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NPS/003/034 – Technical Specification for Pole-Mounted Distribution Transformers

1. Purpose

The purpose of this specification is to detail the technical requirements of Pole-Mounted Distribution Transformers for use on the 11kV and 20kV distribution networks of Northern Powergrid.

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

Document Reference	Document Title	Version	Published Date
NPS/003/034	Technical Specification for Pole-Mounted Distribution Transformers	6.0	June 2021

2. Scope

This specification details the technical requirements of Pole-Mounted Distribution Transformers utilised on the 11kV and 20kV Northern Powergrid distribution networks, including a requirement for suppliers to provide periodic inspection and maintenance information. This specification shall also be applicable to the legacy and special distribution voltages of 3.3kV, 6.6kV and 33kV.

This specification does NOT apply to Ground-Mounted Transformers, or Pad-Mounted Transformers.

Pole-Mounted Distribution Transformers with lid-mounted HV and LV bushings are acceptable to Northern Powergrid, providing they comply with section 3.3.1 of this specification.

The following appendices form part of this technical specification.

- Appendix 1 - Declaration of Compliance
- Appendix 2 - Schedule of Requirements
- Appendix 3 - Addendum to Supplier Requirements
- Appendix 4 - Testing, Inspection and Maintenance Requirements
- Appendix 5 - Summary of Testing Requirements
- Appendix 6 - Technical Information Check List

Technical documents referenced within this specification refer to the latest versions of the relevant International Standards, British Standard Specifications and all relevant Energy Networks Association Technical Specifications (ENA TS) current at the time of supply.

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3. Technical Requirements

3.1. Overview

The technical performance requirements described within this document are for Pole-Mounted Transformers to be utilised on the 11kV and 20 kV distribution networks of Northern Powergrid.

Pole Mounted Transformers are required for use on single pole or H-pole arrangements, depending on the physical size and weight of the transformer using standard steelwork as detailed in Energy Networks Association Technical Specification ENA TS 43-95. The transformers shall be designed and tested for use in particularly exposed conditions.

A number of transformers are required for use near an electricity transmission tower where higher levels of insulation are required in line with Energy Networks Association Engineering Recommendation G78-4 'Recommendations for Low Voltage Supplies to Mobile Phone Base Stations with Antennae on High Voltage Structures'

3.2. Technical Specification

3.2.1. General

The equipment shall comply with Energy Networks Association Technical Specification ENA TS 35-1 Distribution Transformers, Part 1 Common Clauses and Part 4 Pole Mounted Transformers unless varied by this specification; in which case this specification shall take precedence.

Pole-Mounted Transformers with lid mounted HV and LV bushings are acceptable providing they meet the requirements of sections 3.3.1 of this specification.

The equipment shall also comply with the latest versions of all other relevant, IEC International Standards, British Standard Specifications or equivalent Euro-Norms and Energy Networks Association Technical Specifications (ENA TS) at the time of supply, except where varied by this standard.

3.2.2. Variation and Clarifications to ENA TS 35-1 Part 1 – Common Clauses

The following variations, additions or clarifications to ENA TS 35-1 Part 1 are referenced to the clause numbers used in ENA TS 35-1 Issue 6:

5.2 Cooling Mode (Insulating Fluid)

The required external cooling medium shall be air

The internal cooling medium shall be insulating fluid; this fluid shall comply fully with the current version of Northern Powergrid Specification NPS/003/019 – Specification for Electrical Insulating Fluids for use in Plant & Equipment.

6.4 Specification of tappings in enquiry and order

The transformer tapping specification shall meet the requirements of ENA TS 35-1 Part 4 clause 4.6.1 for each transformer Type.

6.6 Losses

Lifetime costs shall be calculated, by the supplier, for every design variant, using the formula in Appendix 3 and the latest Northern Powergrid capitalisation figures

9.5 Centre of Gravity

The centre of gravity shall be as low as reasonably practicable. The centre of gravity of the transformer shall be marked on at least two adjacent sides with symbol 7 of BS EN ISO 780. A centre of gravity marking is not required on 50kVA or smaller single-phase pole mounted transformers.

11.0 Testing

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A summary of the Northern Powergrid testing requirements and classification is given in Appendix 5 of this NPS document.

11.1.1 General

Dielectric test levels shall adhere to the values for each transformer as specified in ENA TS 35-1 Part 4, Clause 5.1

11.1.3 Type Tests

Unless existing test evidence is available (and is formally accepted by Northern Powergrid); the full range of type tests required by ENA TS 35 1 shall be performed on, at least, the first unit of a given type and rating from a production facility. Further details on the tests required can be found in Appendix 5 of this specification

11.1.4 Special Tests

Unless existing test evidence is available and is formally accepted by Northern Powergrid; the full range of type tests (as classified in Appendix 5 of this NPS specification) shall be performed on, at least, the first unit of a given type and rating from a production facility.

14.2 Surface Finish

The transformer and its components (excluding insulating parts) shall not require maintenance for a period of at least 30 years in a polluted / coastal environment according to EN ISO 12944-2 Category C4. The corrosion protection system shall conform to the requirements of ENA TS 98-1. The surface finish colour shall be light grey. Other colours will be considered, subject to formal agreement by Northern Powergrid.

