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NPS/003/001 – Technical Specification for 33kV, 66kV and 132kV Voltage Transformers

1. Purpose

This purpose of this document is to specify the technical requirements for open terminal voltage transformers (VTs) for use on the distribution networks of Northern Powergrid (the Company).

This document supersedes the following documents, all copies of which should be destroyed.

Document Reference	Document Title	Version	Published Date
NPS/003/001	Technical Specification for 33kV, 66kV and 132kV Voltage Transformers	5.1	July 2019

2. Scope

This specification details the requirements for 33kV, 66kV and 132kV Voltage Transformers (VT s) for use in open terminal substations on the distribution networks of Northern Powergrid. The VT's detailed in this specification are designed for protection, measurement and voltage control of power systems up to 132kV. This specification shall be used in conjunction with any project specific requirements detailed in Appendix 5, Addendum to Supplier Requirements.

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3. Technical Requirements

The VT's detailed in this specification are designed for use in outdoor open terminal substations for protection, measurement and voltage control of power systems up to 132kV. The VT's are generally mounted on aluminium or steel support structures and connected to adjacent equipment using copper or aluminium busbars.

3.1. General Design Requirements

3.1.1. Voltage Transformers

VT's shall be in accordance with BS EN 61869 parts 1, 3 and 5, the requirements listed below and in Appendix 1 of this document.

Two secondary outputs should be provided which shall be either protection or metering class (see Appendix 1).

VTs will be connected between line and earth in star configuration with the star point directly earthed.

- 33 - 66kV VTs shall be Inductive VT's to BS EN 61869-3
- 132kV VTs shall be capacitive VTs to BS EN 61869-5

The provision of arcing horns is required.

VTs will preferably have been assessed by the Energy Networks Association (ENA) and awarded an ENA Certificate of Conformance.

The technical specification of VTs must be confirmed using the table in Appendix 2.

3.1.2. External Insulation

The external insulation of the VTs shall comply with the requirements of BS 3297-2 designation "C" and Appendix 1 of this specification.

The external insulation shall be manufactured from either grey silicon rubber hollow core composite material that has been tested in accordance with IEC 61462 and IEC 62217. The Hollow composite external insulation consists of an insulating tube manufactured from high strength glass fibre reinforced plastic bearing the mechanical load which is protected by an elastomeric housing.

Silicon rubber is a very generic term with many formulations. Variations in the composition of this material can adversely affect its long term performance to provide the following very important properties:-

- UV resistance
- Tracking Resistance
- Hydrophobicity

As a result a range of good practice characteristic values have been included within this specification

Material Composition	Minimum % per weight
Base Rubber consisting of approx. 37% Silicone Polymer (Polydimethylsiloxane) (PDMS) and 10% Silica	47 %
Filler (ATH Aluminium tri hydrate and fumed silica)	52 %
Additional parts (pigments, crosslinkers)	1%

Where manufacturers differ from this characteristic composition, they shall provide supporting evidence about the long term experience of their product formulation.

The following table provides a list of characteristic properties that result from the above formulation.

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Manufacturers shall provide details of their characteristic properties for consideration.

Minimum acceptable values are detailed below.

Property	Minimum Value
Density	1.5g/cm
Passing Voltage Level of IEC 60587	4.5kV
Flammability Class of IEC 60695-11-10 of 3mm specimen	VO
Tensile Strength (Din 53504-S1)	6 N/mm ²
Break Elongation (Din 53504-S1)	300%
UV resistance @ 300nm the energy of UV wavelength that equates to a molecular energy breakdown level of 398 kJ/mole *	445 kJ/Mole

* assumed wavelength of UV light (sun) 290 – 350nm

All silicon rubber insulators shall be manufactured using the HTV (high temperature vulcanising) method and shall ensure that the interface between the housing and the core is chemically bonded.

Flash or mould lines shall not exceed 1mm in height.

All glass fibre re-enforced plastic tubes shall be covered by an even concentric layer of silicon rubber that has a minimum insulation thickness of 3mm over the tube.

