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CEB
SPECIFICATION

33/11 kV THREE PHASE 5MVA & 10MVA POWER TRANSFORMERS

CEB Approved Specification
Chairman Dist. Coordination Committee

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Contents

SPECIFICATION FOR 33/11kV THREE PHASE 5MVA & 10MVA POWER TRANSFORMERS

1.0 SCOPE

This specification covers the general requirements of design, manufacture, testing, supply and delivery of 33/11 kV three phase power transformers with following features intended to use in medium voltage distribution system of Ceylon Electricity Board.

1. 5/10 MVA, transformer with on/off load tap changer with/without cable box on 11kV side, with/without cable box on 33kV side.
2. Outdoor AVR unit
3. Remote tap change control panel for paralleling transformers

The required tap changer type and other equipment shall be indicated in the price schedule.

2.0 SYSTEM PARAMETERS

(a)	Nominal voltage	11kV	33kV
(b)	System highest voltage	12kV	36kV
(c)	System frequency	50 Hz	50 Hz
(d)	Number of phases	03	03
(e)	Method of earthing	Effectively/Non effectively earthed	Non effectively earthed
(f)	System fault level	12.5 kA	14.2 kA

3.0 SERVICE CONDITIONS

(a)	Annual average ambient temperature	30 °C
(b)	Maximum ambient temperature	40 °C
(c)	Maximum relative humidity	90%
(d)	Environmental conditions	Humid tropical climate with heavily polluted atmosphere
(e)	Operational altitude	0 – 1000m MASL (as per IEC 60076-1).
(f)	Isokeraunic (Thunder days) level	100 days
(g)	Atmospheric corrosivity category	C5 - M

4.0 APPLICABLE STANDARDS

The equipment and components supplied shall be in accordance with the latest editions of the standards specified below and amendments thereof.

(a)	IEC60076-1:2011	Power transformers - Part 1: General
(b)	IEC 60076-2:2011	Power transformers- Part 2: Temperature rise for liquid-immersed transformers
(c)	IEC 60076-3:2013	Power transformers - Part 3: Insulation levels, dielectric tests and external clearances in air
(d)	IEC 60076-5:2006	Power transformers - Part 5: Ability to withstand short circuit
(e)	IEC 60076-7:2005	Power transformers - Part 7: Loading guide for oil-immersed power transformers

(f)	IEC 60076-8:1997	Power transformers - Part 8: Application guide
(g)	IEC 60076-10:2001	Power transformers - Part 10: Determination of sound levels
(h)	IEC 60137:2008	Insulated bushings for alternating voltages above 1 000 V
(i)	IEC 60156:1995	Insulating liquids - Determination of the breakdown voltage at power frequency - Test method
(j)	IEC 60296:2020	Fluids for electrotechnical applications - Unused mineral insulating oils for transformers and switchgear
(k)	IEC 60616:1978	Terminal and tapping markings for power transformers
(l)	IEC 60815:2008	Selection and dimensioning of high-voltage insulators intended for use in polluted conditions
(m)	IEC 60214-1:2014	Tap-changers - Part 1: Performance requirements and test methods
(n)	IEC 61850:2013	Communication networks and systems for power utility automation
(o)	BS 2562:1997	Specification for cable boxes for transformers and reactors
(p)	BS EN 10025:2009	Hot rolled products of structural steels
(q)	BS EN ISO 1461:2009	Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods
(r)	BS 5493:1997	Code of practice for protective coating of iron and steel structures against corrosion
(s)	ISO 12944:2018	Paints and Varnishes
(t)	ISO/IEC 17020:2012	Conformity assessment — Requirements for the operation of various types of bodies performing inspection
(u)	ISO/IEC 17025:2017	General requirements for the competence of testing and calibration laboratories

5.0 TECHNICAL REQUIREMENTS

5.1 Medium Voltage Characteristics

(a)	Nominal voltage	11 kV	33 kV
(b)	Lightning impulse withstand voltage (peak)	95kV	170kV
(c)	One-minute power frequency withstand voltage	28kV	70kV
(d)	ON load tapping (Primary side)	+5% to -15% (in steps of 1.25%)	
(e)	OFF load tapping (Primary side)	+5% to -7.5% (in steps of 2.5%)	
(f)	Insulator creepage distance	300mm	900mm

5.2 Other Performance Characteristics

	Performance Characteristic	Transformer Capacity	
		5 MVA	10 MVA
(a)	Vector group	Dyn11	
(b)	System frequency	50Hz	
(c)	Cooling type	ONAN	
(d)	Insulation temperature class (IEC 60076).	A	
(e)	Average winding temperature rise (by resistance measurement) at steady state continuous MCR at normal ambient (30°C) under normal service condition.	55 K	
(f)	Top oil temperature rise at normal ambient (30°C) under normal service condition.	50 K	
(g)	Minimum short circuit impedance voltage at 75°C	7.0%.	8.0%.
(h)	Corrected average A-weighted sound pressure level	<68 dB	
(i)	Short time withstand current duration (Under three phase faults)	3 seconds	
(j)	No load loss and load loss (corrected at 75°C) shall be indicated by the bidder in the schedule of particulars. Such indicated values (which will be guaranteed by the bidder) will be considered for the evaluation. However, the total loss of the transformer at 60% of CMR shall be less than 0.5%.		

5.3 Evaluation of Losses

The Bidder shall state in the Guaranteed Technical Particulars, values for component losses of the total loss which shall be as low as is consistent with transport restrictions, reliability and economic use of materials.

Bids will be assessed on the basis of the least 'Present Worth' of capital cost plus guaranteed losses, being the sum of the installed bid Price of the transformers plus:

Sri Lanka Rupees per kW of guaranteed loss		
No load loss	Load loss at CMR	Auxiliary Loss (for transformers with OLTC) at CMR
2,156,377	1,154,493	600,559

The acceptance of transformers yielding component losses higher than the guaranteed values shall be governed by either of the following: -

(A) Component losses in excess of guaranteed values but within the tolerance permitted under IEC 60076 Part 1. Transformers shall be accepted subject to full compliance with all technical particulars including temperature rises at CMR and subject to the Bidder accepting deduction from the Contract Price of charges for each kW on part thereof of component losses in excess of the guaranteed values, at the above evaluation rates.

(B) Component losses in excess of guaranteed values and exceeding the tolerance permitted under IEC 60076 Part 1.

The acceptance of transformers shall be entirely at the discretion of the CEB and subject to the Bidder accepting the deduction from the Contract Price of charges for component losses in excess of the guaranteed values, at the above loss evaluation rates, for each kW on part thereof.

In the event of transformers, which are, either equal to or below the guaranteed losses values, the Bidder will not be entitled to any premium in respect of reduction in losses below the guaranteed values.

6.0 BASIC FEATURES FOR ALL TRANSFORMER TYPES

The transformers shall be 3 phase oil immersed type suitable for outdoor installation. They shall be rated at the normal service conditions stipulated in clause 4.2 of IEC 60076-1 and shall conform to technical specifications given in this document.

They shall comply with the requirements of IEC 60076 as regards to temperature rise and overloads on all tapings and with the voltage of the secondary winding at the specified nominal voltage.

6.1 General Design of the Equipment

6.1.1 The transformers shall be double-wound, mineral oil immersed naturally cooled (ONAN) as per IEC 60076 and shall have a base (Skid) suitable for plinth mounting application.

6.1.2 No material which can be deleteriously affected by the action of oil under the operating conditions of the transformers shall be used in the transformers or leads or bushings.

6.1.3 Construction features shall permit repairs to be easily carried out at site.

6.1.4 Drying shall be carried out by vapor phase treatment or vacuum oven drying to ensure that the core coil assembly moisture content is less than 0.5%. Documentary evidence shall be provided with the offer to confirm this.

6.1.5 Transformers supplied under this specification shall be designed to operate in parallel satisfactorily with the others when operating on the same tap position.

6.2 Magnetic Circuit and Windings

6.2.1 The core shall be of high grade non ageing cold rolled grain-oriented silicon steel laminations and securely clamped. The transformer core shall be of three limbs stacked core type with designed magnetic flux density of 1.6T at rated voltage and frequency at nominal tap position.

6.2.2 The primary and secondary windings shall be constructed from high conductivity E.C. grade

copper. All turns of windings shall be adequately supported to prevent movement.

