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| Assets Planning and Delivery GroupEngineering  |

DESIGN STANDARD DS 26-13

Type Specifications – Electrical

Type Specification for Oil Filled Transformers

 in Kiosk

 Rated < 1500 kVA

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| version 2revision 2 |
| January 2024 |

**FOREWORD**

The intent of Design Standards is to specify requirements that assure effective design and delivery of fit for purpose Water Corporation infrastructure assets for best whole-of-life value with least risk to Corporation service standards and safety. Design standards are also intended to promote uniformity of approach by asset designers, drafters and constructors to the design, construction, commissioning, and delivery of water infrastructure and to the compatibility of new infrastructure with existing like infrastructure.

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[Overview of Western Australia’s Work Health and Safety (General) Regulations 2022 (dmirs.wa.gov.au)](https://www.dmirs.wa.gov.au/sites/default/files/atoms/files/overview_general_regulations.pdf)

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**Head of Engineering**

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DESIGN STANDARD DS 26-13

Type Specifications – Electrical

Type Specification for Cable Connected Oil Filled Transformers in Kiosk Rated ≤ 1500 kVA

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# GENERAL

1. This Specification covers the requirements for the design, manufacture, assembly, inspection, factory testing, packaging, transport to site, positioning at site, on site testing, and commissioning of cable connected two winding step down oil filled transformer in a kiosk rated not greater than 1500 kVA, and as detailed further herein.
2. The transformer shall be required to be installed indoors or outdoors as specified in the Annexure.
3. The transformer shall be supplied to site complete and shall include all necessary accessories and miscellaneous material, minor parts and other parts necessary to complete the mechanical installation, testing and commissioning of the equipment.
4. The electrical connection of the transformer will be carried out by others after on mechanical installation of the transformer has been completed by the Contractor.
5. Once electrical connection of the transformer has been completed, the Contractor shall return to the site to commission the transformer under the overall direction of the Principal.

# SITE

The location of the site for the installation of the transformer shall be as described in the Annexure.

# OPERATING MODE

The mode under which the transformer will be operated shall be as described in the Annexure.

# WORK BY THE PRINCIPAL

The work to be performed by the Principal shall be as detailed in the Annexure.

# INFORMATION FROM THE CONTRACTOR

The Contractor shall provide the following documentation in respect of the substation within the listed number of calendar days after receipt of the Principal’s order.

1. General Arrangement Drawings 28 days
2. Electrical Wiring and Schematic Drawings 28 days
3. Manufacturing and Delivery Schedule 14 days
4. Specification Data Sheets 35 days
5. Inspection and Test Plan 35 days
6. Test Certificates On delivery
7. Operating and Maintenance Manual On delivery

# CONTRACTOR’S DRAWINGS

1. All drawings provided by the Contractor shall be in accordance with the latest issue of the Water Corporation Design Standard DS24 – Electrical Drafting
2. All drawings shall be prepared in AutoCAD format, Release 2018 or later software
3. Drawings shall be prepared on the “Electrical” A1 metric drawing sheet and title block provided in the Water Corporation eXternal (WCX) package (available for download) in accordance with the Water Corporations Design Standard DS80
4. The drawings shall provide within the title block, the details to identify the drawing, including but not limited to its title, plan number, revision status, date of issue, Corporate project number, contractor’s name and reference number (if applicable)
5. Drawings detail shall include, but not limited to, the general arrangement, panel layout, power and control circuit diagrams and equipment specifications, as required
6. The contractor shall submit drawings in both AutoCAD and PDF formats in accordance with the Drawing Submission Process. Adequate contrast within the PDF image shall be maintained between drawing content and background to ensure the clarity and quality of the drawings

# STANDARDS

In particular the transformer shall comply with the requirements of the relevant parts of AS 60076 as further detailed in this Specification. Specific reference is made in this Specification to the Australian and International Standards listed hereunder. In their absence, relevant International Standards together with the requirements of competent authorities having jurisdiction over all or part of the manufacture, installation and operation of the equipment shall be adhered to. Compliance with Standards and Regulations shall include all amendments after the date of tender.

