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| Assets Planning and Delivery GroupEngineering  |

DESIGN STANDARD DS 26-29

Type Specifications – Electrical

Type Specification for Pole Mounted Oil Filled Transformer

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| version 2revision 2 |
| June 2022 |

**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.

Design Standards draw on the asset design, management and field operational experience gained and documented by the Corporation and by the water industry generally over time. They are intended for application by Corporation staff, designers, constructors and land developers to the planning, design, construction and commissioning of Corporation infrastructure including water services provided by land developers for takeover by the Corporation.

Nothing in this Design Standard diminishes the responsibility of designers and constructors for applying the requirements of the Western Australia's Work Health and Safety (General) Regulations 2022 to the delivery of Corporation assets. Information on these statutory requirements may be viewed at the following web site location:

[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)

Enquiries relating to the technical content of a Design Standard should be directed to the Senior Principal Engineer - Electrical, Engineering. Future Design Standard changes, if any, will be issued to registered Design Standard users as and when published.

**Head of Engineering**

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REVISION STATUS

The revision status of this standard is shown section by section below. It is important to note that the latest revisions including additions, deletions and changes to this version of the standard are also identified by the use of a vertical line in the left hand margin, adjacent to the revised section.

| **REVISION STATUS** |
| --- |
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| **2/2** | **14.06.22** |  | **Document reviewed and no changes required** | **EDG** | **EDG** |

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# GENERAL

(a) This Specification covers the requirements for the design, manufacture, assembly inspection, factory testing, packaging and transport to site of a pole mounted oil filled step down transformer rated not more than 200 kVA.

(b) The Transformer shall be supplied to site fully assembled and complete with all necessary accessories.

# DELIVERY SITE

The location of and access to the site for the delivery of the transformer shall be as shown in the Annexure.

# WORK BY THE PRINCIPAL

The installation, connection and on site testing of the transformer will be carried out by the Principal.

# INFORMATION TO BE PROVIDED BY THE CONTRACTOR

The Contractor shall provide the following documentation in respect to the transformer within the listed number of days after receipt of the Principal's order.

(a) General Arrangement Drawings 28 days

(b) Electrical Wiring & Schematic Drawings 28 days

(c) Manufacture and Delivery Schedule 14 days

(d) Specification Data Sheets 35 days

(e) Inspection and Test Plan 35 days

(f) Test Certificates Within 14 days after Delivery

(g) Operating and Maintenance Manual Within 14 days after Delivery

# CONTRACTOR’S DRAWINGS

## General

 The Contractor shall submit two A3 paper copies of the Contractor's drawings for approval.

The Contractor’s Drawings shall show the general arrangement, circuit diagrams and equipment specifications.

All drawings submitted by the Contractor shall be in accordance with the latest issue of the relevant Australian Standards.

Adequate contrast shall be maintained between drawing and background, and the clarity and quality of the drawings shall enable the Principal to microfilm the prints and reproduce, by photographic processes, clear and legible A3 copies for records purposes.

The drawings shall provide, in the title block, the number and title of the Contract, as well as details to identify the drawing, its contents, revision status and date of issue.

All drawings shall be prepared using AutoCAD Release 2000 or later software. Drawings shall be prepared on A1 metric size drawing sheets, incorporating the Principal’s border and title block.

# STANDARDS

The workmanship, equipment and materials provided in accordance with this Specification shall comply in design, construction, rating and performance with the current relevant Australian Standards and Codes. 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.