6.2.3 The core and coil assembly shall be a standard design of the manufacturer with proven records for withstanding short circuit forces. The core/coil assembly shall be mounted on the cover plate so that the assembly could be removed from the tank using the suitably placed lugs provided on the cover plate. All metal parts of the transformer with the exception of the individual core laminations, shall be maintained at same fixed potential.

6.2.4 To ensure that the core and coils of transformers are seated on the floor of the tank, supporting frames shall be designed to accommodate variations in tank height. The core and coil assembly shall be rigidly connected to the tank and suitably closed lugs shall be provided for removing the core and coil assembly from the tank.

6.2.5 The magnetic circuit shall be insulated from all structural parts and shall be capable of withstanding a test voltage to core bolts and to the frame of 2,500 Volts of RMS power frequency voltage for one minute.

6.2.6 Winding temperature indicator shall be provided, fixed to the transformer.

6.3 Transformer Tank

6.3.1 Each transformer shall be enclosed in a suitable stiffened welded steel tanks such that the transformer can be lifted and transported without permanent deformation or oil leakage. The construction shall employ weldable mild steel comply with BS EN 10025 and shall be of sufficient strength and rigidity to withstand moving, shipping and handling without deformation.

6.3.2 Lifting lugs shall be provided, suitable for the weight of the transformer, including core and windings, fittings, and with the tank filled with oil. The lifting lugs shall be positioned such that the tensioned lifting ropes shall not damage any part of the transformer. Each tank shall be provided with jacking pads suitably positioned for transport.

6.3.3 Skid type bases shall have the plates of following minimum thickness: -

Length of Transformer	Minimum Thickness	
	Side Plates	Bottom Plates
Less than 2,500 mm	6 mm	9 mm
Greater than 2,500 mm	9 mm	12 mm

6.3.4 The base of each tank shall be so designed that it is possible to move the complete transformer without damage when using rollers, plates, or rails. Detachable wheels shall be provided which can enable longitudinal and lateral movements. They shall not be fixed directly to the transformer base.

6.3.5 All joints other than those, which may have to be opened, shall be welded. Caulking of defective welded joints may be re-welded subject to the written approval of the CEB's Representative.

The quality of the welded joints is considered established, only if the joints do not exhibit any oil leakage or sweating/leakage for a continuous period of at least 3 months during the guaranteed period. In case of sweating/leakage are observed, supplier shall rectify the same and established for a further period of 3 months of the same. If it is not established during the

guaranteed period, the guarantee period shall be extended until the performance is established.

6.3.6 The tank and cover shall be designed in such a manner as to leave no external pockets in which water can lodge, no internal pockets in which oil can remain when draining the tank or in which air can be trapped when filling the tank, and to provide easy access to all external surfaces for painting.

6.3.7 Radiators provided shall be detachable panel type and connected to the main tank through flanged valves mounted on the tank at top and bottom and each bank shall be fitted with drain valve and air release plug.

Design shall ensure adequate thermal head for circulation of oil to achieve ONAN cooling of the transformer.

6.3.8 Each tank cover shall be of adequate thickness and strength, must not distort when lifted and shall be provided with suitable flanges having sufficient and properly spaced bolts. Inspection openings shall be provided to give access to the internal connections of bushings, winding connections and earthing links. Each opening shall be correctly located and must be of ample size for the purpose of which it is intended. All inspection covers shall be provided with lifting handles.

6.3.9 It must be possible to remove any bushing without removing the tank cover.

6.3.10 Pockets shall be provided for a stem type thermometer and for the bulbs of temperature indicators where specified. These pockets shall be located in the position of maximum oil temperature and it must be possible to remove any bulb without lowering the oil level in the tank. Captive screwed caps shall be provided to prevent the ingress of water to the thermometer pockets when they are not in use.

6.3.11 All nuts and bolts used shall be hot dip galvanized and spaced at sufficiently close intervals to avoid buckling of either flange or covers and shall provide reasonably uniform compression of the gasket.

6.3.12 The transformer tank shall be capable of withstanding, without permanent deflection, a vacuum of 2 millibar pressure when empty of oil or the vacuum required by the recommended drying–out procedure , whichever is the greater.

6.4 Conservator Tanks and Breather

6.4.1 The transformer shall be provided with overhead Conservator Tank, connected to the main tank as well as the tap changer tank at the highest point to prevent the trapping air or gas under the main tank cover.

6.4.2 The capacity of the conservator tank shall be adequate for the expansion and contraction of oil in the whole system under specified operating conditions. Conservator tank capacity shall be adequate for expansion of oil from minimum ambient temperature to at least 100°C.

6.4.3 Bolted end plate for internal cleaning, filling cap, drain valve with captive cap, and oil level indicator with minimum and maximum markings shall be provided. Valves shall be provided at the conservator to cutoff the oil supply to the transformer tank as well as tap-changer tank.

6.4.4 The conservator shall be provided with an oil seal type Silica gel breather, mounted at a height

not exceeding 1.4m above ground level. Conservator tank shall preferably be sealed from the outside atmosphere using a diaphragm.

6.5 Valves

6.5.1 The transformer shall be fitted with necessary valves at the following locations for filling, draining, filtering, conservator isolation etc. Valves provided for filling, draining and filtering shall be of 50mm bore diameter and blank flanges, plate or captive screw caps shall be fitted to all valves and pipe ends not normally connected in service.

a) Filter Valves located near to the bottom and the top of the main tank
b) Conservator Tank (Drain Valve)
c) Conservator Tank (Filling Valve)
d) Main Tank-Conservator Tank connecting pipe (Stop valve on each side of gas-actuated relay)
e) Drain Valve for each radiator
f) Two sampling valves for the main tank. (Top and Bottom oil)

In case of Transformers with OLTC

a) Tap-changer and Diverter Switch Tank (Drain Valve with oil sampling facility& Filter Valve)
b) Tap Changer Tank – Conservator Tank connecting Pipe (Stop Valve on each side of gas actuated relay)

6.5.2 All valves shall be made of gunmetal. They shall be of the sluice type having non-rising spindles and shall be closed by turning the hand wheel in a clockwise direction. Each valve shall be provided with an indicator to show clearly the position of the valve and also a name plate to indicate the purpose of the valve.

6.5.3 The valves shall have machined flanges and equipped with locking pins for locking in the closed / open position. Blank Flange plates or captive screw caps shall be fitted to all valves.

6.6 Oil Level Indicator

6.6.1 Oil Level Indicator of the magnetic type shall be fitted to the conservator tank to show the oil level at all temperature likely to be experienced in service. It shall be marked with normal level at 30 °C clearly visible from normal access level.

6.7 Pressure Relief Device

6.7.1 An approved pressure relief device of suitable size shall be mounted on the tank cover (with a skirt to protrude at least 2.5mm in to the tank to prevent gas accumulation) for the rapid release of any pressure that may be generated in the tank. A normally open signaling contact shall be provided to trip the transformer in case of activation of this device.

6.7.2 The device shall be capable of maintaining the oil tightness of the transformer under all conditions of normal service. It shall prevent the ingress of rain/moisture or oil flow from the transformer after the operation of the device to relieve an internally generated pressure.

6.8 Oil Temperature Indicator and Alarm Devices

6.8.1 Oil Temperature Indicator and Alarm Devices of approved design shall be provided to indicate the hottest oil temperature. Full detail of the method of operation of the devices shall be furnished.

6.8.2 The devices shall have a dial type and, in addition, a pointer/indicator to register the highest temperature reached, which shall be re-settable. They shall be housed in a lockable marshalling kiosk with Ingress Protection rating of IP 55. This marshalling kiosk shall be provided for connection of alarms and indications. All wiring shall be terminated on standard DIN rail terminals and labeled with non-ferrous labels. The marshalling box shall contain vertically hinged doors, a thermostatically controlled anti-condensation heater, a door operated light and a General-Purpose Outlet (GPO) protected by RCD.

6.8.3 Two separate contacts shall be provided, one to initiate an alarm and other to trip the associated circuit breaker.

6.8.4 The tripping contacts of the oil temperature indicator shall be adjustable to close between 60°C to 120°C and to re-open when the temperature has fallen by not more than 10 °C.