AS 1767 Insulating Oil for Transformers and Switchgear (incorporating Amendment 1)

AS/NZS 2312 Guide to the Protection of Iron and Steel Against Exterior Atmosphere Corrosion

AS 2374.1.2 Power transformers - Minimum Energy Performance Standard (MEPS) requirements for distribution transformers

AS 2700 Colour Standard for General Purposes

AS/NZS 3000 Electrical Installations - Buildings, Structures and Premises (Wiring Rules)

AS/NZS 3750 Paints for Steel Structures

 AS 60529 Degree of Protection Provided by Enclosures for Electrical Equipment (IP Code)

 AS/NZS 60076.1 Power transformers - General

AS/NZS 60076.3 Power transformers - Insulation levels, dielectric tests and external clearances in air

AS/NZS 60076.5 Power transformers - Ability to withstand short circuit

 AS/NZS 60076.10 Power transformers - Determination of sound levels

 AS 61869.2 Instrument transformers - Additional requirements for current transformers

AS 62271.202 High voltage switchgear and controlgear - High voltage/low voltage prefabricated substation

AS/NZS ISO 9001 Quality Management Systems – Requirements

EN 50181 Plug in type bushings above 1 kV and up to 52 kV and from 250 A to 2.5 kA - for equipment other than liquid filled transformers

IEC 60815 Guide for the selection of insulators in respect of polluted conditions

IEEE std C57-110 Recommended Practice for establishing transformer capability when supplying non sinusoidal loads

ISO 9223 Corrosion of metals and alloys - corrosivity of atmospheres – Classification determination and estimation

# QUALITY ASSURANCE

The transformer and kiosk shall be manufactured under a quality system certified by an accredited authority in accordance with AS/NZS/ISO 9001 or an approved equivalent.

# SAFETY REQUIREMENTS – ELECTRICAL WORK

All electrical work shall be performed by appropriately qualified and experienced personnel who shall hold a current electrical workers license to perform such work.

# POWER SUPPLY

The incoming electrical supply voltage and other electrical supply conditions shall be as specified in the Annexure.

# TRANSFORMER LOAD

The transformer load shall be as detailed in the Annexure

# AMBIENT CONDITIONS

1. The transformer shall be suitable for continuous and cyclic full load operation under the site ambient conditions detailed hereunder.

(b) If the transformer in a kiosk is specified in the Annexure for installation outdoors, the transformer shall be rated for the following ambient conditions outside the kiosk:

(i) Shade ambient temperature range of -5oC to 50oC

(ii) Maximum relative humidity of 90% with periods of heavy condensation

(iii) Pollution level in accordance with IEC 60815 as specified in the Annexure

 (c) If the transformer in a kiosk is specified in the Annexure for installation indoors, the transformer shall be rated for the following ambient conditions outside the kiosk:

(i) Shade ambient temperature range of 0oC to 45oC

(ii) Maximum relative humidity of 90% with periods of light condensation

(iii) Pollution level in accordance with IEC 60815 as specified in the Annexure

# TYPE OF TRANSFORMER

The type of transformer shall be a cable connected oil filled transformer in accordance with AS 60076.1 and as further specified hereunder.

# OPERATING ENVIRONMENT

The transformer shall be suitable for operation in one of the following environments, as specified in the Annexure:

(a) Indoors in a well ventilated area

(b) Fully exposed outdoors

(c) Outdoors in a kiosk enclosure as per Type Specification DS26-42

# KIOSK ENCLOSURE

(a) The kiosk enclosure shall be provided by the Contractor as part of the Contract

(b) The kiosk enclosure shall comply with requirements of Type Specification DS26-42

(c) The Contractor shall ensurethat the transformer is designed and built so as to meet the requirements of this Specification when operating in that enclosure

#  TRANSFORMER FUNCTIONAL REQUIREMENTS

The transformer shall satisfy the following functional requirements:

1. Number of Phases: 3
2. Frequency: 50 Hz
3. Number of windings: 2
4. Phase to phase voltage:

(i) Primary - as specified in the Annexure

(ii) Secondary (No Load) - as specified in the Annexure

1. Connections:

(i) Primary - DELTA

(ii) Secondary - STAR with star point (i.e. neutral) brought out

1. Vector Group: Group 3, Dyn1
2. HV supply Earth Fault Factor: as specified in the Annexure
3. Secondary winding star point to be solidly grounded
4. kVA rating:

For linear loads the transformer nominal 50 Hz, 50oC kVA rating of the transformer shall not be less than the maximum load specified in the Annexure.

