRACTOR:

C. OTHER PARTICULARS TO BE FILLED UP BY BIDDER/VENDOR/SUPPLIER/ CONTRACTOR:

	Actual Manufacturer of Equipment/Material	Vendor/Supplier/ Contractor
Name of the Company Location and address		
Name and Signature of authorized representative and date		
Official Seal/Stamp of the Company & Date		