6.8.5 The alarm contacts of the oil temperature indicator shall be adjustable to close between 50 °C to 100 °C and to reopen when the temperature has fallen by a desired amount between 15 °C to 30 °C.

6.9 Gas and oil-Activated Relays

6.9.1 Gas and oil activated Relays (Buchholz) shall be fitted to the oil feed pipes from the conservator tank to transformer tank as well as tap changer tank. The Relays shall be mounted in such a way that all gas arising from the tanks shall freely pass into the gas & oil activated relay.

6.9.2 The Relays shall have alarm contacts to close on collection of gas and trip contacts to close following oil surge or low oil level conditions. Gas and Oil-activated Relay shall have provision for checking its operation and facility to collect gas sample at a safe and convenient level.(Gas releasing valve should be fitted with suitable operating height from the ground level.)

6.10 Bushings

6.10.1 The transformer shall be provided with outdoor type porcelain insulator bushings, conforming to IEC 60137, from a reputed manufacturer, for 33kV phase terminal and 11kV phase & neutral terminal. Creepage distances of the 33kV and 11kV bushing insulators shall be 900mm and 300 mm respectively.

6.10.2 33kV, 11kV and Neutral bushings shall be mounted on the tank cover in a manner such that the minimum phase to phase clearance and phase to earth clearance shall not be less than those stated in IEC 60076-3.

6.10.3 The porcelain shall not engage directly with the hard metal and gaskets shall be interposed between them and the surface in contact with the gasket shall be unglazed. They shall be installed in a manner to prevent ingress of moisture and to facilitate easy removal. The neutral bushings and stems shall be identical to those provided for phase terminations. Bushing palms shall be made of brass and be suitable for the bolting of conductor compression lugs.

6.10.4 The palms shall be suitably dimensioned, to suit the bushing rod. General arrangement of the bushing palms is indicated in the drawing No. DS&S/2017/108-1b. After the award exact configuration and positions of holes shall be decided with CEB.

6.11 Transformer Sealing/ Gasket

6.11.1 The transformers shall be provided with lid sealing gaskets. The gasket shall of the good quality type to maintain the sealing effect through its life span and shall prevent seeping of oil due to ageing and extreme operating temperature.

6.11.2 Gaskets provided with the transformers shall be suitable for making oil tight joints, and there would be no deleterious effects on either gaskets or oil when the gaskets are continuously in contact with hot oil. No gaskets shall be used in which the material of the gasket is mounted on a textile backing.

6.11.3 Exterior gaskets shall be of rubberized cork material, weather-proof and shall not be affected by strong sunlight.

6.12 Cable Box

6.12.1 This transformer will be used to connect direct overhead lines or underground cables. Detachable cable boxes, with necessary insulated bus bar extensions and access to make the busbar connections, shall be provided on the tank cover plate of the transformer, to house the 33kV and 11kV phase bushings. It shall be so designed to facilitate, direct vertical termination of the 33kV and 11kV single core cable easily with heat shrinkable cable terminations, and inspection without disturbing the gland plate or incoming cable. The spacing between the bushing shall conform to the standards specified.

6.12.2 The cable box shall be fitted with suitable means to clamp and earth the cable armour and screen wires.

6.13 Terminal Leads

6.13.1 Outgoing leads brought out through bushings shall be such that the core and coils could be removed without interference with these leads, and they shall be specially supported inside the transformer to withstand the effects of vibration and short circuits.

6.13.2 The leads shall be so fixed that they do not break at the connection and would not twist and touch each other in case the bushing is turned accidentally.

6.14 Earthing Connections

6.14.1 All metal parts of the transformer such as coil clamping ring, core bolts, clamping plates etc. shall be earthed and maintained at the same potential. The magnetic circuit shall be earthed to the clamping structure at one point only through a removable link placed on tank cover where leads of earthing connections of clamping structure and magnetic circuit taken out through suitable bushings. The connection to the link shall be on the same side of the core as the main earth connection.

6.14.2 Main earthing connections shall not be less than 50mm^2 copper stranded conductor. Three bolts of M12 size located on either side of the tank base (two) and on the cover plate (one) shall be provided for earthing.

6.15 Surge Arrester Mounting Bracket

6.15.1 The surge arrester mounting brackets made of steel shall be provided to fix to the cover plate of transformer main tank, using extended bolts without disturbing the cover plate assembly. This will be required when cable box is not used.

6.15.2 The bracket shall be hot dip galvanized and suitable to accommodate three Nos. of surge arresters on the 33kV side as indicated in the drawing No. DS&S/2017/108-1a.

6.16 Oil

6.16.1 Transformers shall be filled to the required level with new, unused uninhibited and clean standard mineral insulating oil compliance with IEC 60296:2020 (for more details refer CEB specification 143:2017).

6.17 Radio Interference

6.17.1 When operated at voltage even up to 10% in excess of the normal system rating, transformers shall be substantially free from partial discharges (i.e. corona discharges in either internal or external insulation) which are likely to cause interference with radio or telephone communication.

6.18 Internal and External Finish

6.18.1 Interior of oil tanks shall be thoroughly cleaned by shot blasting or other approved methods and, where exposed to corrosion before use, shall be coated with an approved corrosion preventing compound. The internal surfaces of oil tanks that will be exposed to atmosphere in service shall be painted with an epoxy or other approved oil resisting compound. The exterior shall be thorough cleaned by shot blasting to achieve surface of SA 2.5 and shall be followed by a zinc rich primer at least 60µm of thickness. The paint system shall be selected as per ISO 12944-5 based on atmospheric corrosivity category defined in clause 3.0.

6.18.2 Radiators shall be hot dip, galvanized as per BS EN ISO 1461 (2009) and be artificially weathered and given one coat of zinc chromate primer followed by the same number and type of paint coatings specified for the transformer tank and accessories. Radiators shall be fitted with lifting eyes capable of supporting the combined weight of the radiator and oil.

6.19 Rating Plate

6.19.1 A stainless-steel rating plate shall be fitted to each transformer in an accessible position. The information shall be deeply etched including the diagram of the connections of the windings, the vector diagram showing the general phase relations of the transformer, and a diagrammatic plan of the transformer cover showing the terminal positions and marking and other essential particulars as per clause 7 of IEC60076-1, indelibly in English language.

6.19.2 Following information in addition to the requirement of clause 8 of IEC60076-1 also shall be marked

a) Type of Insulating oil
b) No load losses
c) Full load losses
d) Vacuum withstand capability

7.0 SPECIAL FEATURES AS REQUESTED IN THE PRICE SCHEDULE

7.1 Off Load Tap Changer

7.1.1 Voltage tappings shall be provided on the primary side of each transformer and shall be in accordance with the Clause 5.1.

7.1.2 The tappings shall be selected by an 'off load' tapping switch with an external hand wheel with provision for locking on to a selected tapping. The shaft shall be adequately sealed so that no seepage of oil occurs under all conditions of service.

7.1.3 The voltage operating positions, together with tap change positions shall be clearly and indelibly marked.

7.2 On Load Tap Changer

7.2.1 On Load Tap Changer (OLTC) shall comply with IEC 60214 and shall be suitable for power flow in both directions. Only designs which have been type tested in accordance with these standards will be accepted. Maschinenfabrik Reinhausen (MR) Tap Changers, manufactured in Germany, and the associated operating mechanisms are widely used in CEB for standardization purposes. Voltage tappings shall be provided on the high voltage side of the transformer in accordance with the Clause 5.1.

7.2.2 Insulating oil for the tap changer diverter switch shall be separate from the tank oil and fed from a separate compartment in this conservator tank. The diverter switch shall be readily accessible and easily removable for maintenance. Facilities shall be provided to permit readily inspection of the tapping connections and selector and diverter contacts without the necessity for removing the selector or diverter switches from their housing.

7.2.3 Alternatively, maintenance less OLTCs with vacuum technology will be acceptable. If provided, all details regarding service intervals, lifetime and spares required shall be provided with the offer. The offered model shall be used in utilities satisfactorily for at least five years.

7.2.4 The tapings shall be changed by (Local / Remote) Push Button as well as by manual handle, Direction of operation for Raise /Lower tap shall be provided. Tap changer mechanism shall send signal to initiate Indication/Alarm for the following

(a) Tap changer in progress
(b) Tap change incomplete
(c) Out of Step Indication
(d) Supply voltage failure
(e) Tap position
(f) Tap changer counter

7.2.5 Tap changer operating mechanism motor shall be three phase 400V & 50Hz and all auxiliary supply voltage shall be DC 110V.