For non-linear loads the transformer 50oC kVA rating of the transformer after derating for harmonic currents as determined in accordance with IEEE Std. C57-110 shall not be less than the maximum load specified in the Annexure.

1. Type of Load: as detailed in the Annexure
2. Type of Construction: core type
3. Type of cooling: ONAN
4. Temperature limits: maximum oil 100oC – maximum winding 105oC
5. High Voltage insulation level

(i) Lightning Impulse Withstand Voltage: as per AS 60076.3, Table 2, column 2, full wave lightning impulse test

(ii) Short Duration 50 Hz Withstand Voltage: As per AS 60076.3, Table 2, column 5, applied voltage AC withstand test

1. Voltage Tappings

##### (i) Range: +5%

 (ii) Step Size: 2.5%

 (iii) Tapped Winding: primary

1. Impedance: as detailed in the Annexure.
2. Losses
	* 1. Transformer efficiency at 50% full load shall be in accordance with the values shown at AS 2374.1.2 Table 1
		2. Transformer shall be of a low loss design with minimum eddy current losses

(The transformer’s capability when supplying non sinusoidal loads shall be determined in accordance with IEEE Std. C57-110.)

1. Maximum no load sound power level: reduced limit as per AS 60076.10 Fig. ZA1
2. Electromagnetic Interference: When the transformer is operated at voltages up to 10% in excess of the normal system rating, the transformer shall be substantially free of partial discharges which are likely to cause interference with radio, television, or telephone communications.
3. Degree of protection: IP55 as per AS 60529

# MISCELLANEOUS FITTINGS

The transformer shall be provided with the following miscellaneous fittings:

1. EN 50181 Type C standard profile primary winding connection bushings in an enclosed cable box, suitable for use with fully screened dead break elbow High Voltage cable terminations and surge arresters.
2. Air insulated secondary winding connection bushings in an enclosed cable box providing a degree of protection of not less than IP55 and suitable for terminating the transformer output cabling specified in the Annexure.
3. If the transformer is rated greater than 315 kVA, the above secondary connections cable box shall include a protection class 5P10 current transformer measuring the current into the transformer secondary winding star point. This current transformer shall have a 1 Amp rated secondary current and shall be as further detailed in the Annexure.
4. If specified in the Annexure as being required, a 15 Amp HRC fuse, wiring and terminals providing a 240 VAC power supply for a capacitive circuit breaker tripping supply unit located with the associated incoming High Voltage supply circuit breaker.
5. Manual off circuit tapping switch brought out via an oil tight gland and complete with warning label next to the handle indicating that the transformer must be de-energised before operating the switch.
6. An earthed screen between the primary and secondary windings (only if the type of load has been specified in the Annexure as non-linear)
7. Earthing connection for the tank.
8. 100mm dial type thermometer with top oil temperature indicator, with or without alarm and trip change over contacts as specified in the Annexure.
9. Pressure relief valve with operation indicator, with or without trip change over contacts as specified in the Annexure.
10. Oil filling hole and cap
11. Oil level indicator
12. Oil drain valve with a sampler
13. Oil catchment tray capable of retaining all of the oil in the event of an oil leak from the tank or the radiators.
14. Lifting lugs.
15. Rating, connection diagram and terminal marking stainless steel plates.
16. Skid type base, suitable for direct bolting onto the base of the kiosk enclosure if the transformer is to be supplied in a kiosk enclosure. Otherwise suitable for bolting down onto a concrete block foundation.
17. The surge arresters specified in the Annexure are to be installed in the immediate vicinity of the transformer HV terminals. The surge arresters shall be connected directly to the transformer earth.

# CONSTRUCTION REQUIREMENTS

## General

The core, windings, tank, framework, clamping arrangements and general structure of the transformers, when assembled, shall form a rigid construction which shall minimise vibration and shall be unaffected by normal use, short circuit conditions or handling during transport, installation, inspection or repair.

