Electricity Distribution

nationalgrid

Company Directive

ENGINEERING SPECIFICATION
EE SPEC: 184/1

36kV Outdoor Structure Mounted Instrument Transformers

Policy Summary

Specification for the purchase of 36kV structure mounted instrument transformers for use on the WPD 33kV network.

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Implementation Date: **August 2020**

Approved by:

Carl Ketley-Lowe

Engineering Policy Manager

Date: **31st August 2020**

Target Staff Group	**Primary System Design, Engineering Design and Purchasing**
Impact of Change	**Green – No impact on current working practices**
Planned Assurance Checks	**Engineering Policy Team to work with Purchasing to ensure compliance.**

All references to Western Power Distribution or WPD must be read as National Grid Electricity Distribution or NGED

IMPLEMENTATION PLAN

Introduction

This document specifies the requirements for 36kV outdoor structure mounted instrument transformers. It does not cover pole mounted voltage transformers used to provide supplies to overhead automation equipment (pole mounted circuit breakers and pole mounted gas switch disconnectors).

36kV inductive voltage transformers have been added to the document that was initially restricted to 36kV outdoor structure mounted current transformers. A specification for resistor capacitor voltage transformers (RCVT) will be added shortly.

Main Changes

The addition of 36kV inductive voltage transformers to the document will allow a tender process to be commenced.

Specification allows to the provision of a stainless steel tank version for 36kV inductive voltage transformers to provide a high level of corrosion resistance when installed within 50km of the coast.

The future inclusion of 36kV RCVT will provide for an option to purchase on an as required basis where there is a specific requirement for accurate measurement of harmonics on the 33kV network.

Impact of Changes

None.

Implementation Actions

Primary System Design and Engineering Design may utilise these structure mounted instrument transformers as required during 33kV network and substation upgrades or alterations.

Implementation Timetable

A tender process will be run using EESPEC 184 so as to put in place a call-off contract for 36kV inductive voltage transformers.

Current transformers and RCVT will be quoted and ordered using EE SPEC: 184 on an as required basis. Planned/expected usage does not warrant a Framework Contract.

This specification is not available to third parties for equipment to be offered for adoption by WPD.

REVISION HISTORY

Document Revision & Review Table		
Date	**Comments**	**Author**
August 2020	• Specifications added to the document for 36kV inductive voltage transformers.	Stephen Hennell
February 2020	• This is a new document.	Stephen Hennell

Contents

1.0 INTRODUCTION

1.1 This Technical Specification sets out Western Power Distribution (WPD) requirements for 36kV outdoor structure mounted instrument transformers.

1.2 Where this WPD Technical Specification is being used for Tender purposes then unless otherwise specified in writing at time of Tender, all equipment offered against this Technical Specification shall be compliant with this Technical Specification.

1.3 Any selection of options or changes to this specification by WPD shall be made in writing.

1.4 Manufacturers and suppliers shall satisfy the requirements of BS EN ISO 9000 and BS EN ISO 9001 for all items supplied.

1.5 WPD has a distinct preference for equipment which holds an Energy Networks Association (ENA) Notice of Conformity (NoC) to the current version or a previous version of an ENA Technical Specification (TS). Where equipment does not have an ENA NoC then the following preferences apply in order:-

- Equipment from a design where other ratings have an ENA NoC;
- Equipment manufactured in a facility where other equipment having an ENA NoC is manufactured;
- Other non ENA Assessed equipment.

2.0 REFERENCES

2.1 Primary references are listed below in Table 1. Secondary references not listed but referenced in other standards shall be used as required.

2.2 Users of all standards and technical specifications shall ensure they are applying the most recent editions together with any amendments.

2.3 Where the IEC base document is listed for information, the prime document that shall take priority is the British Standard enacting the European Standard (EN) or European Harmonisation Document (HD).

BS No.	Title	IEC / ISO base
BSEN 61869-1	Instrument transformers – General requirements	IEC 61869-1
BSEN 61869-2	Instrument transformers – Additional requirements for current transformers	IEC 61869-2
BSEN 61869-3	Instrument transformers – Additional requirements for inductive voltage transformers	IEC 61869-3
BSEN 61869-4	Instrument transformers – Additional requirements for combined transformers	IEC 61869-4

BS No.	Title	IEC / ISO base
BSEN 61869-5	Instrument transformers – Additional requirements for capacitive voltage transformers	IEC 61869-5
BSHD 60269	Cartridge fuses for voltages up to and including 1000V ac and 1500V dc	IEC 60269
ENA TS 48-5	Environmental Test Requirements for Protection and Control Equipment and Systems	