3.1.3. End Fittings

The end fittings transfer the mechanical load to the hollow tube core. The interface between the end fittings and the hollow tube shall be sealed by an elastomer with permanent elasticity. The sealing bond shall adhere to the surface of the metal fittings as well as the housing. Sealing by compression only is not acceptable.

3.1.4. Secondary Wiring Enclosure

The VT shall incorporate secondary fuses and links in a waterproof Secondary Terminal Enclosure with a removable lid. This enclosure shall as a minimum comply with IP 44 in accordance with IEC 60529 and be so placed as to permit changing of fuses with the equipment alive. Both Secondary terminals shall be insulated for a 2kV withstand test. Where voltage transformers are fitted on two or three phases of a circuit, a single terminal box per circuit is required to facilitate single point *Earthing of secondary circuits. All wiring and connection arrangements shall be as detailed in ENA TS 50-19 and ENA Engineering recommendation S15

All fixings used to secure the lid to the enclosure shall be captive.

The enclosure shall provide a means of terminating of an armoured protection cable using an M20 cable gland.

* For further information regarding Earthing please see BS EN 50522.

3.1.5. Design Life

VTs shall be designed to provide a minimum operating life of 40 years in normal outdoor service conditions as defined by BS EN 61869-1 clause 4.2.5.

3.1.6. Short Circuit Withstand Capability

The voltage transformer shall be designed and constructed to withstand without damage, when energised at rated voltage, the mechanical and thermal effects of an external short-circuit for the duration of 1 s. Harmonic Measurement

The voltage transformer may require the factory installation of equipment which will enable the detection of all harmonics up to at least the 100th harmonic, further measurements up to the 200th

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harmonic would be advantageous. All of these readings should be to an accuracy of at least 10%. The details of this equipment should be given at the tender stage to enable the confirmation of the suitability of the equipment.

3.1.7. Frequency Response

It is required to provide frequency response details for each VT when it is delivered to site for use during commissioning.

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4. References

The products described within this specification shall comply with all current versions of the relevant International Standards, British Standard Specifications and all relevant Energy Networks Association Technical Specifications (ENATS) current at the time of supply

4.1. External Documentation

Reference	Title
BS 3297-2	Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000 V
BS EN 61869-1	General requirement for Instrument Transformers
BS EN 61869-3	Instrument Transformers – Part 3: Inductive Voltage Transformers
BS EN 61869-5	Instrument Transformers – Part 5: Capacitive Voltage Transformers
BS EN 61936-1	Power Installations Exceeding 1kV a.c
BS EN 50522:2010	Earthing of Power Installations Exceeding 1kV a.c
Din 53504	Determination of tensile strength at break, tensile stress at yield, elongation at break and stress values of rubber in a tensile test
ENA TS 50-19	Energy Network Association Technical Specification – Standard Numbering For Small Wiring (For Switchgear And Transformers Together With Their Associated Relay Panels)
IEC 60168	Tests on indoor and outdoor post insulators of ceramic material or glass for systems with nominal voltages greater than 1000V
IEC 60529	Degrees of protection provided by enclosures (IP code)
IEC 60587	Electrical Insulating materials used under severe ambient conditions – test methods for evaluating resistance to tracking and erosion
IEC 60695-11-10	Flammability classification
IEC 61462	Composite hollow insulators – pressurised and un-pressurised insulators for use in electrical equipment with rated voltage greater than 1000V – Definitions, test methods, acceptance criteria and design recommendations
IEC 62217	Polymeric Insulators for indoor and outdoor use with a nominal voltage >1000V – general definitions, test methods and acceptance criteria.
IEC 62231	Composite Station Post insulators for substations with a.c. voltages >1000V up to 245kV - – general definitions, test methods and acceptance criteria.
S12	Energy Network Association – Engineering Recommendation – Standard schematic diagrams (Part 1; Schematic diagrams)

4.2. Internal Documentation

Reference	Title
None	

4.3. Amendments from Previous Version

Reference	Description
3.1.2	Removed the option for porcelain insulators
3.1.7	Requirement for Harmonic measurement equipment to be installed in specified
3.1.8	Requirement for the supply of Frequency response information

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5. Definitions

Term	Definition
The Company	Northern Powergrid
Voltage Transformer	An instrument in which the secondary voltage, in normal conditions of use, is substantially proportional to the primary voltage, in accordance with the specified ratio and which differs in phase from the primary voltage by an angle which is approximately zero for an appropriate direction of the connections

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6. Authority for Issue

6.1. CDS Assurance

I sign to confirm that I have completed and checked this document and I am satisfied with its content and submit it for approval and authorisation.