## Cores

1. The cores shall be constructed of high grade, cold rolled grain orientated silicon steel coated with temperature resistant inorganic insulation. The structure shall be formed into legs which are interconnected to the yokes with mitred joints. The active parts of the core shall be insulated from the structural support except for the earthing straps and any bolts passing through the core shall be fully insulated from it.
2. The cores shall be so designed and constructed to ensure that excessive temperatures do not occur at the centres of the cores.
3. Facilities shall be provided for lifting the cores, with windings, from the tanks for inspection and repair.

## Windings

1. Windings shall be wound in the same direction.
2. Winding assemblies shall be dried and shrunk during construction so that shrinking during the life of the transformer will be minimal.
3. Convenient means shall be provided to take up any slackness that does occur due to shrinkage of the windings.

## Tanks

1. The tank, which shall be of the sealed type, shall be constructed of steel plate, without conservators or breathers.
2. The tank and radiators shall be constructed in such a manner that the transformer internal pressure may vary between 50 kPa vacuum and 115 kPa positive pressure without damage or oil leakage for a fin-wall style of design or, 0 kPa vacuum and 150 kPa positive pressure in case of panel style of cooling radiators.
3. Joints and stiffeners shall be continuously welded along the upper line of contact with the tank to prevent lodging of water behind the bracing. The undersides may be tack welded. Joints between the tank and tank covers and the flanges of bushings shall be rendered oil-tight by the insertion of gaskets of neoprene or similar material that is impervious to and unaffected by transformer oil. The gaskets shall be under controlled pressure.
4. All parts of the tank shall be so designed and constructed to eliminate the formation of air pockets inside the tank.
5. The tank covers shall be removable independently of the cores and windings.

## Drying Out and Oil Filling

1. The transformer shall be dried out thoroughly at the Contractor’s works before filling with oil.
2. The transformer shall be filled with oil in such a manner as to prevent air inclusion in the coil/core assembly.

## Protective Coatings on Exposed Surfaces

### Paint Coating

The exposed metal surfaces shall be treated in accordance with the Water Corporations coating specification C1 or C2 as specified in the Annexure.

Specification C1 is to be used when the transformer is to be installed in corrosivity categories C1-C3.

Specification C2 is to be used when the transformer is to be installed in corrosivity categories C4-C5.

All paints comprising the paint system shall be from the same manufacturer.

### Surface Preparation

All exposed metal surfaces shall be treated in accordance with the Water Corporations surface preparation specification A1.

### Paint Colour

The colour of the top coat paint applied to external surfaces shall be a standard colour in accordance with AS 2700, as specified in the Annexure.

## Protective Coatings on Internal Surfaces

### Surface Preparation

All tank internal surfaces above oil level shall be abrasive blast cleaned in accordance with AS 1627.4 Class 2.5.

### Paint Coating

A protective paint coating consisting of a zinc phosphate/micaceous iron oxide epoxy primer conforming to AS 3750.13. Type 2 shall be applied to minimum dry film thickness of 20 microns to all tank internal surfaces above oil level surfaces.

# SHIELD ON PRIMARY WINDING HV CONNECTORS

(a) An appropriate bolt on shield shall be provided on the transformer to prevent removal of the primary winding High Voltage cable dead break elbow connectors unless the shield is removed first.

(b) If the transformer is not to be housed in a kiosk enclosure, the above shield shall be padlockable, or shall be interlockable with the associated High Voltage switchgear, so as to prevent removal of the shield unless the transformer is isolated from all possible sources of electrical supply.

(c) An aluminium label engraved as hereunder shall be fitted to the above shield.

Caution

Dead break connectors

Do not connect or disconnect live

# TESTING

## Type Tests on Transformer in Kiosk Enclosure

Evidence shall be submitted on delivery indicating that all type tests required by the relevant parts of AS 60076 have been carried out satisfactorily on the transformer in a kiosk enclosure or on a transformer in a kiosk of an identical design.

## Routine Tests

* 1. The transformer shall undergo routine testing in accordance with the relevant parts of AS 60076.
	2. In addition to the above, evidence shall be submitted on delivery indicating that the transformer provided in a kiosk enclosure passed successfully the routine tests and verifications stated in section 7 ‘Routine Tests’ of AS 62271.202 on the transformer/enclosure arrangement.
	3. The Contractor shall supply one copy of the routine test certificate on delivery of the transformer.