Table 1 References

3.0 GENERAL

3.1 Normal service conditions

3.1.1 The instrument transformer shall be suitable for use with an ambient air temperature in the range -25degC to +40degC. [BSEN 61869-1; 4.2.1]

3.1.2 The altitude does not exceed 1000m. [BSEN 61869-1; 4.2.2]

3.1.3 Other service conditions shall be as BSEN 61869-1 clause 4.2.5:-

- the average value of the ambient air temperature, measured over a period of 24 h, does not exceed 35 °C;
- solar radiation up to a level of 1 000 W/m2 (on a clear day at noon) should be considered;
- the ambient air may be polluted by dust, smoke, corrosive gases, vapours or salt. The pollution does not exceed the pollution levels given in IEC 60815;
- the wind pressure does not exceed 700 Pa (corresponding to a 34 m/s wind speed);
- the presence of condensation or precipitation should be taken into account;
- the ice coating does not exceed 20 mm.

3.2 The system on which these instrument transformers are to be used may utilise:

- an “impedance earthed neutral system”; or
- a resonant earthed system.

For some parts of the WPD system where Arc Suppression Coil (ASC) earthing is applied then an earth fault factor of 1.9 for 8hours would be required. [BSEN 61869-1; 4.4]

3.3 The rated primary insulation levels for the instrument transformer primary terminals are:-

- Highest voltage for equipment (U_m) 36kV
- Rated power-frequency withstand voltage 70kV
- Rated lightning impulse withstand voltage (peak) 170kV

3.4 Partial discharge levels shall not exceed those in Table 2 below. The test procedure is given in BSEN 61869-1 clause 7.3.2.2. [BSEN 61869-1; 5.3.3.1]

Instrument transformer type	**PD Test Voltage (rms) kV**	**Maximum permissible PD level**	
CT and earthed VT	U_m $1.2U_m/\sqrt{3}$	10 5	50 20
Unearthed VT	$1.2U_m$	5	20

Table 2 Partial Discharge Levels

3.5 The rated power-frequency withstand voltage for secondary insulation shall be 3kV. [BSEN 61869-1; 5.3.5]

A class PX current transformer having a rated knee point emf E_k ≥2kV shall be capable of withstanding a rated power-frequency withstand voltage of 5kV rms for 60s. [BSEN 61869-2; 5.3.5]

3.6 The rated frequency is 50Hz.

3.7 Where the equipment design uses liquids then the requirements of BSEN61869-1 clause 6.1 shall apply.

3.8 WPD does not require / will not accept equipment that is gas filled.

3.9 The requirements for temperature rise of parts of the equipment shall be as BSEN 61869-1 clause 6.4.

3.10 Equipment earthing requirements

3.10.1 The frame of each equipment device, if intended to be earthed, shall be provided with a reliable earthing terminal for connection to an earthing conductor suitable for specified fault conditions. The connecting point shall be marked with the "earth" symbol as indicated by symbol No 5019 of IEC 60417. [BSEN 61869-1; 6.5.1]

3.10.2 The earthing terminal connecting point shall be suitable for either termination of copper tape and/or accepting a lugged cable end using an M12 bolted connection. Clamp type arrangements are not acceptable to WPD. Where a bolt or stud is provided then plain and spring washers are also to be provided.

3.10.3 The electrical continuity of the earthing circuits shall be ensured taking into account the thermal and electrical stresses caused by the current they may have to carry. For the interconnection of enclosure, frames, etc, fastening (eg bolting or welding) is acceptable for providing electrical continuity. [BSEN 61869-1; 6.5.3]

3.11 Corrosion protection

3.11.1 All exposed hardware shall be stainless steel.

3.11.2 Any aluminum castings shall be anodized.

3.11.3 Other exposed metal parts shall be shot blasted and spray galvanized. This shall be followed by two coats of zinc rich primer and two coats of polyurethane based paint. The preferred paint colour is Dark Admiralty Grey (BS381C 632), however other colours may be acceptable (eg RAL 7033).

3.12 Requirements for the external insulation

3.12.1 The creepage distances shall be as given Table 3 below:-

Site Pollution Severity Class	**Minimum mm/kV**	**Ratio = creepage distance divided by arcing distance**
IEC/TS 60815:2008 e	Unified specific creepage distance 53.7	≤4.0
IEC/TR 60815:1986 IV Very Heavy	Specific creepage distance 31	

Table 3 Creepage distances [IEC/TR60815 & IEC/TS60815]

3.12.2 WPD requires insulators for Site Pollution Severity Class e (IEC/TR 60815:1986) or Class IV (IEC/TR 60815:1986); however there are some substation locations where Class d or Class III may be acceptable (eg >50km from coast).