		Date
Liz Beat	Governance Administrator	11/03/2024

6.2. Author

I sign to confirm that I have completed and checked this document and I am satisfied with its content and submit it for approval and authorisation.

Review Period – This document should be reviewed within the following time period;

Standard CDS review of 3 years?	Non Standard Review Period & Reason	
Yes	Period: n/a	Reason: n/a
Should this document be displayed on the Northern Powergrid external website?		Yes
		Date
Paul McAdoo	Lead Policy & Standards Engineer	22/05/2024

6.3. Technical Assurance

I sign to confirm that I am satisfied with all aspects of the content and preparation of this document and submit it for approval and authorisation.

		Date
Joe Helm	Lead Policy & Standards Engineer	12/03/2024
Michael Crowe	Protection Manager (Northern)	20/03/2024

6.4. Authorisation

Authorisation is granted for publication of this document.

		Date
Paul Black	Head of System Engineering	25/03/2024

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Appendix 1 – Electrical Ratings 33kV, 66kV and 132kV VTs

33kV		
	BS EN 61869 Part 1 & 3 Reference	
Nominal System Voltage		33 kV
Highest Voltage for Equipment U_m (rms)	BS EN 61869 Part 1, Table 2	36 kV
Rated Frequency		50Hz
Design		Outdoor Post Type VT,
Ambient air temperature range	BS EN 61869 Part 1, clause 4.2.1	-25/40 °C
Altitude	BS EN 61869 Part 1, clause 4.2.2	Does not exceed 1000m
Other Service conditions for Outdoor instrument transformers	BS EN 61869 Part 1, clause 4.2.5	
System earthing	BS EN 61869 Part 1, clause 4.4	C2) Impedance Earthed
Rated Secondary Voltage	BS EN 61869 Part 3, clause 5.301.2	$110/\sqrt{3}$ V
Ratios		$33000/\sqrt{3} : 110/\sqrt{3}$
Number of secondary outputs		3 (Protection, metering, instrumentation or dual purpose as specified at the time of ordering)
Class of Secondary Output Types (Notes Metering Accuracy types dependent upon design type of VT) Capacitor Type = Class 1/3P Electromagnetic Type = Class 0.5/3P		Metering: Class 0.5 Protection: Class 3P Dual purpose: Class 3P / 0.5
Output	BS EN 61869 Part 3, clause 5.5	50VA per winding
Voltage Factor	BS EN 61869 Part 3, clause 5.302	1.2 Continuous 1.9 for 30 sec
Limits of Temperature Rise <i>To be limited by the lowest class of insulation either of the winding or the surrounding medium – manufactures to specify</i>	BS EN 61869 Part 1, clause 6.4	In accordance with Table 5 or manufactures data for specific material types
Rated short time thermal current		Minimum 25kA for 3 secs but not less than that of associated HV Switchgear
Partial Discharge – permissible levels (PD levels in Pc)	BS EN 61869 Part 1, clause 5.3.3.1 Table 3	Values associated with earthed neutral systems
Insulation requirements for secondary windings	BS EN 61869 Part 1, clause 5.3.4	3kV (r.m.s) for 60 secs

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Appendix 1 – Electrical Ratings 33kV, 66kV and 132kV VTs (continued)