## Short Circuit Test

The AS/NZS 60076.5, Ability to Withstand Short Circuit, identifies the requirements for transformers to sustain without damage the effects of overcurrents originated by external short circuit.

The transformer manufacturer shall submit:

1. Short circuit withstand capability test certificate of the proposed transformer design, or
2. The theoretical evaluation of the ability of a power transformer to withstand the dynamic effects of short circuit and the thermal ability of a transformer. The documentation needed for the purpose includes all necessary technical data, such as electromagnetic design data sheets, calculations of short circuit currents, electromagnetic forces and mechanical stresses, supplemented by drawings, material specifications, manufacturing practices and process instructions, etc., either produced for the specific purpose of the electromagnetic and mechanical design of the transformer or as part of the manufacturer’s technology documentation.

## Test Certificates

All test certificates shall describe the tests carried out and the test results obtained.

# LIQUIDATED DAMAGES FOR EXCESS LOSSES

In addition to any liquidated damages specified in the General Conditions of Contract, the Contractor shall be liable to the Principal for liquidated damages in respect to cost of the amount of transformer total losses in excess of the value quoted previously by the Contractor in the Tender Technical Response Schedule.

Such liquidated damages shall be calculated on the basis of the capitalised cost of losses quoted in the Annexure.

# INSTALLATION AT SITE

1. The Contractor shall deliver the transformer to the site
2. The Contractor shall uncrate and position the equipment if necessary

# POST INSTALLATION REQUIREMENTS

## Final Inspection

Before final testing and commissioning of the transformer takes place, the Contractor shall undertake an inspection to verify that the transformer is undamaged and that the mechanical and electrical installation is correct.

## Final Testing and Commissioning

The Contractor shall carry out the following tests after Final Inspection has been completed:

1. Insulation Resistance Check
2. Voltage Ratio Check

Once Final Inspection and Final testing have been completed, the Contractor shall commission the transformer in conjunction with the Principal’s electrical staff.

## As-Constructed Drawings

The Contractor shall provide as-constructed information on all drawings detailing all changes and modifications made during the construction and installation phases of the project.

The contractor shall submit drawings in both AutoCAD and PDF formats in accordance with the Drawing Submission Process. Adequate contrast within the PDF image shall be maintained between drawing content and background to ensure the clarity and quality of the drawings.

## Manuals

The Contractor shall supply 1 copies of comprehensive instruction manuals, written in English and covering the complete operation and maintenance requirements of all equipment supplied under the Contract. The manuals shall be printed on high grade A4 size paper and shall be bound in a high grade A4 size loose leaf binder.

Information included in the manuals shall include:

1. Operating instructions
2. Safety instructions and warnings
3. Maintenance instructions and schedules
4. Recommended spare parts and special tool list
5. As constructed drawings
6. Detailed equipment performance specifications
7. Test reports and test certificates

# SPECIAL REQUIREMENTS

In addition to the above the transformer shall be supplied in accordance with any special requirements detailed in the Supplementary Annexure.

**Annexure to Specification**

**for**

**Oil Filled Transformer in Kiosk**

**Project:**

**Site Location:**

**Work to be done by the Principal:**

………………………………………………………………………………………………………………..

…………….………………………………………………………………………………………………….

**Capitalised Cost of Losses**: $/kW

**Special Service Conditions:**

Pollution Level in accordance with IEC 60815 ………………………………………………………

Average shade ambient temperature ………………………………………………………….…….oC

**Operating Environment**(i.e. indoors, or outdoors in a kiosk enclosure)……………………………………………………………….

**HV Electrical Supply Conditions**

 Highest Voltage for Equipment Um ………………………………………………………………...kV

 System Fault Level ………………………………………………………………………………..MVA

 Earth Fault Factor ………………………………………………………………………………………

**Annexure to Specification**

**for**

**Oil Filled Transformer in Kiosk**

**Transformer Load:**

Type of load (i.e. linear or non-linear)

 Maximum load/Transformer kVA rating kVA

**Transformer Rated Characteristics**

 Primary phase to phase voltage kV

 Secondary phase to phase no load voltage kV

 Impedance %

**Secondary Star Point Current Transformer**

Rated primary current Amps

 Rated burden VA

**Oil Over Temperature Instrument Contacts**

 Warning contacts (required or not)

 Trip contacts (**required** or not)

**Over Pressure Instrument Contacts**

Warning contacts (required or not)

 Trip contacts (required or not)

**Winding Temperature Monitoring**

 Warning/alarm contacts ………………………………………………………………………..