3.12.3 Insulators having an alternating shed profile are preferred.

3.13 Whilst there are no specific requirements for internal arc fault containment or control on non-gas filled units, WPD would expect manufacturers to be able to provide data on how their equipment performs in the event of an internal arcing fault.

3.14 Auxiliary enclosures

3.14.1 The degree of protection for low-voltage and/or auxiliary enclosures shall be at least IP44 according to BSEN60529.

3.14.2 Shall be fabricated of stainless steel and painted.

3.14.3 Shall be provided with a securing and locking device that provides security against unauthorized access. The locking arrangement shall be robust and accommodate a padlock with 41mm square body and with a 4mm to 7mm diameter shackle having a clear inside width of 21mm and an inside length of 16mm to 45mm. The holes provided for the shackle shall not be less than 8mm diameter.

3.14.4 Where an auxiliary enclosure (eg. terminal box) is fitted it shall be placed so that work can be carried out on this box with the equipment after the equipment is installed and cables terminated.

3.14.5 Auxiliary enclosures shall be suitable for the termination of armoured multicore cables using cable glands. Insulated cable glands, where specified and requested by WPD, shall be insulated to 4kVac for 1 minute.

3.14.6 Adequate terminal blocks shall be provided to terminate all the cores of all multicore cables as detailed in the Summary of Technical Parameters for the instrument transformer.

3.15 Markings

3.15.1 All instrument transformers shall carry at least the following markings:-

a) the manufacturer's name or other mark by which he may be readily identified;

b) the year of manufacture, a type designation and a serial number,

c) rated frequency;

d) highest voltage of equipment;

e) rated insulation level;

f) temperature category;

g) mass in kg

h) class of insulation if different from Class A;

[NOTE If several classes of insulating material are used, the one, which limits the temperature rise of the windings, should be indicated.]

i) On transformers with more than one secondary winding, the use of each winding and its corresponding terminals should be indicated.

j) all indications relative to the measuring characteristics (see specific standard);

k) type of the insulating fluid;

3.15.2 All information shall be marked in an indelible manner on the instrument transformer itself or on a stainless steel rating plate with engraved text securely attached to the transformer

3.16 Equipment shall be subject to a series of tests as detailed in BSEN 61869-1 clause 7. The minimum tests required by WPD are detailed in Table 4 below:-

T e s t s	**Subclause**
Type tests	**7.2**
Temperature-rise test	7.2.2
Impulse voltage test on primary terminals	7.2.3
Wet test for outdoor type transformers	7.2.4
Electromagnetic Compatibility tests	7.2.5
Test for accuracy	See specific requirements standard
Verification of the degree of protection by enclosures	7.2.7
Enclosure tightness test at ambient temperature	7.2.8
Routine tests	**7.3**
Power-frequency voltage withstand tests on primary terminals	7.3.1
Partial discharge measurement	7.3.2
Power-frequency voltage withstand tests between sections	7.3.3
Power-frequency voltage withstand tests on secondary terminals	7.3.4
Test for accuracy	7.3.5
Verification of markings	7.3.6
Enclosure tightness test at ambient temperature	7.3.7

Table 4 – Type and Routine Tests

3.17 Clearances for overhead conductor connected equipment

3.17.1 Minimum clearance from ground level of a fixed access platform to exposed live conductors shall be basic electrical clearance (as defined in BSEN61936) plus 300mm plus personal reach. Clearance to support insulation shall be 300mm plus personal reach.

3.17.2 For the purposes of this specification personal reach is 2.25m.

3.17.3 Support structures will be supplied separately by WPD or others unless specifically requested and agreed in writing by WPD.

3.18 Small wiring and terminals

3.18.1 Small wiring and terminals shall comply with ENA TS 41-36 with the following additions:

- The application of small wiring, ancillary electrical equipment and protection shall in general follow the principles in Engineering Recommendation S15.
- Secondary wiring shall comprise of:
  - AC wiring: 2.5mm^2 (minimum) copper stranded cable with PVC insulation to BS6231 Type BR, or equivalent tri-rated cable complying with BS6231.
- The insulation of AC wiring shall be coloured white in all circuits, except earthing which shall be coloured green/yellow.
- A.C. wiring shall be terminated with crimped connections in accordance with ENA TS 50-18.
- Terminal blocks used for protection, alarm and control circuits shall be screw clamp with spring type, in accordance with ENATS 50-18 Type B. Sufficient space shall be allowed so that connections can be tightened or un-tightened and wires removed and re-inserted.
- An earth terminal shall be included at one end of a row with the terminal blocks provided. This shall be connected to a suitable earth point on the equipment.