Requirements for external Insulation		
Insulation Type		Silicon Rubber
Rated insulation levels of the primary winding – (Wet 1min PF Withstand)	BS EN 61869 Part 1, Table 2	70 kV
Rated insulation levels of the primary winding – (peak) – Dry Impulse	BS EN 61869 Part 1, Table 2	170 kV
Length of Post Insulators (min)		320mm +/- 1mm
Minimum phase to earth creepage distance Dm<300mm		950mm
External Insulation Requirements: Pollution level – creepage distance	BS EN 61869 Part 1, Clause 6.6.1 Table 6	Level 3: 25mm/kV (Heavy)
Mechanical Requirement for CT	BS EN 61869 Part 1, Clause 6.7	Load class II: Static withstand load 2.5kN
Insulator Base Fixing Arrangement		Where the base of the CT support insulator mounted directly onto support steelwork the PCD shall be as stated. (Where an additional under base is used, the fixings shall be agreed with the purchaser)
Pitch circle diameter (mm)	127	
Bolt Hole (tapped hole)	4 x M16	
Metal Fittings (internal/external)	External	

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Appendix 1 – Electrical Ratings 33kV, 66kV and 132kV VTs (continued)

66kV		
	BS EN 61869 Part 1 & 3 Reference	
Nominal System Voltage		66 kV
Highest Voltage for Equipment U_m (rms)	BS EN 61869 Part 1, Table 2	72.5kV
Rated Frequency		50Hz
Design		Outdoor Post Type VT,
Ambient air temperature range	BS EN 61869 Part 1, clause 4.2.1	-25/40 °C
Altitude	BS EN 61869 Part 1, clause 4.2.2	Does not exceed 1000m
Other Service conditions for Outdoor instrument transformers	BS EN 61869 Part 1, clause 4.2.5	
System earthing	BS EN 61869 Part 1, clause 4.4	C2) Impedance Earthed
Rated Secondary Voltage	BS EN 61869 Part 3, clause 5.301.2	$110/\sqrt{3}$ V
Ratios		$66000/\sqrt{3} : 110/\sqrt{3}$
Number of secondary outputs		3 (Protection, metering, instrumentation or dual purpose as specified at the time of ordering)
Class of Secondary Output Types (Notes Metering Accuracy types dependent upon design type of VT) Capacitor Type = Class1/3P Electromagnetic Type = Class 0.5/3P		Metering: Class 0.5 Protection: Class 3P Dual purpose: Class 3P / 0.5
Output	BS EN 61869 Part 3, clause 5.5	50VA per winding
Voltage Factor	BS EN 61869 Part 3, clause 5.302	1.2 Continuous 1.9 for 30 sec
Limits of Temperature Rise <i>To be limited by the lowest class of insulation either of the winding or the surrounding medium – manufactures to specify</i>	BS EN 61869 Part 1, clause 6.4	In accordance with Table 3 or manufactures data for specific material types
Rated short time thermal current		Minimum 25kA for 3 secs but not less than that of associated HV Switchgear
Partial Discharge – permissible levels (PD levels in Pc)	BS EN 61869 Part 1, clause 5.3.3.1Table 3	Values associated with earthed neutral systems
Insulation requirements for secondary windings	BS EN 61869 Part 1, clause 5.3.4	3kV (r.m.s) for 60 secs

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Appendix 1 – Electrical Ratings 33kV, 66kV and 132kV VTs (continued)

Requirements for external Insulation		
Insulation Type		Silicon Rubber
Rated insulation levels of the primary winding – (Wet 1min PF Withstand)	BS EN 61869 Part 1, Table 2	140 kV
Rated insulation levels of the primary winding – (peak) – Dry Impulse	BS EN 61869 Part 1, Table 2	325 kV
Length of Post Insulators (min)		630mm +/- 1mm
Minimum phase to earth creepage distance Dm<300mm		1600mm
External Insulation Requirements: Pollution level – creepage distance	BS EN 61869 Part 1, Clause 6.6.1 Table 6	Level 3: 25mm/kV (Heavy)
Mechanical Requirement for CT	BS EN 61869 Part 1, Clause 6.7	Load class II: Static withstand load 2.5kN
Insulator Base Fixing Arrangement		Where the base of the CT support insulator mounted directly onto support steelwork the PCD shall be as stated. (Where an additional under base is used, the fixings shall be agreed with the purchaser)
Pitch circle diameter (mm)	127	
Bolt Hole (tapped hole)	4 x M16	
Metal Fittings (internal/external)	External	

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Appendix 1 – Electrical Ratings 33kV, 66kV and 132kV VTs (continued)