7.2.6 The voltage sensing equipment shall prevent operation of the tap-changer if the reference voltage is lost.

7.2.7 The relays, switches and push buttons shall be enclosed in a weather-proof cubicle and be readily accessible for maintenance at ground level with the transformer energized.

7.2.8 Necessary protective devices as per IEC 60214 shall be provided with the OLTC.

7.2.9 The Motor Drive Unit of the OLTC shall contain a thermostatically controlled anti-condensation heater, a door operated light and a manual handle for emergency and maintenance operation. It shall be weather-proof and dust proof (IP55) and shall be bolted to the transformer main tank in a convenient position such that the operator standing at ground level can carry out maintenance on all equipment contained in the cabinet with the transformer energized.

The manufacturer of On Load Tap Changer shall have experience of twenty-five (25) years in the field of manufacturing On Load Tap Changers.

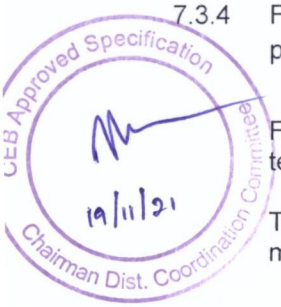
7.3 Outdoor type Automatic Voltage Regulating relay

7.3.1 Automatic Voltage Regulating relay (AVR) provided shall control the voltage of a single transformer or group of transformers operating in parallel. The Motor Drive Unit of the On Load Tap Changer shall incorporate a rack mounted type Automatic Voltage Regulating (AVR) Relay. The offered model shall include IEC 61850 communication interface. The relay shall operate from the nominal reference voltage derived from a circuit mounted voltage transformer (Not included in the scope of supply) and the relay voltage reference balance point shall be adjustable. Maschinenfabrik Reinhausen (MR) AVR, manufactured in Germany, and the associated operating mechanisms are widely used in CEB for standardization purposes.

7.3.2 The relay bandwidth shall preferably be adjustable to any value between 1.5 times and 2.5 times the transformer tap step percentage, the nominal setting being twice the transformer tap step percentage.

7.3.3 The relay shall be insensitive to frequency variations between the limits of 49Hz and 51 Hz, and it shall be complete with a time delay element adjustable between 10 and 120 seconds. The relay shall also incorporate an under voltage blocking facility which renders the control inoperative if the reference voltage falls below 80 percent of the nominal value with automatic restoration of control when the reference voltage rises back to 85 percent of the nominal value.

7.3.4 For each transformer the voltage transformer supply to the AVR relay shall be monitored for partial or complete failure.



Full technical details of the Motor drive unit and AVR relay indicating the model numbers, technical specification and other features shall be furnished with the offer.

The manufacturer of AVR relay shall have experience of twenty five (25) years in the field of manufacturing AVR relays.

7.4 Remote Tap Change Control Panel (RTCC)

7.4.1 Remote Tap Change Control Panel shall enable two or more transformers in one station to

operate in parallel. Equipment required for automatic voltage regulation including voltage regulation relays which has same technical features as described in clause 7.3, over current blocking relays, auxiliary relays, meters, switches, signal lamps, test terminals and all other accessories required for operation shall be provided as necessary for satisfactory and complete operation. Suitable automatic paralleling equipment shall be provided in a transformer tap change control panel to be installed inside the control station which enables selection of mode of operation with a selector switch. In RTCC panel a selector switch shall be provided to enable selecting mode of operation. Maschinenfabrik Reinhausen (MR) AVR, manufactured in Germany, and the associated operating mechanisms are widely used in CEB for standardization purposes. Therefore, the said type or equivalent is accepted.

7.4.2 RTCC panel shall be provided for each transformer and it shall be metal clad, dust, moisture, rodent and vermin proof with degree of protection not less than IP 41. Each shall form a complete enclosure with lockable rear doors and shall be fitted with interior lamp, door switch, heaters, cable gland plates for bottom entry of cables and all other equipment to provide the features specified. Standard requirements which may be varied to suit manufacturer's design as follows:

Instruments

A. Digital Voltmeter (to indicate voltage at the low voltage terminals of the transformer) and Digital Oil temperature indicator.

B. Tap position indicator with integral or separate scale to indicate the LV side voltage in kV appropriate to each winding tap.

C. Relays for automatic voltage control

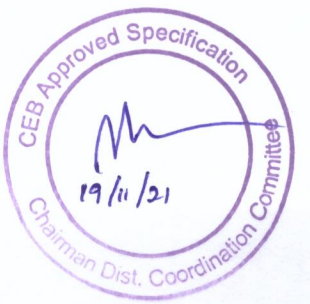
D. Controls

- Automatic/Manual voltage control selector switch (OLTC Control Mode)
- Local/Remote/Supervisory tap change control selector switch
- Raise/Lower push buttons
- Independent/Master/Follower selector switch (Parallel Operation Mode)
- AVR voltage reference adjuster
- Isolating switches and MCBs as necessary to isolate RTCC panel main power supply, Motor drive power supply, etc.

E. Indicator and Alarms

The RTCC panel shall have an audible and visual annunciation system for the following trips and alarms.

i. Low oil level - Main tank
ii. Low oil level – OLTC tank
iii. Oil temperature alarm
iv. Oil temperature trip
v. Winding temperature alarm
vi. Winding temperature trip
vii. Buchholz alarm
viii. Buchholz trip
ix. Motor drive power supply failure
x. VT failure
xi. OLTC Protection relay trip
xii. Main tank pressure relief valve trip
xiii. Out of Step (Parallel failure)



At least 7 spare alarm windows shall be supplied on the annunciation system in addition to the above alarms.

Following separate indicating lamps (panel mounted type) shall also be provided at each RTCC panel to indicate;

i. RTCC Panel is in Local Mode – Green Lamp
ii. RTCC panel is in Remote Mode – Green Lamp
iii. RTCC is in supervisory Mode – Green Lamp
iv. Parallel operation in Master Mode – Green Lamp
v. Parallel operation in Follower Mode – Green Lamp
vi. Parallel operation in Independent Mode – Green Lamp
vii. A tap change is in progress – White Lamp
viii. Tap change is incomplete – Red Lamp

7.4.3 All indication devices shall operate correctly at any voltage between 80% and 110% of the nominal value and all panel wiring shall be capable of withstanding a voltage of 2kV AC, 50Hz for 1 minute.

7.4.4 The "V.T. Fail" alarm shall be so arranged that it is inoperative when the circuit breaker controlling the lower voltage side of the transformer is open and also that it is disconnected when the tap changer is on control other than automatic control.

7.4.5 It must not be possible to operate any tap changer by remote or local electrical control while the equipment is switched for automatic operation. In the event of reverse power flow occurring through the transformer the automatic voltage control function shall be automatically switched out.

7.5 SCADA Provision

The following SCADA signals shall be made available by the supplier to facilitate communication with a SCADA system.

Input output Schedule for the SCADA system

	SCADA Provision	Signal Type
Status Indications	Tap Control (Remote/Local)	SPI
	T/F AVR Operating Mode	SPI
	Tap Position	BCP/AI
	Tap changer in progress	SPI
	Winding Temperature	AI
	Oil Temperature	AI
Alarm/ Trip Indication	Tap change incomplete/Mechanism Fault	SPI
	Out of Step Indication	SPI
	Supply voltage failure	SPI
	Transformer Buchholz Alarm	SPI
	(a.) Tank	
	(b.) OLTC	
	Transformer Buchholz Trip	SPI
	(c.) Tank	
	(d.) OLTC	

	Temperature Alarm	SPI
	(e.) Winding	
	(f.) Oil	
	Temperature Trip	SPI
	(g.) Winding	
	(h.) Oil	
	Low oil Level	SPI
	OLTC Surge Trip	SPI
	Main tank Pressure Release Valve (PRV) Trip	SPI
	Common fault	SPI

DPI – Double Point Indication
SPI – Single Point Indication
DPC – Double Point Command
SPC – Single Point Command
BCP – Binary Coded Measurement
AI – Analog Input

8.0 REQUIREMENTS FOR SELECTION

8.1 Quality Assurance

The manufacturer shall possess ISO 9001:2015 or latest Quality Assurance Certification for the manufacture of transformers for the plant where the manufacture of power transformers is done. Bidders shall furnish a copy of the ISO certificate certified as true copy of the original by the manufacturer, along with the offer.