Specific reference is made within the Specification to the following Australian and International Standards:

AS 1627.4 Metal-Finishing - Preparation and Pre-treatment of Surfaces Abrasive Blast Cleaning

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

AS 2374.1.2 Power Transformers – Minimum Energy Performance Standards, (MEPS), requirements for distribution transformers

AS 2700 Colour Standard for General Purposes

AS 60076.1 Power transformers - General (IEC 60076.1 modified)

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

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

AS/NZS 60076.10 Power Transformers - Determination of sound levels (IEC 60076.10 modified)

AS/NZS 3750 Paints for Steel Structures

AS/NZS ISO 9001 Quality Management Systems - Requirements

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

IEEE C57-110 Establishing liquid filled and dry type power and distribution transformer capability when supplying non sinusoidal load currents

ISO 9223 Corrosion of metals and alloys - Corrosivity of atmospheres -Classification, determination and estimation

# QUALITY ASSURANCE

The transformer 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 transformer shall be suitable for operation from a High Voltage power supply and have the following characteristics:

(a) Voltage range: ± 10% of primary voltage detailed in the Annexure.

(b) Frequency range: 50 Hz ± 2½%.

(c) Earth fault factor as detailed in the Annexure

# OPERATING MODE

The transformer shall be suitable for both continuous and cyclic operation at full load in the mode(s) of operation specified in the Annexure and under the specified ambient conditions.

# INSTALLATION SITE AMBIENT CONDITIONS

(a) The installation site ambient conditions shall be considered to be as follows:

(i) outdoor shade temperature range: -5oC to + 50oC

(ii) outdoor shade maximum average daily temperature: + 30oC

(iii) maximum relative humidity of 90 % with periods of heavy condensation

(iv) pollution level in accordance with IEC 60815: as specified in the Annexure.

1. The transformer shall be suitable for mounting outdoors in full sun.

# TECHNICAL REQUIREMENTS

## Standards

The transformer shall be designed and constructed in accordance with all relevant current parts of AS 60076 and with the requirements listed hereunder.

## Linear Load kVA Rating

The transformer’s linear load kVA rating shall be rated for 50 oC.

Non-linear Load Output Current Rating

If the transformer has been specified in the Annexure to be rated for supplying a non-linear current load, its output current rating shall be the linear load output current rating, as determined from the linear load kVA rating, further derated to take account of the increase in losses due to the harmonic currents. The amount of derating required will depend on the harmonic profile of the load and is specified in terms of the “eddy current harmonic loss factor” and the “other stray losses harmonic loss factor”.

The transformer maximum allowable non-linear current shall be determined in accordance with IEEE C57-110, as detailed hereunder:

1. Ir = rated 50 Hz current (amps)

(b) Pnl = no load test measured losses (watts)

(c) Psct = short circuit test measured losses (watts) at Ir

(d) θr = top oil temperature rise (deg. C) at Ir

(e) θgr = conductor hot spot temperature rise above top oil temperature rise (deg. C) at Ir

(f) Ptr = Pnl + Psct = total losses (watts)at Ir

(g) Pwr = I2R losses (watts) based on measured winding resistance and Ir

(h) Pts = Psct - Pwr = total stray losses (watts) at Ir

(i) Pec = 0.33\*Pts = eddy current losses (watts) at Ir

(j) Pos = 0.67\*Pts = other stray losses (watts) at Ir

(k) In = rms value of a particular non-linear load current (amps)

(l) Fec = eddy current harmonic loss factor as specified in the Annexure

(m) Fos = other stray losses harmonic loss factor as specified in the Annexure

(n) Pwrn = Pwr \*(In / Ir )2 = I2R losses (watts) at In

(o) Pecn = Fec \*Pec = eddy current losses (watts) at In

(p) Posn = Fos\*Pos = other stray losses (watts) at In

(q) Ptn = Pnl + Pwrn +Pecn +Posn = total losses (watts) at In

(r) θn = θr \*( Ptn / Ptr )0.8 = top oil temperature rise (deg. C) at In

 (s) θgn = θgr\* [( Pnl + Pwrn +4\*Pecn +Posn )/(Pnl + Pwr +4\*Pec +Pos)]0.8

 = conductor hot spot temperature rise above top oil temperature rise (deg. C) at In

(t) θct = θn + θgn = conductor hot spot temperature rise (deg. C) at In

(u) The non-linear current In shall not be permitted to exceed the magnitude which causes the top oil temperature to exceed the allowable maximum, nor to exceed the magnitude which causes the conductor hot spot temperature to exceed the allowable magnitude, and the transformer shall be rated accordingly.