3.19 Fuses and Links

3.19.1 Secondary fuselinks, links and fuse carriers shall be in accordance with ENATS 50-18 and BS HD 60269-2 reference A.

3.19.2 Fuses and fuse holders up to 20A rating shall be in accordance with BS HD 60269-2 reference A1.

3.19.3 Fuse holders and bases shall be coloured as follows:

3.19.4 2A, 4A, 6A, 10A fuselink ratings: Black

3.19.5 16A fuselink rating: Green

3.19.6 Solid links: White

3.19.7 Eaton Bussmann (previously GE Power Controls) or Mersen Red Spot fuse holders shall be provided unless otherwise agreed at the time of tender.

3.19.8 All fuses and links shall be mounted vertically, grouped logically and consistently in the panel and shall be clearly labelled. The label shall show the function of the fuses/links and include the fuse/link number as specified on the schematic drawings.

3.19.9 Fuse terminals shall be suitably shrouded to minimise electric shock hazards. The incoming (supply) side of each circuit shall be connected on the bottom terminal of the fuse/link.

3.20 All equipment and systems shall satisfy requirements of the EMC directive. EMC emissions and immunity requirements shall, as a minimum, satisfy the requirements of the generic emission and immunity standards for industrial environments BSEN 61000-6-2 and BSEN 61000-6-4 and also all relevant EMC product standards.

3.21 The manufacturer shall provide information regarding any environmental aspects of the instrument transformer during service life, dismantling and disposal.

3.22 It is essential that the transport, storage and installation of instrument transformers, as well as their operation and maintenance in service, be performed in accordance with instructions given by the manufacturer. Consequently, the manufacturer should provide on time instructions for the transport, storage, installation, operation and maintenance of instrument transformers.

3.23 For each type of instrument transformer the installation instructions provided by the manufacturer should at least include the items listed below:-

- Required information for unpacking and lifting safely.

- Where the instrument transformer is not fully assembled for transport then all transport units should be clearly marked. Drawings showing assembly of these parts should be provided with the instrument transformer.

- Instructions for the mounting of instrument transformers, operating devices and auxiliary equipment should include sufficient details of locations and foundations to enable site preparation to be completed.

- Instructions on connections shall include information on:

    a) connection of conductors, comprising the necessary advice to prevent overheating and unnecessary strain on the instrument transformers and to provide adequate clearance distances;

    b) connection of auxiliary circuits;

    c) connection for earthing;

- Instruction shall be provided for inspection and test which should be made after the instrument transformer has been installed and all connections have been completed. These instructions should include:-

    a) a schedule of recommended site tests to establish correct operation;

    b) procedures for carrying out any adjustment that may be necessary to obtain correct operation;

    c) recommendations for any relevant measurements that should be made and recorded to help with future maintenance decisions;

    d) instructions for final inspection and putting into service.

3.24 The manufacturer shall issue a maintenance manual including the following information:-

- maintenance frequency and active time;
- detailed description of the maintenance work;
  - recommended place for the maintenance work (indoor, outdoor, in factory, on site, etc.);
  - procedures for inspection, diagnostic tests, examination, overhaul, check of functionality (limits of values and tolerances, for example, opto-electrical component operating efficiency);
  - reference to drawings;
  - reference to part numbers (when applicable);
  - use of special equipment or tools (cleaning and degreasing agents);
  - precautions to be observed (e.g; cleanliness).
- Comprehensive drawings of the details of the instrument transformers important for maintenance, with clear identification (part number and description) of assemblies, sub -assemblies and significant parts.
- List of recommended spare-parts (description, reference number, quantities, etc.) and advice for storage.
- Estimate of active scheduled maintenance time.
- How to proceed with the equipment at the end of its operating life, taking into consideration environmental requirements.

3.25 The manufacturer should be responsible for ensuring the continued availability of spare parts required for maintenance for a period not less than 10 years from the date of the final manufacture of the instrument transformer.

3.26 The manufacturer of the equipment covered by this specification shall provide a guarantee for that equipment. The guarantee period that the manufacturer warrants will be a minimum of five (5) years from the date of completion of commissioning of the relevant plant / equipment.

3.27 Drawings

3.27.1 The manufacturer shall provide the following drawings for approval within one month of the commencement date of the contract or by mutually agreed date at the placement of the order:

- General Arrangement of each instrument transformer

- Schematic Diagram for each instrument transformer
- Wiring diagram for each instrument transformer

3.27.2 Once approval has been obtained an additional copy of the drawings shall be provided.

3.27.3 All drawings shall be provided electronically in .dwg CAD format.

3.28 Test Certificates

The manufacturer shall supply copies of the instrument transformer test certificates in pdf format by electronic mail to the WPD project manager in advance of delivery.