<u>132kV</u>		
	BS EN 61869 Part 1 & 5 References	
Nominal System Voltage		132 kV
Highest Voltage for Equipment U_m (rms)	BS EN 61869 Part 1, Table 2	145kV
Rated Frequency		50Hz
Design		Outdoor Post Type VT,
Ambient air temperature range	BS EN 61869 Part 1, clause 4.2.1	-25/40 °C
Altitude	BS EN 61869 Part 1, clause 4.2.2	Does not exceed 1000m
Other Service conditions for Outdoor instrument transformers	BS EN 61869 Part 1, clause 4.2.5	
System earthing	BS EN 61869 Part 1, clause 4.4	Solidly Earthed Neutral System.
Rated Secondary Voltage	6.2.2 BS EN 61869 Part 5, clause 5.501.2	110/ $\sqrt{3}$ V
Ratios		132000/ $\sqrt{3}$: 110/ $\sqrt{3}$
Number of secondary outputs		3 (Protection, metering, instrumentation or dual purpose as specified at the time of ordering)
Class of Secondary Output Types (Notes Metering Accuracy types dependent upon design type of VT) Capacitor Type = Class1/3P Electromagnetic Type =Class 0.5/3P		Metering: Class 0.5 Protection: Class 3P Dual purpose: Class 3P / 0.5
Output	BS EN 61869 Part 5, clause 5.5	50VA per winding
Voltage Factor	BS EN 61869 Part 5, clause 5.01.4	1.2 Continuous 1.5 for 30 sec
Limits of Temperature Rise <i>To be limited by the lowest class of insulation either of the winding or the surrounding medium – manufactures to specify</i>	BS EN 61869 Part 1, clause 6.4	In accordance with Table 3 or manufactures data for specific material types
Rated short time thermal current		Minimum 31.5kA for 3 secs but not less than that of associated HV Switchgear
Partial Discharge – permissible levels (PD levels in Pc)	BS EN 61869 Part 1, clause 5.3.3.1Table 3	Values associated with earthed neutral systems
Insulation requirements for secondary windings	BS EN 61869 Part 1, clause 5.3.4	3kV (r.m.s) for 60 secs

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Appendix 1 – Electrical Ratings 33kV, 66kV and 132kV VTs (continued)

Requirements for external Insulation		
Insulation Type		Silicon Rubber
Rated insulation levels of the primary winding – (Wet 1min PF Withstand)	BS EN 61869 Part 1, Table 2	275 kV
Rated insulation levels of the primary winding – (peak) – Dry Impulse	BS EN 61869 Part 1, Table 2	650 kV
Length of Post Insulators (min)		1300 +/- 2.5mm
Minimum phase to earth creepage distance		3350mm
External Insulation Requirements: Pollution level – creepage distance	BS EN 61869 Part 1, Clause 6.6.1 Table 6	Level 3: 25mm/kV (Heavy)
Mechanical Requirement for CT	BS EN 61869 Part 1, Clause 6.7	Load class II: Static withstand load 3kN
Insulator Base Fixing Arrangement		Where the base of the CT support insulator mounted directly onto support steelwork the PCD shall be as stated. (Where an additional under base is used, the fixings shall be agreed with the purchaser)
Pitch circle diameter (mm)	127	
Bolt Hole (Tapped Hole)	4 x M16	
Metal Fittings (internal/external)	External	

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Appendix 2 – Declaration of technical performance of VT

MANUFACTURERS TYPE REFERENCE				
Rating	Units	33kV System Voltage	66kV System Voltage	132kV System Voltage
Equipment Design Voltage				
Rated Frequency	Hz			
Ambient Air Temperature Range	°C			
Service Conditions – Suitable for outdoor use?				
Suitable for solidly earthed system?				
Limits of Temperature Rise – and or Insulation class	°C			
WVT / CVT				
Ratio				
Number of Secondary Outputs				
Class of Secondary Outputs				
Highest Voltage of Equipment	kV			
Impulse Withstand Level	kV			
Power Frequency Withstand Voltage	kV			
Rated Frequency	Hz			
Rated Voltage Factor: Continuous Short Time				
Rated capacitance of the capacitor divider	Pf			
Rated capacitance of the high voltage capacitor	Pf			
Rated capacitance of the intermediate voltage capacitor	Pf			
Number of capacitor units				
Oil (Capacitor divider) Type Mass	kg			
Oil (Magnetic unit) Type Mass	kg			
Weight of Complete VT	kg			
Standard edition and year				
Current I: Connection A1-A2	A			
Voltage <i>U_{pr}</i>	kV			
<i>U_{sr}</i> (V): Rated Secondary Voltage for each secondary winding. Protection Metering Dual Purpose	V			
Values of rated output Protection Metering Dual Purpose	VA			
Accuracy Class:				