## Functional Requirements

The transformer shall comply with the following functional requirements:

(a) Number of Phases: 3

(b) Frequency: 50 Hz

(c) Number of Windings: 2

(d) Vector Group: Dynl

(e) Voltages: Primary: as detailed in the Annexure

 Secondary: 433 volts phase to phase

(f) Connections: Primary: delta

 Secondary: star with the neutral brought out

(g) Linear load kVA rating: as determined para. 12.2 above

(h) Non-linear load output current rating: as determined para. 12.3 above

## Transformer Service Conditions

The transformer shall be suitable for operation under the following service conditions:

1. Service ambient conditions as determined para. 11 above
2. H.V. supply earth fault factor as specified in the Annexure
3. Grounding of secondary winding: directly earthed

(d) Type of load: as specified in the Annexure

## Design

The transformer shall be in accordance with the following design requirements:

1. General; low loss design with minimum eddy current losses
2. Cooling: ONAN employing natural cooling oil
3. Impedance: as specified in the Annexure
4. Voltage tappings:

 (i) range: +/- 5%

 (ii) step size: 2.5%

 (iii) tapped winding: primary

1. Degree of Protection in accordance with AS 60529: IP56

## Performance Requirements

The transformer’s performance shall be in accordance with the following requirements:

1. Inrush current : not more than 7 times full load current
2. If transformer rated at 11 kV or 22 kV,
minimum linear load efficiency at 50% FLC: as per AS 2374.1.2, Table 3
3. If transformer rated at 33 kV,
minimum linear load efficiency at 50% FLC: 99.5%(c) Lightning impulse withstand voltage (LIWV): as specified in the Annexure, full wave lightning impulse

(d) Short duration 50 Hz withstand voltage: as specified Table 2 AS 60076.3, column 5, applied voltage or line terminal AC withstand

(e) Full load oil temperature limit: 100oC

(f) Full load winding temperature limit: 105oC

(g) Sound level as per AS/NZS 60076-10 Annex ZA1: reduced limit

## Miscellaneous Fittings

The transformer shall be provided with the following fittings:

(a) High Voltage aerial connected porcelain bushings.

(b) At Low Voltage terminations air insulated bushings within AS 60529 -IP66 rated air insulated connector boxes suitable for connecting cabling.

(c) Manual off circuit tapping switch brought out via an oil tight gland and complete with warning label located next to the handle indicating that the transformer must be de-energised before operating the switch.

(d) An earthed screen between the primary and secondary windings, only if the type of load has been specified in the Annexure as non-linear.

(e) A transformer tank earthing lug suitable for connection of earthing cable.

(f) 100mm dial type thermometer with top oil temperature indicator.

(g) Surge Diverters as specified in the Annexure.

(h) Oil filling hole and cap.

(i) Oil level indicator.

(j) Oil drain valve with a sampler.

(k) Lifting lugs.

(l) Cross arm mounting brackets suitable for a 100mm by 100mm steel cross arm.

(m) Stainless steel rating plate.

(n) Terminal marking plate.

## 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 minimize vibration and shall be unaffected by normal use, short circuit conditions or handling during transport, installation, inspection or repair.

### Cores

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.. The cores shall be so designed and constructed as to ensure that excessive temperatures do not occur at the centres of the cores. Facilities shall be provided for lifting the cores, with windings, from the tank for inspection and repair.

### Windings

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

### Tanks

The tank, which shall be of the sealed type, shall be constructed of steel plate, without conservators or breathers. The tank and radiators shall be constructed in such a manner that the transformer internal pressure may vary between 50 kPa vacuum and 15 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.. Joints and stiffeners shall be continuously welded along the upper line of contact with the tank to prevent lodging of waster 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. All parts of the tank shall be so designed and constructed as to eliminate the formation of air pockets inside the tank. The tank covers shall be removable independently of the cores and windings.