 Trip contacts ……………………………………………………………………………………

**Primary Cables**

Cable type ………………………………………………………………………………………

 Cable rated voltage…………………………………………………………………………….kV

 Cable conductor size…………………………………………………………………………mm2

 Number of cables per phase………………………………………………………………….

**HV Terminal Surge Diverters**

 Type of surge diverters per phase ……………… ………………………………………..…

**Secondary Cables**

Cable type

 Cable rated voltage kV

 Cable Conductor size …mm2

 Number of cables per phase

 Number of cables for neutral (if applicable) ……………………………………………

**Annexure to Specification**

**for**

**Oil Filled Transformer in Kiosk**

**LV Feed to HV Circuit Breaker Capacitive Trip Supply**(only required if transformer has 415 Volt nominal secondary voltage and the HV switchboard does not have battery powered trip supply)

LV feed (required or not) ……………………………………………………………………………………….

**Protective Coatings on Exposed Surfaces**

Colour of top coat paint in accordance with AS 2700 ……………………………………………………

|  |
| --- |
| **Type Specification for Oil Filled Transformer in Kiosk****Tender Technical Response Schedule** |
| **Clause No.** | **Subject** | **Noted** | **Compliance** | **Comments** |
|  |  |  | **Yes** | **No** |  |
| **1** | **General** |  |  |  |  |
| **2** | **Site** |  |  |  |  |
| **3** | **Operating Mode** |  |  |  |  |
| **4** | **Work by the Principal** |  |  |  |  |
| **5** | **Information from the Contractor** |  |  |  |  |
| **6** | **Contractor’s Drawings** |  |  |  |  |
| **7** | **Standards** |  |  |  |  |
| **8** | **Quality Assurance** |  |  |  |  |
| **9** | **Safety Requirements – Electrical Work** |  |  |  |  |
| **10** | **Power Supply** |  |  |  |  |
| **11** | **Transformer Load** |  |  |  |  |
| **12.** | **Ambient Conditions** |  |  |  |  |
| **13.** | **Type of Transformer** |  |  |  |  |
| **14.** | **Operating Environment** |  |  |  |  |
| **15.** | **Kiosk Enclosure** |  |  |  |  |
| **16.** | **Transformer Functional Requirements** |  |  |  |  |
| 16(a) | Number of phases |  |  |  |  |
| 16(b) | Frequency |  |  |  |  |
| 16(c) | Number of windings |  |  |  |  |
| 16(d) | Primary phase to phase voltage |  |  |  |  |
|  | Secondary no load phase to phase voltage |  |  |  |  |
| 16(e) | Primary connection |  |  |  |  |
|  | Secondary connection |  |  |  |  |
| 16(f) | Vector group |  |  |  | Vector group = |
| 16(g) | H.V. supply earth to fault factor |  |  |  |  |
| 16(h) | Secondary winding star point to be grounded |  |  |  |  |
| 16(i) | kVA rating |  |  |  | 50 deg. C rated kVA = |
| 16(j) | Type of load |  |  |  |  |
| 16(k) | Type of construction |  |  |  |  |
| 16(l) | Type of cooling |  |  |  | Cooling type = |
| 16(m) | Temperature Limits |  |  |  |  |
|  | Max. oil temperature = 100 deg. C |  |  |  | FLC oil temperature deg. C = |
|  | Max winding temperature = 105 deg. C |  |  |  | FLC winding temperature deg. C = |
| 16(n) | Lightning impulse withstand voltage |  |  |  | LIWV kVp = |
|  | Short duration 50 Hz withstand voltage |  |  |  | ACSD WV kVrms = |
| 16(o)  | Voltage tappings |  |  |  | Range % = |