8.2 Manufacturing Experience

The bidder shall ensure that, each transformer offered is manufactured by a manufacturer with a minimum of fifteen (15) years successful experience in manufacturing comparable equipment, in rated or higher voltage and capacity. In addition, minimum of ten years (10) experience shall be in manufacturing for orders outside the country of the manufacturer for comparable equipment.

If the offered equipment is manufactured under license, the manufacturing experience of equipment manufactured by the parent company shall not be counted as manufacturing experience of the licensee equipment.

In addition, the Bidder shall submit a reference list of two or more transformers of same or similar design and rating manufactured and supplied by the manufacturer for orders from outside the country of the manufacture. Offered transformer will only be accepted if transformers identical/similar in design have a minimum of five years (5) field experience.

Notwithstanding to above if the supplier has supplied similar transformers to CEB and they were in satisfactory operation over the last five (5) years those transformers will be considered.

Bidder shall provide adequate evidence of compliance to above requirements. Bids non-complying with above requirements or with incomplete evidence of compliance would be rejected.

8.3 Type Tests

Type Test Certificates conforming to the above referred standards, issued by:

Either

(a) an accredited independent testing laboratory

or

(b) an accredited testing laboratory where the type test has been witnessed by an accredited

independent inspection body

shall be furnished with the offer. Type Test Certificates shall clearly indicate the relevant standard, items concerned, showing the manufacturers identity, type No. /catalogue No. and basic technical parameters.

Proof of accreditation and accredited scope, by a national/ international authority that are full members of ILAC (International Laboratory Accreditation Cooperation), i.e. signatories to the ILAC mutual recognition arrangement (MRA) to assess and accredit:

(a) testing laboratories using ISO/IEC 17025 (in case of accredited independent testing laboratories)

(b) inspection bodies using ISO/IEC 17020 (in case of accredited independent inspection bodies)

shall be forwarded with the offer. Accredited independent laboratory/inspection body shall not be the same entity or associate of the manufacturer.

Test certificates shall be complete including all the pages as issued by the testing authority. Type test certificates shall be in English language. Parts of test certificates shall not be acceptable.

8.3.1 Type tests as per IEC 60076-1 for the transformers and "Wet Power Frequency Test" as per IEC 60137 for the transformer bushings shall be furnished with the offer. Type Tests as per above standards done on transformers of same or higher voltage not exceeding 72.5 kV, and capacity of a similar design having uniform insulation will be acceptable.

The Lightning Impulse Type test shall comply with Table 2 (Test voltage levels) of IEC 60076-3. However, the Lightning Impulse levels given in Clause 5.1 (Medium Voltage Characteristics) shall be proven in FAT for the awarded Transformer.

8.3.2 Ability to Withstand Short Circuit

8.3.2.1 General

All transformers shall be capable of withstanding on any tapping and without damage the thermal and dynamic effects of external short circuits under the conditions stated in IEC 60076-5 Clause 4.

Manufacturer shall demonstrate the ability to withstand the thermal effect of short circuit by calculation, and the ability to withstand the dynamic effect of short circuit either by test (as per IEC60076-5 Clause 4.2) or calculation, design and manufacture considerations (as per 8.3.2.2 below). The method of demonstration of the ability to withstand the dynamic effects of short circuit shall be stated in the bid.

8.3.2.2 Calculations, Design and Manufacture Considerations

In case of proving ability of withstanding short circuit conditions by calculations, following guidelines shall be followed.

a) Thermal ability to withstand the short circuit

Calculations shall be done according to IEC 60076-5:2006 Clause 4.1 to prove the thermal ability to withstand the short circuit, for at least 3 seconds at rated conditions and after all loading conditions as specified in IEC 60076-7 Clause 7.3.3 and shall be submitted with the offer.

b) Ability to withstand the dynamic forces

During the bidding stage manufacturer shall prove his ability of designing and manufacturing transformers similar in capacity and rated voltage not exceeding 72.5kV which can withstand dynamic effects of short circuit as per IEC 60076-5 by means of complete test reports of short circuit tests. These tests shall be conducted in a test laboratory which is a member of Short circuit Testing Liaison (STL) and the laboratory shall also possess ISO/IEC17025 certification. The similarity of the reference transformer and offered transformer shall be shown/provided in compliance with Annex B of IEC 60076-5.

9.0 ADDITIONAL REQUIREMENTS

9.1 Spare Parts and Tools

The supplier shall specify the spare parts required for proper and continuous functioning of the transformers. The supplier shall also specify if any special tools are required for the maintenance of transformers. A schedule of prices and quantities of spare parts and special tools shall be given by the supplier. Cost of spares and special tools shall not be taken for the evaluation.

9.2 Outline Drawings, Maintenance Manual

A comprehensive maintenance manual shall be provided with each transformer and it shall include.

- A hard cover suitable for normal handling.
- A comprehensive index of all materials in the manual.
- Instructions for the routine maintenance of the equipment and associated auxiliary equipment including data for the calibration of winding temperature indicators.
- Detailed description including required plant for the vacuum / oil filling procedure.
- A detailed evacuation procedure of the conservator where an air bag or diaphragm is provided.
- Outline drawings and other necessary drawings baring an effect on customers' installation.
- A photograph from each side and end of the associated core and windings and of the fully erected unit. The photographs should be about 200 mm x 150 mm in size.
- Copies of routine test certificates.

10.0 INFORMATION TO BE FURNISHED WITH THE OFFER

a) Guaranteed Technical Particulars requested in Annex – B1.
b) Constructional features and materials used for components
c) Separate explanatory drawings and dimensions of tap changer.
d) Overall dimensional drawings
e) Drawing of rating plate to scale incorporating the particulars called for.
f) Certified copy of the quality assurance conforming to ISO 9001:2015 or latest.
g) Documents to prove manufacturer's experience in accordance with Clause 8.2, Clause 7.2 and Clause 7.3.
h) Documents in accordance with Clause 6.1.4
i) A schedule of prices and quantities of spare parts and special tools shall be given by the supplier in accordance with Clause 9.1.
j) Type test certificates in accordance with clause 8.3
k) Ability to withstand short-circuit in accordance with clause 8.3.2

11.0 PACKING/LABELING AND MARKING

11.1 Terminal Marking

All transformers shall have the primary and secondary terminal markings plainly and indelibly marked on the transformer adjacent to the relevant terminal. These markings shall conform to the standard

specified and shall be 25mm in height.

11.2 Transportation and Packing

Impact recorders (with 3-axis measurement) for transport shall be rigidly attached to the transformer in order to record all horizontal and vertical impacts suffered during transport from factory to the site. The recorder is to be operative from time of packing until the transformer is delivered and it is to be suitably sealed and the seal shall only be broken by the CEB on arrival at site in order to release the registered data.

The manufacturer shall state the safe limits of shock impacts 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 the CEB Engineers.

In case an Impact Recorder is not installed on the transformer and/or not been functional up to the delivery to the site, or found to have been subjected to excessive shock above the manufacturer's guaranteed value, the CEB shall have the right to reject the transformer and the CEB decision shall be final.

If the transformer is transported without oil, provision should be made to prevent the ingress of moisture and to maintain the internal insulation in good condition. In addition, the transformer should be filled with breathable gas/dry air and maintained at a continuous positive pressure. At all times alternative standby means should be provided to restore any loss of air pressure immediately.

12.0 DESIGN REVIEW (FOR 10MVA TRANSFORMERS ONLY)

After awarding the bid, the selected bidder with the consultation of manufacturer (if manufacturer is not the bidder) shall arrange to facilitate the CEB to review Design of the Transformer, on the following.

12.1 Ability to withstand short circuit

a) Thermal ability to withstand the short circuit

The transformer shall have the thermal ability to withstand the short circuit for 3 seconds and calculations for the offered transformer shall be done according IEC 60076-5:2006 Clause 4.1 to prove the thermal ability to withstand the short circuit, for at least 3 seconds at rated conditions and after all loading conditions as specified in IEC 60076-7 Clause 7.3.3.

b) Evaluation of ability to withstand thermal and dynamic effects of short circuit

At detailed design stage, manufacturer shall submit evaluation of ability of withstanding thermal and dynamic of short circuit within 4 weeks from contract award.