### Drying Out and Oil Filling

The transformer shall be dried out thoroughly at the Contractor's works before filling with oil. 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

### General

The exposed metal surfaces shall be protected by the application of a painting system either Type LP1-A or LP2-A in accordance with AS2312. All paints comprising the paint system shall be from the same manufacturer.

The paint coating shall be rated as providing medium term, protection in tropical, industrial, marine and severe marine environments in accordance with AS 2312 (and ISO 9223).

### Paint Colour

The colour of the top coat paint applied to external surfaces shall be a standard colour in accordance with AS2700 as specified in the Annexure.

### Surface Preparation

All exposed metal surfaces shall be abrasive blast cleaned in accordance with AS 1627.4 Class 2.5.

## 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.

# TESTING

## Type Tests

Evidence shall be submitted on delivery indicating that all type tests required by AS 60076.1 have been carried out satisfactorily on the transformer or on a transformer of an identical design.

In addition, type tests shall include sound power level tests in accordance with AS/NZS 60076.10.

## Type Tests MEPS

Evidence shall be submitted on delivery that efficiency testing in accordance with AS 2374.1.2 has been carried out satisfactorily on the transformer or on a transformer of identical design.

## Routine Tests

Prior to delivery, the transformer shall undergo all routine tests required by AS 60076.1

## 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:

* a short circuit withstand capability test certificate of the proposed transformer design, or
* 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 od 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.

# DELIVERY

The Contractor shall deliver the transformer to the Principal’s representative at the site specified in the Annexure.

# 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 Response Schedule.

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

# POST DELIVERY REQUIREMENTS

## As-Constructed Drawings

The Contractor shall provide as constructed information on all drawings.

As-constructed drawings shall be supplied electronically with A3 size hard copies.

## Manuals

The Contractor shall supply 3 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:

(a) operating instructions;

(b) safety instructions and warnings;

(c) maintenance instructions and schedules;

(d) recommended spare parts and special tool list;

(e) as constructed drawings;

(f) detailed equipment performance specifications and;

(g) 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**

**Pole Mounted Oil Filled Transformer**

**Project: ……………………………………………………………………………………**

 **……………………………………………………………………………………**

**Delivery Site: ……………………………………………………………………………………**

 **……………………………………………………………………………………**

Type of Access to Delivery Site: …………………………………………………………………

 **Installation Site:** Pollution level in accordance with IEC 60815

 **Operating Mode:**  Single or parallel operation………………………………………………….…..

 Linear or non linear load ……………………………………………………….

 Eddy current harmonic loss factor, Fec ……………………………………………………………..………

 Other stray losses harmonic loss factor Fos ……………………………………..

 **H.V. Electrical Supply Conditions:**

 Highest voltage for equipment Um ………………………………………………………………………………………………………. kV

 System fault level ………………………………………………………………………… ……..MVA

 Method of system earthing …………………………………………………………………………….

 Earth fault factor …………………………………………………………………… ….

 **Transformer Requirements**

 **Primary Winding**

Rated voltage ……………………………………………………………………………………. kV

Linear load continuous rating …………………………………………………………………… kVA

LIWV (AS 60076.3 Table 2 refers) ……………………………………………………………… kV

**Secondary Winding**

Rated voltage …………………………………………………………………………………….. kV

Linear load continuous rating ……………………………………………………………………. kVA

Maximum current …………………………………………………………. …………………….. Amps

LIWV (AS 60076.3 Table 2 refers) ………………………………………………………………...kV

 Size and Number of cables per phase

**Annexure to Specification**

**for**

**Pole Mounted Oil Filled Transformer**

**Surge Diverters** (Required or not Required) ………………………………………………………..

 If required type of surge diverter per phase ……………………………………………………

**General**

Overall impedance: ………………………………………………………………………………. %

Maximum iron loss at no load …………………………………………………………………… Watts

Maximum iron loss at 100% load ………………………………………………………………... Watts

Maximum load loss at 100% load …………………………………………………………….. Watts

External paint colour in accordance with AS 2700 …………………………………………………….