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MANUFACTURERS TYPE REFERENCE				
Rating	Units	33kV System Voltage	66kV System Voltage	132kV System Voltage
Protection Metering Dual Purpose				
Maximum simultaneous output for windings of a complete CVT regarding the accuracy class Protection Metering Protection + Metering				
External Insulation Requirements: Pollution level	Class / kV/mm			
HV Insulator creepage distance	mm			
HV Insulator minimum arcing distance	mm			
Length of Insulator	mm			
Typical PD Values	Pc			
Winding insulation medium				
Static mechanical withstand load	N			
Insulation material on CT				
HV Post Insulator material				
Bolt sizes for connection (HV & LV)				
Weight of complete Unit				
Details of mounting arrangements Flange mounting plate PCD details				
Has the equipment been awarded an ENA certificate of performance? Please provide reference number.				

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Appendix 3 – Pre-commission testing, Routine Inspection and Maintenance requirements

Suppliers shall provide details of the recommended pre-commission testing and inspection required. They shall also provide information regarding periodic inspection and maintenance requirements to be undertaken during the lifetime of their product. Typical information shall be as detailed in Annex B of BS EN 61869 Part 1

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Appendix 4 - SELF CERTIFICATION CONFORMANCE DECLARATION

33, 66 & 132kV Inductive or Capacitive Voltage Transformers shall comply with the latest issues of the relevant national and international standards.

This check sheet identifies the clauses of BS EN 61869-1, BS EN 61869-3, BS EN 61869-5, IEC 61462 and IEC 62217 relevant to 33, 66 & 132kV Inductive or Capacitive Voltage Transformers for use on the Companies distribution network.

The manufacturer shall declare conformance or otherwise, clause by clause, using the following levels of conformance declaration codes. A separate sheet shall be provided for each product being offered.

Conformance declaration codes

N/A = Clause is not applicable/ appropriate to the product

Cs1 = The product conforms fully with the requirements of this clause

Cs2 = The product conforms partially with the requirements of this clause

Cs3 = The product does not conform to the requirements of this clause

Cs4 = The product does not currently conform to the requirements of this clause, but the
Manufacturer proposes to modify and test the product in order to conform.

Manufacturer:

Product Reference:

Name:

Signature:

Date:

Instructions for completion

- When Cs1 code is entered no remark is necessary
- When any other code is entered the reason for non-conformance shall be entered
- Prefix each remark with the relevant 'BS EN' 'IEC' or 'ENATS' as appropriate.

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BS EN 61869-3 / BS EN 61869-5 – Type test requirements			
Clause/Sub-clause	Requirement	Conformance Code	Remarks and or type test report numbers
7.2.2	Temperature rise test		
7.4.1	Chopped Impulse test – (CVTs only)		
7.2.3	Impulse Voltage Test on primary terminals		
7.2.4	Wet test for outdoor type transformers		
7.2.5	Electromagnetic Compatibility Tests		
7.2.6	Accuracy Check		
7.2.7	Verification of the degree of protection by enclosures		
7.2.8	Enclosure tightness test at ambient temperatures		
7.2.9	Pressure test for the enclosure		
7.2.501	Capacitance and tan δ measurement at power frequency (CVTs only)		
7.2.301 or 7.2.502	Short-time withstand current tests		
7.2.503	Ferro resonance Test (CVTs only)		
7.2.504	Transient response Test (for protective CVTs only)		
7.2.505	Type tests for carrier frequency accessories (CVTs only)		