A hard copy of the test certificates shall accompany each instrument transformer.

4.0 CURRENT TRANSFORMERS

4.1 Terminal Connections

4.1.1 Either terminal palms size 1 to clause 3.1.2 and Figure 1 of ENATS 41-16 or terminal stems of 30mm diameter and minimum length 80mm are required (ENATS 41-16 cl 3.1.1).

4.1.2 Where these cannot be provided the Tenderer shall specify what is offered.

4.2 CT secondary windings shall be supplied with a removable factory fitted short in the terminal box.

4.3 Rated short-time withstand current

The rated short-time withstand current (ENATS 41-36 cl 1.4.5) shall be a minimum of 25kA. The value of rated duration of short circuit shall be 3s. (ENATS 41-36 cl 1.4.7)

4.4 Rated insulation levels

4.4.1 The insulation requirements for secondary terminals shall be to clause 5.3.5 of IEC 61869-1:2007 with the addition that the secondary winding insulation of class PX and class PXR current transformers having a rated knee point emf Ek ≥ 2 kV shall be capable of withstanding a rated power frequency withstand voltage of 5 kV r.m.s. for 60 s.

4.4.2 The rated withstand voltage for inter-turn insulation shall be 4,5 kV peak. For class PX and class PXR current transformers having a rated knee point emf of greater than 450 V, the rated withstand voltage for the inter-turn insulation shall be a peak voltage of 10 times the r.m.s. value of the specified knee point emf, or 10 kV peak, whichever is the lower.

4.5 Rated output

The rated output shall be 15VA.

4.6 Rated primary current

The rated primary current shall be 800A.

4.7 Rated secondary current

The rated secondary current shall be 1A.

4.8 Ratio

The current transformer shall have a rated turns ratio of 800/400/1.

4.9 Class P secondary winding

The rated accuracy of the current transformer shall be 5P20.

4.10 Class PX secondary winding

4.10.1 The minimum knee point requirements for CT's with a 1A secondary rating are specified below, where:

VK = Knee point voltage

RCT = DC secondary resistance of the CT

N = Ratio of the CT (i.e. primary current / rated secondary current)

4.10.2 CT's for Current Differential, Pilot Wire or Distance Protection:

$VK \geq 9.1x104(RCT + 0.5)/N$

4.10.3 CT's for Transformer Bias Differential and REF Protection

$VK \geq 5.0 \times 104(RCT + 1.5)/N$

4.10.4 CT's for High Impedance Busbar Protection

$VK \geq 5.0 \times 104(RCT + 1)/N$

4.10.5 For CT's with an alternative secondary rating, the minimum knee point requirement shall be calculated in accordance with the protection relay manufacturer's recommendations.

4.10.6 3.5.3 Where multi-ratio CT's are specified the knee point requirements shall be satisfied on each CT ratio.

4.10.7 3.5.4 In addition to the knee point requirements, the magnetising current for each CT shall be less than 50mA at the CT's knee point voltage. This requirement must be satisfied for each CT ratio.

4.11 Markings

4.11.1 The terminal markings shall identify the:

a) primary and secondary windings;

b) winding sections, if any;

c) relative polarities of windings and winding sections;

d) intermediate taps, if any.

4.11.2 The marking shall consist of letters followed, or preceded where necessary, by numbers. The letters shall be in block capitals. [BSEN 61869-2; 6.13.201]

4.11.3 The markings shall be as indicated in Table 208 of BSEN 61869-2 clause 6.13.201.3.

4.12 Rating plate markings

4.12.1 In addition to those markings defined in BSEN 61869-1 Clause 6.13, all current transformers shall carry the general rating plate markings as defined in this clause.

a) the rated primary and secondary current (e.g. 100/1 A);

b) the rated short-time thermal current (Ith), (e.g. Ith = 40 kA);

c) the rated dynamic current (Idyn) if it differs from 2,5 × Ith (e.g. Idyn = 85 kA);

d) on current transformers with two or more secondary windings, the use of each winding and its corresponding terminals;

e) the rated continuous thermal current if different from the rated primary current.

4.12.2 A current transformer satisfying the requirements of several combinations of output and accuracy class may be marked according to all of them.