**Capitalised Cost of Losses:**

Full Load Losses: ………………………………………………………………………………… $/kW

No Load Losses: …………………………………………………………………………………. $/kW

Special Requirements ………………………………………………………………………………….

……………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………

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| **Type Specification for Pole Mounted Oil Filled TransformerTender Technical Response Schedule** |
| **Clause** | **Subject** | **Noted** | **Compliance** | **Comments** |
| **No.** |  |  | **Yes** | **No** |  |
| **1** | **Scope** |  |  |  |  |
| **2** | **Delivery Site**  |  |  |  |  |
| **3** | **Work by the Principal** |  |  |  |  |
| **4** | **Information from Contractor** |  |  |  |  |
| **5** | **Contractor’s Drawings** |  |  |  |  |
| **6** | **Standards** |  |  |  |  |
| **7** | **Quality Assurance** |  |  |  |  |
| **8** | **Safety Requirements** |  |  |  |  |
| **9** | **Power Supply** |  |  |  |  |
| **10** | **Operating Mode** |  |  |  |  |
| **11** | **Installation Site Ambient Conditions** |  |  |  |  |
| **12** | **Technical Requirements** |  |  |  |
| 12.1 | Standards |  |  |  |  |
| 12.2 | Linear Load kVA Rating |  |  |  |  |
|  |  |  |  |  |  |
| 12.3 | Non-Linear Current Rating |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| 12.4 | Functional Requirements |  |  |  |  |
|  | 3 phases |  |  |  |  |
|  | Operating Frequency |  |  |  | Offer rated Hz = |
|  | Number of Windings  |  |  |  | Offer no. windings = |
|  | Vector Group |  |  |  | Offer vector group = |
|  | Voltages |  |  |  | Offer primary rated kV = |
|  |  |  |  |  | Offer secondary rated kV = |
|  | Connection  |  |  |  | Offer primary connection = |
|  |  |  |  |  | Offer secondary connection = |
|  | Linear Load kVA |  |  |  | Offer rated kVA = |
|  | Non-Linear Load Amps |  |  |  | Offer In max Amps = |

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| **Type Specification for Pole Mounted Oil Filled TransformerTender Technical Response Schedule** |
| **Clause** | **Subject** | **Noted** | **Compliance** | **Comments** |
| **No.** |  |  | **Yes** | **No** |  |
| 12.5 | Transformer Service Conditions |  |  |  |  |
|  | Service Ambient Conditions |  |  |  |  |
|  | Supply Earth Fault Factor |  |  |  |  |
|  | Secondary Winding Grounding  |  |  |  |  |
|  | Type of Load  |  |  |  |  |
| 12.6 | Design |  |  |  |  |
|  | Low Loss Design |  |  |  | Offer FLC efficiency % = |
|  |  |  |  |  | Offer no load 50 Hz losses, kW = |
|  |  |  |  |  | Offer full load 50 Hz losses, kW = |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  | Flux density |  |  |  | Offer Flux density T = |
|  | Type of Cooling |  |  |  |  |
|  | Impedance |  |  |  | Offer impedance % = |
|  | Voltage Tappings |  |  |  |  |
|  | Range |  |  |  | Offer tapping range % = |
|  | Size |  |  |  | Offer tapping step % = |
|  | Tapped Primary Winding |  |  |  |  |
|  | Degree of Protection |  |  |  | Offer IP = |
| 12.7 | Performance Requirements |  |  |  |  |
|  | Inrush Current |  |  |  | Offer inrush current % = |
|  | Linear Load Efficiency |  |  |  | Offer 100% load efficiency % = |
|  |  |  |  |  | Offer 50% load efficiency % = |
|  | Lightning Impulse Withstand |  |  |  | Offer LIWV, kVp = |
|  | Short Duration 50 Hz Withstand Voltage |  |  |  | Offer primary 50 Hz withstand kVrms = |
|  |  |  |  |  | Offer secondary 50 Hz withstand kVrms = |
|  | Oil Temperature Limits |  |  |  | Offer max. oil temp, deg C = |
|  | Winding Temperature Limit |  |  |  | Offer max. winding temp, deg C = |
|  | Sound Level |  |  |  | Offer reduced sound power level, dBA = |
| 12.8 | Miscellaneous Fittings |  |  |  |  |
|  | H.V. Terminations |  |  |  | Offer HV bushings = |
|  | L.V. Terminations  |  |  |  | Offer LV bushings = |
|  | Tapping Switch |  |  |  |  |
|  | Earth Screen |  |  |  |  |
|  | Tank Earth Connection |  |  |  |  |
|  | Dial Type Thermometer |  |  |  |  |