|  |
| --- |
| **Type Specification for Oil Filled Transformer in Kiosk****Tender Technical Response Schedule** |
| **Clause No.** | **Subject** | **Noted** | **Compliance** | **Comments** |
|  |  |  | **Yes** | **No**  |  |
|  |  |  |  |  | Step size % = |
|  |  |  |  |  | Tapped winding = |
| 16(p) | Impedance |  |  |  | Impedance % = |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| 16(q) | Losses |  |  |  | 50% load efficiency % = |
|  | MEPS losses limit |  |  |  |  |
| 16(r) | Maximum no load sound power level |  |  |  | No load sound power dBA = |
| 16(s) | Interference |  |  |  |  |
| 16(t) | Degree of protection |  |  |  | IP rating = |
| **17.** | **Miscellaneous Fittings** |  |  |  |  |
| 17(a) | Primary dead break elbow and surge arrester cable terminations |  |  |  |  |
| 17(b) | Secondary cable terminations |  |  |  |  |
| 17(c) | Secondary winding star point CT |  |  |  |  |
| 17(d) | 240 VAC supply to capacitive trip supply unit |  |  |  |  |
| 17(e) | Tapping Switch |  |  |  |  |
| 17(f) | Earthed screen |  |  |  |  |
| 17(g) | Earthing connection  |  |  |  |  |
| 17(h) | Dial type oil temperature thermometer with:  |  |  |  |  |
|  | Alarm contacts |  |  |  | Alarm temperature deg C = |
|  | Trip contacts |  |  |  | Trip temperature deg C = |
| 17(i) | Pressure relief valve with trip contact |  |  |  | Trip pressere kPa = |
| 17(j) | Oil filling hole and cap |  |  |  |  |
| 17(k) | Oil level indicator |  |  |  |  |
| 17(l) | Oil drain valve with a sampler |  |  |  |  |
| 17(m) | Oil catchment tray |  |  |  |  |
| 17(n) | Lifting lugs |  |  |  |  |
| 17(o) | Ratings, connection diagram and terminal marking plate |  |  |  |  |
| 17(p) | Skid base |  |  |  |  |
| 17(q) | HV Surge diverters |  |  |  |  |
| **18.** | **Construction Requirements** |  |  |  |  |
| 18.1 | General |  |  |  |  |
| 18.2 | Cores |  |  |  |  |
| 18.3 | Windings |  |  |  |  |
| 18.4 | Tanks |  |  |  |  |
| **Type Specification for Oil Filled Transformer in Kiosk****Tender Technical Response Schedule** |
| **Clause No.** | **Subject** | **Noted** | **Compliance** | **Comments** |
|  |  |  | **Yes** | **No** |  |
| 18.5 | Drying Out and Oil Filling |  |  |  |  |
| 18.6 | Protective Coatings on Exposed Surfaces |  |  |  |  |
| *18.6.1* | Paint Coating |  |  |  |  |
| *18.6.2* | Surface Preparation |  |  |  |  |
| *18.6.3* | Paint Colour |  |  |  |  |
| 18.7 | Protective Coatings on Internal Surfaces |  |  |  |  |
| 18.7.1 | Surface preparation |  |  |  |  |
| 18.7.2 | Paint coating |  |  |  |  |
| **19.** | **Shield on Primary Winding HVConnectors** |  |  |  |  |
| **20.** | **Testing** |  |  |  |  |
| 20.1 | Type Tests on Transformer in Kiosk Enclosure |  |  |  |  |
| 20.2 | Routine Tests |  |  |  |  |
| 20.3 |  Short Circuit Test |  |  |  | Test certificate or theoretical evaluation attached =   |
| 20.4 | ***Test Certificates*** |  |  |  |  |
| **21.** | **Liquidated Damages for Excess Losses** |  |  |  |  |
| **22.** | **Installation at Site** |  |  |  |  |
| **23.** | **Post Installation Requirements** |  |  |  |  |
| 23.1 | **Final Inspection** |  |  |  |  |
| 23.2 | **Final Commissioning and Testing** |  |  |  |  |
| 23.3 | **As Constructed Drawings** |  |  |  |  |
| 23.4 | **Manuals** |  |  |  |  |
| *24.* | **Special Requirements** |  |  |  |  |
|  |  |  |  |  |  |

END OF DOCUMENT