4.12.3 Equipment shall be subject to a series of tests as detailed in BSEN 61869-2 clause 7. The minimum tests required by WPD are detailed in Table 5 below:-

T e s t s	**Subclause**
Type tests	**7.2**
Temperature-rise test	7.2.2
Impulse voltage test on primary terminals	7.2.3
Wet test for outdoor type transformers	7.2.4
Electromagnetic Compatibility tests	7.2.5
Test for accuracy	7.2.6
Verification of the degree of protection by enclosures	7.2.7
Enclosure tightness test at ambient temperature	7.2.8
Short-time current tests	7.2.201
Routine tests	**7.3**
Power-frequency voltage withstand tests on primary terminals	7.3.1
Partial discharge measurement	7.3.2
Power-frequency voltage withstand tests between sections	7.3.3
Power-frequency voltage withstand tests on secondary terminals	7.3.4
Test for accuracy	7.3.5
Verification of markings	7.3.6
Enclosure tightness test at ambient temperature	7.3.7
Determination of the secondary winding resistance	7.3.201
Determination of the secondary loop time constant	7.3.202
Test for rated knee point e.m.f. and exciting current at rated knee point e.m.f.	7.3.203
Inter-turn overvoltage test	7.3.204

Table 5 Type and Routine Tests for Current Transformers

5.0 INDUCTIVE VOLTAGE TRANSFORMERS

5.1 General

5.1.1 This specification covers three phase oil insulated outdoor voltage transformers used for protection and metering purposes with outdoor bushing primary terminations equipped with arcing horns.

5.1.2 Units shall be to BSEN 61869-3 and ENATS 41-36.

5.1.3 Units shall be of 5 limb star – star - broken delta configuration. The neutral points of both the primary and secondary windings shall be individually brought out to insulated external terminals.

5.1.4 Primary fuses shall be provided within the bushings, held in place by a spring-loaded contact. Current ratings of the fuse links shall allow for magnetizing inrush currents. A rating of 3.15A is preferred.

5.1.5 A sight glass or sight glasses shall be provided so as to allow visual checking of the oil level from ground level during routine inspection.

5.1.6 For voltage transformers installed within 50km of the coast a stainless steel tank will be required therefore a design and cost option for this shall be provided at the time of tender. [*Note: This requirement is to ensure that any corrosion due to airborne salt spray is minimised*.]

5.2 Ratings

5.2.1 Rated Output

100VA at a power factor of 0.8 lagging.

Residual voltage winding – 50VA at unity power factor.

5.2.2 Rated Accuracy Class

All Star connected windings shall satisfy the rated accuracy class requirements for both Class 3P and Class 0.5 irrespective of their intended use.

Residual voltage windings connected to form a broken delta shall be Class 3P but are not required to satisfy Class 0.5

5.2.3 Rated Primary Voltage

33000V

5.2.4 Rated Secondary Voltages

110V

5.2.5 Rated Secondary Voltage for Residual Voltage Windings

63.5V

5.3 All windings shall be rated for a voltage factor of 1.9 for 8 hours

5.4 Voltage transformers shall have their rated transformation ratios and voltages shown on drawings, diagrams and rating plates as shown in Table 3.

System Voltage	Primary Winding	Secondary Windings		
		Protection	Metering	Residual[1]
	Voltage (Upn)	Voltage (Usn)	Voltage (Usn)	Voltage (Usn)
33kV	33000/√3	110/√3	110/√3	110/3

Table 3 VT Ratios

Note 1: Residual voltage windings shall be connected to form a broken delta that will provide an output voltage from the broken delta winding of 3 x 110/3 (i.e. 110 volts for a solid single phase earth fault close to the voltage transformer).

5.5 Secondary windings used for protection and metering purposes shall be fused at 6A. VT residual windings shall be connected through removable links.

5.6 Metering VTs

5.6.1 Metering VTs shall be error tested by the manufacturer. In all cases individual test certificates shall be provided.

5.6.2 All metering VT test certificates shall include tests to confirm compliance with BSEN 61869-3.

5.6.3 In addition, VT errors shall be supplied on brown/black (L1/L2) and black/grey (L2/L3) phases at 10VA 0.5 power factor lagging burden. These additional VT errors shall either be separately tested or alternatively calculated from other error test results.

5.6.4 Electronic copies of the of test certificates in PDF format, including any error tests used as the basis of the calculations described above, shall be provided in advance of switchboard delivery for each metering voltage transformer. These shall be sent to the WPD project engineer by electronic mail.

5.6.5 A hardcopy of the test certificates shall also be dispatched with the voltage transformer.

5.7 Terminal Connections

5.7.1 Either terminal palms size 1 to clause 3.1.2 and Figure 1 of ENATS 41-16 or terminal stems of 30mm diameter and minimum length 80mm are required (ENATS 41-16 cl 3.1.1).