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| **Type Specification for Pole Mounted Oil Filled TransformerTender Technical Response Schedule** |
| **Clause** | **Subject** | **Noted** | **Compliance** | **Comments** |
| **No.** |  |  | **Yes** | **No** |  |
|  | HV Surge Diverters |  |  |  | Offer max. operating kV = |
|  |  |  |  |  | Offer temp over voltage kV = |
|  |  |  |  |  | Offer discharge Amps = |
|  |  |  |  |  | Offer maximum residual kV = |
|  | Oil Filling Hole |  |  |  |  |
|  | Oil Level Indicator |  |  |  | Type = |
|  | Oil Drain Valve with a sampler |  |  |  |  |
|  | Lifting Lugs |  |  |  |  |
|  | Cross Arm Brackets |  |  |  |  |
|  | Rating Plate  |  |  |  |  |
|  | Terminal Marking Plate |  |  |  |  |
| 12.9 | Construction Requirements |  |  |  |  |
| 12.9.1 | General |  |  |  |  |
| 12.9.2 | Cores |  |  |  |  |
| 12.9.3 | Windings |  |  |  |  |
| 12.9.4 | Tanks |  |  |  |  |
| 12.9.5 | Drying Out and Oil Filling |  |  |  |  |
| 12.10 | Protective Coatings on Exposed Surfaces |  |  |  |  |
| 12.10.1 | General |  |  |  | Offer AS/NZS 2312 System = |
|  |  |  |  |  | Classification = |
|  |  |  |  |  | Offer primer DFT microns = |
|  |  |  |  |  | Offer intermediate DFT microns = |
|  |  |  |  |  | Offer top coat DFT microns = |
|  |  |  |  |  | Offer total DFT microns = |
| 12.10.2 | Paint Colour |  |  |  | Offer AS 2700 No. = |
| 12.10.3 | Surface Preparation |  |  |  |  |
| 12.11 | Protective Coatings on Internal Surfaces |  |  |  |  |
| 12.11.1 | Surface Preparation  |  |  |  |  |
| 12.11.2 | Paint Coating |  |  |  | Offer DFT microns = |
| **13** | **Testing** |  |  |  |  |
| 13.1 | Type Tests General |  |  |  |  |
| 13.2 | Type Tests MEPS |  |  |  |  |
| 13.3 | Routine Tests |  |  |  |  |
| 13.4 | Short Circuit Test |  |  |  | Test certificate or theoretical evaluation attached = |
| 13.5 | Test Certificates |  |  |  |  |

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| **Type Specification for Pole Mounted Oil Filled TransformerTender Technical Response Schedule** |
| **Clause** | **Subject** | **Noted** | **Compliance** | **Comments** |
| **No.** |  |  | **Yes** | **No** |  |
| **14** | **Delivery**  |  |  |  |  |
| **15** | **Liquidated Damages** |  |  |  |  |
| **16** | **Post Delivery Requirements** |  |  |  |  |
|  | As-constructed drawings |  |  |  |  |
|  | Manuals |  |  |  |  |
|  | Dimensions |  |  |  | O/A length m = |
|  |  |  |  |  | O/A width m = |
|  |  |  |  |  | O/A height m = |
|  |  |  |  |  | Weight kg = |
| **17** | **Special Requirements** |  |  |  |  |

END OF DOCUMENT