Following documents, drawings and calculations shall be submitted with this evaluation as per IEC 60076-5 Annex A. If any of document or documents could not be provided due to proprietary nature of information, manufacturer shall show those documents to engineer at employers' premises or manufacturers' premises.

Documents required under Clause A.3.2

- Electromagnetic design data sheets as needed for calculation.
- Drawings or sketches of the complete winding and insulation arrangement within the core window with indication of the types of material.
- Calculation of the short-circuit current values (both peak and symmetrical r.m.s. values) affecting each single winding as a result of the service duty requirements specified and types of fault taken into consideration, with also due regard to the tapping positions in case of winding(s) provided with taps.

- Calculation of the main short-circuit forces (peak values occurring at the highest peak of the respective current), with reference to the fault cases, tapping positions and geometrical and relative positions of windings considered for design purposes. Full information has to be given if any simplified geometrical configurations have been adopted for the windings, core and tank for the purpose of magnetic leakage field and electromagnetic force calculations.

- Calculation of basic mechanical stresses on winding conductors and adjacent mechanically coupled structures originated by the short-circuit forces.
- Drawings, sketches, or computer outputs, concerning the winding support structure and core-and-coil clamping arrangement.

- Instructions for quality assurance and quality control concerning both materials and manufacturing practices, with specific reference to manufacturing activities.

- Checks concerning main transformer external components, in particular high-voltage bushings, especially in the case where they are slope-mounted on turrets, etc.

Calculation of EM Forces (Clause: A.3.2 (d))

- Radial inward or outward force on each physical winding.

- Maximum axial compression force on each physical winding (fc).

- Maximum axial end thrust force (up/down) on each physical winding.

- Maximum axial force-per-limb on common press ring (or plate), if used, and core clamps.

- Thrust force acting on the lead exits of each main low-voltage winding (t*f).

Calculation of Stresses (Clause: A.3.2 (e))

- Mean hoop tensile stress on outer windings (σ*t).

- Mean hoop compressive stress on disc-, helical-, single-layer-type inner windings (σ*c)12.

- Equivalent mean hoop compressive stress on layer-type inner windings.

- Stress due to radial bending on conductors in the span between axial sticks and between spacers used to build any axial cooling ducts within the winding radial width.

- Stress due to axial bending on conductors in the span between radial spacers with disc- and helical-type windings.

- Compressive stress on radial spacers with disc- and helical-type windings.

- Compressive stress on conductor paper insulation with layer-type windings.

- Compressive stresses on end stack insulation structures and end rings.

- Compressive stress on common press rings (or plates).

- Tensile stress on tie rods (flitch plates) of the clamping structure.

Drawings (Clause: A.3.2 (f))

- Arrangement of the radial supports against the core limb.

- Configuration of the end stack insulation structures.

- Arrangement of common press rings.
- Overall core-and-coil clamping arrangement.
- Means for securely fastening the winding lead exits and lv connection leads or bars to the bushings and lead runs to tap-changers.
- Means for the application of any axial pre-load.

Instructions for Quality Assurance and Control (Clause: A.3.2 (g))

- Winding of the conductors on the mandrel and control of the pulling force.
- Sizing and elastic stabilizing of windings and coils.
- Assembling within specified tolerances.
- Drying and impregnation with oil.
- Application of pre-load.
- Fastening/securing of winding supports.
- Leads and clamping devices.

Acknowledgement of the manufacturer's design information for short-circuit strength (Clause A.3.3.3.1)

- The list of transformers built by the manufacturer which have been subject to the short-circuit test, including main transformer data, such as rated power, rated voltage, tapping range, and short-circuit impedance.
- The results of the tests performed on models, if any, and their impact on the design rules.
- The contents of the technical standards for short-circuit strength of power transformers used by the manufacturer in regular design and production activities.
- Service records and in-field failure rates as regards short-circuit performance.
- The number of units produced and the number of service years of successfully operated transformers.

Checking procedure (Clause A.3.3.3.2)

- Preliminary examination of the winding and main insulation structures and clamping arrangement of the transformer.
- Comparing any force and stress values calculated on the transformer with the corresponding allowable or critical values that the manufacturer has adopted in his design practice.

12.2 Magnetizing curve

The Magnetizing Curve relevant to the design of the offered transformer shall be provided. The curve shall represent a maximum voltage of 10% surpassing the knee point voltage.

12.3 Thermal overload curve

The Thermal Overload Curve (Load Vs Time at 40 ^{0}C) relevant to the design of the offered transformer shall be provided up to 200% of the rated power of the transformer (for ONAN rating).

12.4 Over flux capability curve

The Over Flux Capability Curve (Voltage over Hertz Vs Time at 40 ^{0}C) relevant to the design of the offered transformer shall be provided up to 140% of the rated secondary Voltage (33 kV) at 50 Hz (for ONAN rating).

12.5 Drawings

Drawings and sketches of the complete winding and insulation arrangement within the core window with indication of the type of the materials shall be provided.

12.6 Hot spots and temperature rise

The results of the design calculation concerning the location of the hot spots and the estimation of the temperature rises for Continues Maximum Rating (CMR) and Short time emergency loading (as per IEC 60076-7) shall be provided.

12.7 Flux density distribution

The results of the design calculation related to flux density distribution shall be provided.

13.0 INSPECTION AND TESTING

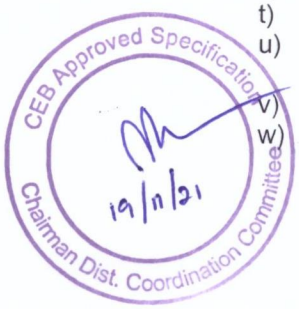
13.1 Inspection

The selected Bidder shall make necessary arrangements for inspection of the equipment by an Engineer appointed by the CEB and also to carry out in his presence necessary Acceptance / sample tests of the materials and equipment, offered.

13.2 Acceptance Tests

13.2.1 The following acceptance tests shall be performed on all transformers at the manufacturer's works and the tests shall be witnessed by the representative nominated by the CEB.

a) Temperature rise test
b) Measurement of winding resistance
c) Measurement of voltage ratio and check of voltage vector relationship
d) Measurement of short-circuit impedance and load loss
e) Measurement of no-load loss and current
f) Dielectric routine tests (as per table 1 of IEC 60076-3)
g) Oil breakdown test
h) Pressure test at 30kPa above atmospheric
i) Dimensional test
j) Measurement of dry film thickness of paints
k) Check operation of OLTC (if applicable)
l) Check AVR relay (if applicable)
m) Check control circuit
n) Bushing current transformer tests
o) Check of core and frame insulation for liquid immersed transformers with core or frame insulation
p) Measurement of Tan δ
q) Measurement of Zero sequence impedance
r) Partial discharge test
s) DGA and Moisture content in paper and oil
t) Measurement of sound level (as per IEC 60076-10-1)
u) Measurement of frequency response (Frequency Response Analysis or FRA). The test procedure shall be agreed between manufacturer and CEB.
v) Paint Thickness and review of paint method and material.
w) Dielectric type tests (as per table 1 of IEC 60076-3)



Note: 1. Tests a) and t) shall be applicable for one transformer in a single order and tests f), o), p), r), s), t), u) shall be performed after the temperature rise test on that transformer.

13.2.2 Criteria for Factory Acceptance Tests

If the test results of the inspection are not within the acceptable limits of Clause 5.2, CEB shall have the right to reject the transformer as defective. If any defect arises during the testing of the transformer and CEB representative for the inspection considered the defect as a major defect then the transformer will be rejected as defective, will not be accepted after the repairs by the manufacturer. In which case the manufacturer shall agree to replace the transformer with a new design without any additional cost. However, if the CEB representative considers the defect as a minor defect, the manufacturer's request for re-inspection and repairs may be considered subjected to the following.

a) Dismantling and inspection of the transformer for repairs shall be done in the presence of an Engineer nominated by General Manager of Ceylon Electricity Board.

b) All the Routine & Special Tests specified above must be repeated. Manufacturer shall agree to bear the cost of travelling and accommodation of the representative nominated by CEB for the period of inspection, repairs and testing of the defective transformer.