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IEC 60044-2 / IEC 60044-5 – Routine test requirements

Clause/Sub-clause	Requirement	Conformance Code	Remarks and or type test report numbers
7.3.1	Power- frequency withstand test on primary windings		
7.3.2	Partial Discharge measurement		
7.3.3	Power frequency withstand test between sections		
7.3.4	Power frequency withstand test on Sec terminals		
7.3.5	Test for accuracy		
7.3.6	Verification of markings		
7.3.7	Enclosure tightness at ambient temperature		
7.3.8	Pressure test for the enclosure		
7.3.501	Ferro Resonance Check (CVTs only)		
7.3.502	Routine test for carrier frequency accessories (CVTs only)		

BS EN 61869-1 – Special Type test where the external insulation is provided using porcelain)

Clause/Sub-clause	Requirement	Conformance Code	Remarks and or type test report numbers
7.4.6	Internal arc fault test (to be provided where units are manufactured using porcelain insulation.		

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IEC 61462 – Type tests			IEC 62217			Remarks
Clause / Sub-clause	Requirement	Conformance Code	Clause / Sub-clause	Requirement	Conformance Code	
7.2	<i>Tests on interfaces and connections of end fittings</i>		9.2	<i>Tests on interfaces and connections of end fittings</i>		
7.2.2	Reference dry power frequency test		9.2.3	Reference dry power frequency test		
7.2.3	Thermal Mechanical pre-stressing test		9.2.4	Product specific pre-stressing		
7.2.4	Water Immersion pre-stressing test		9.2.5	Water immersion pre-stressing		
7.2.5	Verification test		9.2.6	Verification test		
7.2.5.1	Visual Examination		9.2.6.1	Visual Examination		
7.2.5.2	Steep Front Impulse Test		9.2.6.2	Steep Front Impulse Test		
7.2.5.3	Dry Power Frequency Voltage Test		9.2.6.3	Dry Power Frequency Voltage Test		
7.3	<i>Tests on shed and housing material</i>		9.3	<i>Tests on shed and housing material</i>		
7.3.1	Hardness Test		9.3.1	Hardness Test		
7.3.2	Accelerated weathering test		9.3.2	Accelerated weathering test		
7.3.3	Tracking and erosion test		9.3.3	Tracking and erosion test		
			9.3.3.1	1000 hour salt fog test		
7.3.4	Flammability Test		9.3.4	Flammability Test		
7.4	<i>Tests on the tube material</i>		9.4	<i>Tests on the core material</i>		
7.4.1	Dye penetration test		9.4.1	Dye penetration test		
7.4.2	Water diffusion test		9.4.2	Water diffusion test		
			Annex A	Wheel test		
			Annex B	5000H - Test at Multiple stresses		

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IEC 61462 – Sample tests			IEC 62217			
Clause / Sub-clause	Requirement	Conformance Code	Clause / Sub-clause	Requirement	Conformance Code	Remarks
9.3.1	Verification of dimensions					
9.4	Mechanical tests					
9.5	Galvanising Test					
9.6	Check of the interface between end fittings and the housing					

IEC 61462 – Routine tests			IEC 62217			
Clause / Sub-clause	Requirement	Conformance Code	Clause / Sub-clause	Requirement	Conformance Code	Remarks
10.2	Visual examination					
10.4	Routine mechanical test					
10.5	Routine tightness test					
11.0	Documentation					

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Appendix 5 - Addendum to supplier requirements

Project-specific installation and protection requirements will be provided by the Company's Primary Engineering Projects section for inclusion in this appendix.

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Appendix 6 - Technical Information Check List

The following information shall be provided by the supplier for technical review by Northern Powergrid. Additional information shall be provided if requested.

Requirement	Provided (Y/N)
Full product descriptions and part number/reference, including a complete set of drawings for each variant	
Appendix 2 – Completed declaration of technical performance of VT	
Appendix 3 - Pre-commissioning testing/inspection requirements, including details on the end of life disposal of these units	
Appendix 4 – completed self-certification conformance declaration	
Appendix 5 – Addendum to suppliers requirements – site specific project requirements	
Type test evidence	
Routine test plan (example)	