5.7.2 Where these cannot be provided the Tenderer shall specify what is offered

5.8 Terminal Markings

Primary winding terminals shall be marked in capital letters A, B, C and N (denoting a terminal intended to be earthed) and a, b, c, n denoting the corresponding secondary terminals.

Terminals intended to supply a residual voltage shall be marked da and dn.

[As indicated in Figures 303, 305 and 310 of BSEN 61869-3.]

5.9 Rating Plate Markings

In addition to those markings stated in BSEN 61869-1, the voltage transformer shall carry the following markings:

- Rated primary and secondary voltage;
- Rated output and the corresponding accuracy class for each separate secondary winding;
- Rated voltage factor and time.

5.10 Test

Equipment shall be subject to a series of tests as detailed in BSEN 61869-3 clause 7. The minimum tests required by WPD are detailed in Table 6 below:-

T e s t s	**Subclause**
Type tests	**7.2**
Temperature-rise test	7.2.2
Impulse voltage test on primary terminals	7.2.3
Wet test for outdoor type transformers	7.2.4
Electromagnetic Compatibility tests	7.2.5
Test for accuracy	7.2.6
Verification of the degree of protection by enclosures	7.2.7
Enclosure tightness test at ambient temperature	7.2.8
Short-time current tests	7.2.201

Tests	Subclause
Pressure test for the enclosure	7.2.9
Short-circuit withstand capability test	7.2.301
Routine tests	**7.3**
Power-frequency voltage withstand tests on primary terminals	7.3.1
Partial discharge measurement	7.3.2
Power-frequency voltage withstand tests between sections	7.3.3
Power-frequency voltage withstand tests on secondary terminals	7.3.4
Test for accuracy	7.3.5
Verification of markings	7.3.6
Enclosure tightness test at ambient temperature	7.3.7
Pressure test for the enclosure	7.3.8
Special Tests	
Chopped impulse voltage withstand test on primary terminals	7.4.1
Multiple chopped impulse test on primary terminals	7.4.2
Measurement of capacitance and dielectric dissipation factor	7.4.3
Transmitted overvoltage test	7.4.4
Mechanical tests	7.4.5
Internal arc fault test	7.4.6

Table 6 Type and Routine Tests for Inductive Voltage Transformers

5.11 Low Level VT Fuse / Terminal Box

5.11.1 Shall be fabricated from stainless steel and painted.

5.11.2 Provided with 4No side mounting points to allow fixing onto voltage transformer support structure (supplied by others).

5.11.3 Fuses shall be arranged horizontally at top of the box, with terminals arranged horizontally across the lower part of the terminal box. Sufficient space shall be allowed for the installation and termination of pilot cables into the terminal box.

5.11.4 Terminals shall be arranged such that the incoming connections from the voltage transformer are on the left. Outgoing connections shall be on the right.

5.11.5 Bolted links shall be provided to allow the voltage transformer low voltage star/neutral points to be connected to earth within the terminal box. These shall be situated on the extreme rhs of the row of terminals.

5.11.6 Fuses and terminals shall be clearly labelled such that labels can be read when internal wiring and pilot cables etc have been installed and terminated.

5.11.7 Fuses, terminals and internal wiring markings and labels shall be as per the table in Schedule B.

5.11.8 Two terminal box options are required – 36VT1 for use with 36IVT; and 36VT3 for use with 36IVT(M).

36VT1 shall be equipped for one protection winding and a broken delta winding.

36VT3 shall be equipped for one protection winding, one metering/protection winding and a broken delta winding.

6.0 RESISTOR CAPACITOR VOLTAGE TRANSFORMERS

6.1 This section of the EESPEC will be issued shortly following further development work.

SCHEDULE A

CURRENT TRANSFORMER – SUMMARY OF TECHNICAL PARAMETERS

Information			
Particulars of System			
Voltage(kV)			33
Frequency (Hz)			50
Number of phases			3
Neutral earthing			Impedance / reactance (ASC)
Current Transformer Characteristics			
Class			Outdoor -25^{o}C +40^{o}C
Nominal Voltage U_n (kV)			33
Rated Voltage U_m (kV)			36
Rated frequency (Hz)			50
Rated power frequency withstand voltage U_d (kV)			70
Rated lightning impulse withstand voltage (peak) (kV)			170
Rated Normal current (A)			800
Rated short-time withstand current (kA)			≥25
Rated duration of short circuit (sec)			3
Site pollution severity class			Very Heavy (31mm/kV)
<u>36SCT1</u> Class P protection winding		Ratio	800/400/1
		Class	5P20
		Rated output (VA)	15
		Rated continuous thermal current (I_{th})	120%
		Secondary power-frequency withstand voltage for secondary insulation (kV)	3
<u>36SCT2</u> Class P protection winding & Class PX protection winding	Class P winding	Ratio	800/400/1
		Class	5P20
		Rated output (VA)	15
		Rated continuous thermal current (I_{th})	120%
		Secondary power-frequency withstand voltage for secondary insulation (kV)	3
	Class PX winding	Ratio	800/400/1
		Rated knee point emf	
		Upper limit of exciting current at rated knee point emf (mA)	50
		Upper limit of secondary winding resistance	