14.0 ANNEX

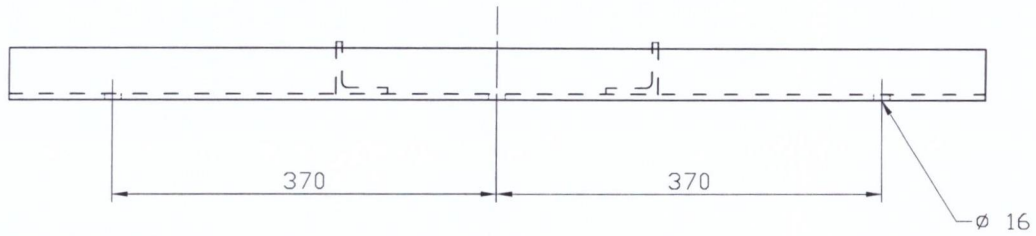
Annex - A1 : Drawing of Surge Arrestor Mounting Bracket

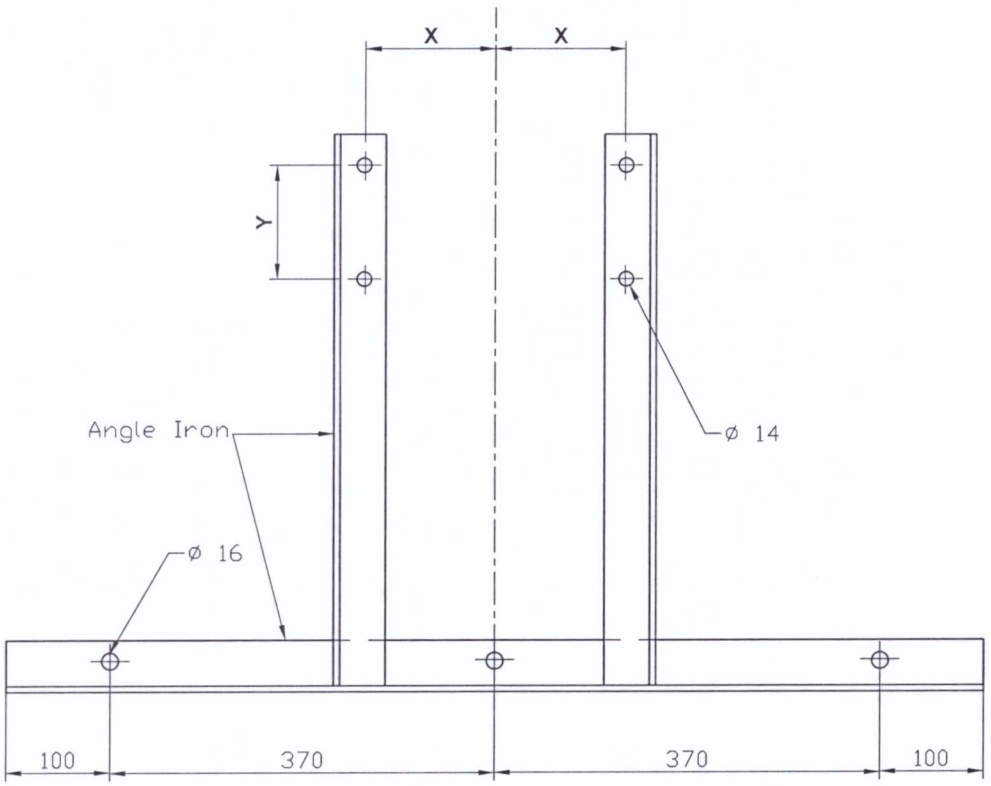
Annex - A2 : Details of Bushing Flag

Annex – B1 : Schedule of Guaranteed Technical Particulars

Annex – B2 : Other Technical Requirements

Annex – C : Non-Compliance Schedule





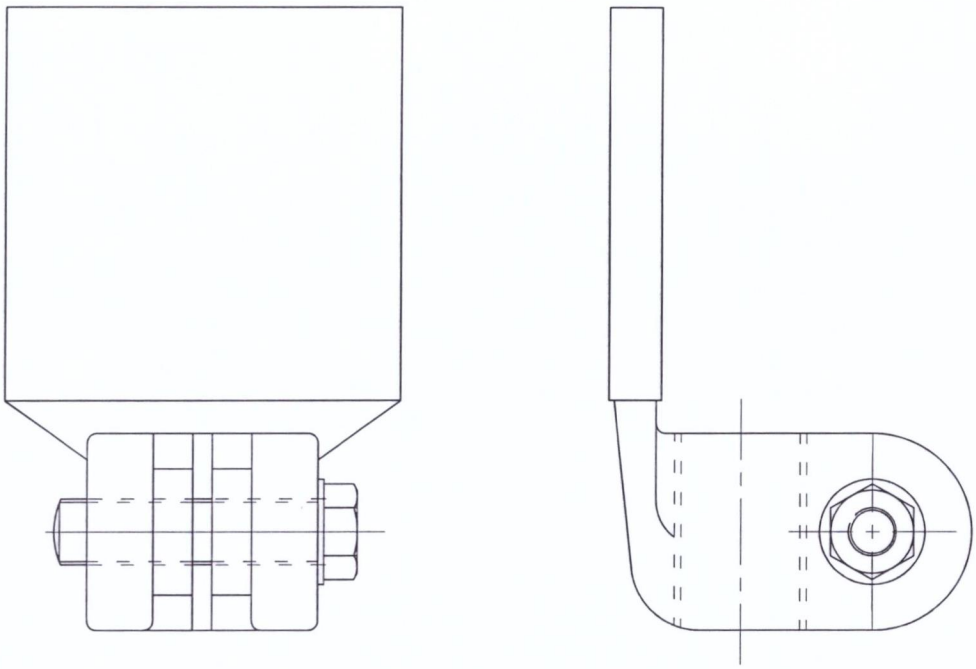
33/11 kV, 5MVA & 10MVA POWER TRANSFORMERS

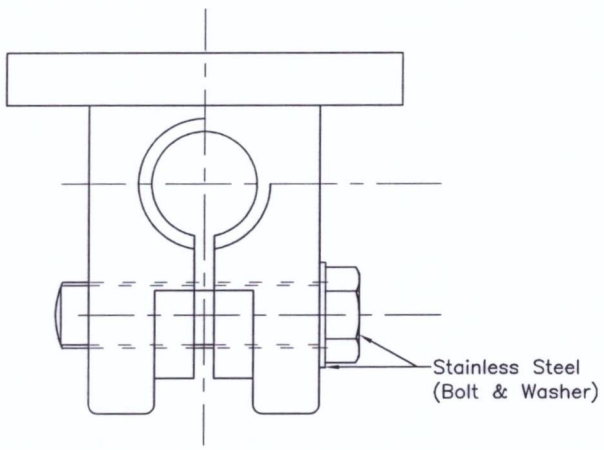
Note : " X " and " Y " depend on mounting points at the T/F body or Top Plate

CEB Approved Specification
19/11/21
Chairman Dist. Coord.

All dimensions are in mm.

CEYLON ELECTRICITY BOARD	DISTRIBUTION STANDARDS & SPECIFICATION	SCALE : NOT TO SCALE
	SURGE ARRESTOR MOUNTING BRACKET	DRAWN : LALANI
		DATE : Nov. 2017
	DESIGNED BY / APPROVED BY	DRG. NO : DS&S/2017/108-1a
DISTRIBUTION COORDINATION BRANCH	EE (DC) / CHAIRMAN, SPECIFICATION COMMITTEE	CAD NO :





CEB Approved Specification
19/11/21
Chairman Dist. Coordination Committee

NOTE
Material : Tin Plated Brass

CEYLON ELECTRICITY BOARD	DISTRIBUTION STANDARDS & SPECIFICATION	SCALE : NOT TO SCALE
	DETAILS OF BUSHING FLAGS	REDRAWN : Harsha
		DATE : Jun. 2021
	DESIGNED BY / APPROVED BY	DRG. NO : DS&S/2021/108-1b
DISTRIBUTION COORDINATION BRANCH	EE (DC) / CHAIRMAN, SPECIFICATION COMMITTEE	CAD NO :

Annex- B1

SCHEDULE OF GUARANTEED TECHNICALPARTICULARS

(Following Information shall be furnished with the offer for each capacity of transformer offered)

			CEB Requirement	Offered
1.	a) Name of manufacturer			
	b) Country of origin / Make			
2.	Applicable Standards		As per clause 4.0	
3.	Voltage rating	kV		
4.	Capacity	kVA		
5.	Vector group		Dyn11	
6.	Frequency	Hz	50	
7.	Cooling type		ONAN	
8.	Insulation temperature class		Class A	
9.	Average winding temperature rise (by resistance measurement) at steady state continuous MCR at annual average ambient temperature (30°C) under normal service condition.	K	55	
10.	Top oil temperature rise at annual average ambient temperature (30°C) under normal service condition.	K	50	
11.	Minimum Short circuit impedance voltage at 75^{0}C	%	7% for 5MVA transformers 8% for 10MVA transformers	
12.	Corrected average A-weighted Sound Pressure level	dB	< 68	
13.	(a) No load Loss at 75 ^{0}C	W		
	(b) Load Loss at 75 ^{0}C	W		
14.	Auxiliary Loss at 75 ^{0}C (if applicable)	W		
15.	Lightning impulse withstand voltage (peak)			
	i. 33kV side	kV	170	
	ii. 11kV side	kV	95	
16.	Wet power frequency withstand voltage (for transformer bushings)			
	ii. 33kV side	kV	70	
	iii. 11kV side	kV	28	
17.	Total creepage distance of			
	i. 33kV side	mm	900	
	ii. 11kV side	mm	300	
18.	Type of Oil Level Indicator provided		Magnetic	

19.	Type of Winding temperature Indicator provided			
	(a) with a pointer/indicator to register highest temperature reached?	Yes/No	Yes	
	(b) with contacts for alarm adjustment range?	Yes/No	Yes	
	(c) with contacts for trip adjustment range?	Yes/No	Yes	
20.	Type of Pressure Relief Device provided		As per clause 6.7	
21.	Whether the Gas & oil Activated Relay provided			
	a) for the Transformer?	Yes/No	Yes	
	b) for the Tap-changer?	Yes/No/ Not Applicable		
	c) with contacts to initiate signal for			
	(i) alarm on collection of gas?	Yes/No	Yes	
	(ii) trip on oil surge?	Yes/No	Yes	
	(iii) trip on low oil level condition?	Yes/No	Yes	
22.	Whether the oil temperature Indicator device provided			
	a) with a pointer/indicator to register highest temperature reached?	Yes/No	Yes	
	b) with contacts for alarm adjustment range?	Yes/No	Yes	
	c) with contacts for trip adjustment range?	Yes/No	Yes	
23.	Type of Silica Gel Breather provided		As per clause 6.4	
24.	Valves		As per clause 6.5	
	a) Material		Gunmetal	
	b) Type		Sluice type as per clause 6.5.2	
	c) Size		As per clause 6.5.1	
	d) Locations			
	– Filter Valves located near to the bottom and the top of the main tank	Yes/No	Yes	
	– Conservator Tank (Drain Valve)	Yes/No	Yes	
	– Conservator Tank (Filling Valve)	Yes/No	Yes	
	– Main Tank-Conservator Tank connecting pipe (Stop valve on each side of gas-actuated relay)	Yes/No	Yes	
	– Drain Valve for each radiator	Yes/No	Yes	
	– Two sampling valves for the main tank. (Top and Bottom oil)	Yes/No	Yes	
	In case of Transformers with OLTC			
	– Tap-changer and Diverter Switch Tank (Drain Valve with oil sampling facility& Filter Valve)	Yes/No	Yes	

	– Tap Changer Tank – Conservator Tank connecting Pipe (Stop Valve on each side of gas actuated relay)	Yes/No	Yes	
25.	Whether the offered transformers fully conform to CEB Specification? (if not please provide details)	Yes/No	Yes	
	a) Clause 6.1 - General Design of the Equipment?	Yes/No	Yes	
	b) Clause 6.3 - Transformer Tank?	Yes/No	Yes	
	c) Clause 6.11 - Transformer Sealing?	Yes/No	Yes	
	d) Clause 6.18 - Internal & External Finish ?	Yes/No	Yes	
	e) Clause 6.19 - Rating Plate?	Yes/No	Yes	
	f) Clause 6.10 - Bushings ?	Yes/No	Yes	
	g) Clause 6.13 -Terminal Leads?	Yes/No	Yes	
	h) Clause 6.14 - Earthing Connections?	Yes/No	Yes	
	i) Clause 6.16- Oil?	Yes/No	Yes	
	j) Clause 6.7 - Pressure Relief Valve?	Yes/No	Yes	
	k) Clause 11.1 – Terminal Marking ?	Yes/No	Yes	
	l) Clause 6.17– Radio Interference?	Yes/No	Yes	
	m) Clause 11.2 – Transportation and Packing?	Yes/No	Yes	
26.	Off Load Tap Changer (if applicable)		As per clause 7.1	
	a) Tap changer Steps	%		
	b) Number of steps			
27.	On Load Tap Changer (if applicable)		As per clause 7.2	
	a) Whether the Tap changer is MR of German origin or any other?			
	b) Model No and Type of OLTC	Oil/Vacuum		
	c) Tap changer Steps	%		
	d) Number of steps			
	e) Whether Local/Remote/ Manual option available?	Yes/No	Yes	
	f) Operating facility provided?	Yes/No	Yes	
	g) Whether necessary protective devices as per IEC 60214 provided?	Yes/No	Yes	
	h) Operating Voltage of the motor	AC Volt		
	i) Auxiliary Supply Voltage	DC Volt		
28.	Automatic Voltage Regulator (AVR) relay (if applicable)			
	a) Whether AVR relay conforms to clause 7.3?	Yes/No	Yes	
	b) Model No. and Country of Origin of the AVR relay provided.			

29.	Whether SCADA provision conforms to clause 7.5 (if applicable)?	Yes/No	Yes	
30.	Guaranteed value for impact level as per clause 11.2			
31.	Indicate the particulars of Spares to be supplied with each transformers			
32.	Whether the information as per Clause 10 is furnished with the offer?	Yes/No	Yes	
32.	Whether the complete Type Test Certificates as per Clause 8.3 are furnished with the offer?	Yes/No	Yes	
34	Model No. of the bushing provided in the type test certificate for transformer as per IEC 60076-1			
35.	Whether bidder agree to perform lightening impulse voltage test at 95kV voltage (for 11kV side) during Factory Acceptance Tests, if the type tests provided for the same test at 75kV test voltage.	Yes/No	Yes	
36.	Whether the report on demonstration on ability to withstand short circuit as per clause 8.3.2 is furnished with the offer?	Yes/No	Yes	
37.	Whether the Acceptance /Sample Tests as per Clause 13.2 will be carried out? (Please specify any deviation)	Yes/No	Yes	
38.	Place of testing			
39.	The value of Magnetizing Current at principle tap (as a % of full load current at HV winding)	%		
40.	Whether the certificate of ISO 9001:2015 or latest Quality Assurance furnished? Yes/No			
41.	Total weight of oil	kg		
42.	Insulating Oil Volume/Weight	Liters/kg		
43.	Total Weight of the Transformer (CEB to specify maximum weight of transformers intended for replacements)	kg		
44.	Whether the Complete dimensional drawing furnished?	Yes/No	Yes	
45.	Overall dimensions (CEB to specify maximum dimensions of transformers intended for replacements)	Length Width Height		

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Signature of the Manufacturer and seal

.....

Date

I/We certify that the above data are true and correct

.....

Signature of the Bidder and seal

CEB Approved Specification
19/11/21
Chairman Dist. Coordination Committee

.....

Date

ANNEX B2: OTHER TECHNICAL REQUIREMENTS

Note: Compatibility issues with the existing SCADA system and any other technical requirements, if required have to be mentioned here by the procurement entity.

Annex – C

NON-COMPLIANCE SCHEDULE

On this schedule the bidder shall provide a list of non-compliances with this specification, documenting the effects that such non-compliance is likely to have on the equipment life and operating characteristics. Each non-compliance shall be referred to the relevant specification clause.

Clause No.	Non-Compliance

.....
Signature and seal of the Manufacturer

.....
Date

I/We certify that the above data are true and correct

.....
Signature and seal of the Bidder

.....
Date

CEB Approved Specification
19/11/21
Chairman Dist. Coordination Committee