Other WPD Requirements	
Number of multicore cables to be terminated	
Number of secondary terminals required to terminate multicore cable cores	

Supplier To Declare	
Terminal connections	
Insulation medium	
Mass of complete unit (kg)	
Maximum dynamic floor/support loading(s) (kN)	
Maximum terminal loadings (kg)	
Dimensions (m)	
Insulator material	
Insulator shed arrangement	

SCHEDULE B

INDUCTIVE VOLTAGE TRANSFORMER – SUMMARY OF TECHNICAL PARAMETERS

Information			
Particulars of System			
Voltage(kV)			33
Frequency (Hz)			50
Number of phases			3
Neutral earthing			Impedance / reactance (ASC)
Voltage Transformer Characteristics			
Class			Outdoor -25^{o}C +40^{o}C
Nominal Voltage U_n (kV)			33
Rated Voltage U_m (kV)			36
Rated frequency (Hz)			50
Rated power frequency withstand voltage U_d (kV)			70
Rated lightning impulse withstand voltage (peak) (kV)			170
Voltage Factor			1.9 for 8hrs
Site pollution severity class			Very Heavy (31mm/kV)
Altitude			<1000m
36IVT* Star/star/broken delta	Protection winding	Voltage Ratio (V)	33000/110
		Accuracy Class	0.5 / 3P
		Rated output (VA)	100VA
	Broken delta	Voltage Ratio (V)	33000/63.5
		Accuracy Class	3P
		Rated output (VA)	50VA
36IVT(M)* Star/star/star/broken delta	Protection winding	Voltage Ratio (V)	33000/110
		Accuracy Class	0.5 / 3P
		Rated output (VA)	100VA
	Metering winding	Voltage Ratio (V)	33000/110
		Accuracy Class	0.5 / 3P
		Rated output (VA)	100VA
	Broken delta	Voltage Ratio (V)	33000/63.5
		Accuracy Class	3P
		Rated output (VA)	50VA

[*Note: Add /SS to VT reference for stainless steel tank]

VT Secondary Wiring & Low Level Terminal Box - Fuse/Link & Ferrules

Secondary Winding	VT Terminal Box		Low Level Terminal Box			Label Inscription
	VT Winding Termination	Interconnecting Cable	VT to Terminal Rail & Fuse/Link	Fuse / Link	Fuse/Link to Terminal Rail	
		Ferrule	Ferrule		Ferrule	
Protection Winding	1a	E110	E110	6A	E10	Protection
	1b	E130	E130	6A	E30	
	1c	E150	E150	6A	E50	
	1n	E170	E170	Link	E70	
Metering Winding	2a	E120	E120	6A	E20	Metering
	2b	E140	E140	6A	E40	
	2c	E160	E160	6A	E60	
	2n	E180	E180	Link	E80	
Broken Delta	da	E185	E185	Link	E85	Broken Delta
	dn	E186	E186	Link	E86	

Supplier To Declare	
Terminal connections	
Mass of complete unit (kg)	
Maximum dynamic floor/support loading(s) (kN)	
Maximum terminal loadings (kg)	
Dimensions (m)	
Insulator material	
Insulator shed arrangement	

APPENDIX A

SUPERSEDED DOCUMENTATION

This document supersedes EE SPEC: 184 dated February 2020 which has now been withdrawn.

APPENDIX B

RECORD OF COMMENTS DURING CONSULTATION

Link to Record of Comments Received

APPENDIX C

ASSOCIATED DOCUMENTATION

ENA TS 41-36	Switchgear for service up to 36kV (Cable and overhead line connected)
ENA TS 41-24	Guidelines for design, installation, testing and maintenance of main earthing systems in substations
ENA TS 41-38	Power installations exceeding 1kVac – Design of high-voltage open-terminal stations
ENA TS 50-18	Application of ancillary electrical equipment
EE SPEC: 136	Ancillary Electrical Equipment for Use in Conjunction with Switchgear and Protection/Control Panels

APPENDIX D

KEY WORDS

Instrument Transformer, Current Transformer, Voltage Transformer, Resistor Capacitor Voltage Transformer, Structure Mounted, CT, VT, RCVT, IT.