14.5.4 Lifting Fittings

Pole Mounted Transformers shall be designed and constructed to allow them to be lifted into position using soft slings attached to the lifting eyes, without the use of a spreader bar. The lifting eyes shall retain all their properties and functionality for the lifetime of the transformer and shall be painted yellow. Care shall be taken in the positioning of the lifting eyes to ensure that the slings do not interfere with, or potentially cause damage to the insulator bushings when the transformer is lifted.

3.2.3. Variation and Clarifications to ENA TS 35-1 Part 4 – Additional Requirements for Pole Mounted Transformers

4.1 General

Transformer dimensions and weights shall be minimised as far as reasonably practicable. The weight limits set out in Figures 1 and shall apply to platform mounted transformers.

Subject to acceptability of wind loading and electrical clearance, etc., but regardless of kVA rating:

- Transformers less than 400kg may be mounted with a single-bolt fixing arrangement.
- Transformers less than 1,000kg may be mounted on a single-pole platform arrangement as detailed in ENA TS 43-95 Fig 23. As such they shall be designed to be a maximum offset from the pole of 725mm to fit on the platform.
- Transformers less than 1,400kg may be mounted on an 'H' pole platform arrangement as detailed in ENA TS 43-95 fig 24. As such they shall be designed to be a maximum width of 1380mm to fit between the legs of an 1830mm centres H pole.
- Transformers up to 1750kg will be considered but are a non-preferred option as the use of these requires the use of non-standard support arrangements (with associated additional costs). In either case they must still be capable of being mounted on an 'H' pole platform arrangement as detailed in ENA TS 43-95 fig 24. As such they shall be designed to be a maximum width of 1380mm to fit between the legs of an 1830mm centres H pole.

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- 200kVA units that weigh less than 1,000kg shall be supplied drilled to fit both single pole platform arrangements (for use at new installations) and 'H' pole arrangements (to allow replacement of older, heavier 'units that are mounted on 'H' poles).

Note - Transformers with weights in excess of 400kg shall not be supplied with a bracket that would allow single bolt fixing.

4.3 HV Terminations

HV bushings shall always be supplied with arcing horns (coordination gap feature) fitted.

HV bushing studs shall be M12 for all kVA ratings

Arrangements where both HV and LV terminations are mounted on the tank cover are acceptable where the design complies with clause 3.3.1 of this specification.

The HV terminal phase markings for three phase transformers shall be 1U, 1V, 1W and terminal markings for single phase transformers shall be 1.2, 1.1, left to right when facing the terminals

4.4 LV Terminations

The LV neutral shall NOT be equipped with a surge arrester.

Arrangements where both HV and LV terminations are mounted on the tank cover are acceptable where the design complies with clause 3.3.1 of this specification.

All transformers which have a rating above 25kVA and do NOT have a three phase LV output shall be supplied equipped to allow on-site conversion between single phase (250V two wire) and split phase (250V-0-250V single phase three wire) outputs by the relocation of links external to the transformer tank. These transformers shall always be supplied to Northern Powergrid with the links installed and connected for single phase LV output.

The LV bushings shall be:

Transformer Rating	Bushing Stud
100kVA and below	M12
Above 100kVA	M20

Terminal markings shall be as follows:-

Three Phase Systems	2W, 2V, 2U 2N left to right when facing the terminals
Single Phase 3-Wire Systems	2.1, 2.3, 2.2 left to right when facing the terminals
Single Phase 2 or 3 wire Systems	2.1, 2.3 on the left-hand side of the tank and 2.2 on the right-hand side of the tank
Single Phase up to 50kVA for use on 2 wire systems only	2.1, 2.3 on the left-hand side of the tank and 2.4 , 2.2 on the right-hand side of the tank

4.6 Specification of Tappings

4.6.1 General

All transformers shall be provided with a de-energised tap-changer operated by an external self-positioning tapping switch in accordance with IEC 60214-1 Clause 7. Tappings shall be provided on the higher voltage winding for a variation of the no-load primary voltage of -5%, -2.5%, 0%, +2.5%, and +5%.

With respect to the tappings, switch position No1 shall correspond to the +5% tapping position. Unless specified otherwise all transformers shall be supplied with the tap changer set at tap position 3 i.e., 0%.

4.6.2 Single-Phase 16 kVA, 25 kVA and 50 kVA transformer tappings

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On single-phase pole mounted transformers rated 16kVA, 25kVA and 50kVA, with standard voltage ratios of 6,600/250V, 11,000/250, 20,000/250 and 33,000/250V, the Northern Powergrid preference is still for an external self-positioning tapping switch, however an alternative tapping arrangement may be provided on the lower voltage winding, by means of connection to external LV bushings

5.1 Dielectric Test Levels

Insulation levels for Pole Mounted Transformers shall be in accordance with ENA 35-1 Part 4, Table 3; the test voltages for particularly exposed conditions shall apply.

3.3. Special Requirements

3.3.1. HV & LV Bushing Arrangements

In addition to the HV and LV arrangements detailed in clause 4.3 and 4.4 of ENA TS 35-1 Part 4; arrangements where both HV and LV terminations are mounted on the tank cover are acceptable.

Where both HV and LV terminations are mounted on the tank cover then the design shall inherently prevent voltage transfer from HV to LV, taking account of possible causes including: snow, vandalism, debris, birds or animals.

If this cannot be achieved practicably then the LV terminals shall be equipped with approved, individual, durable, long-term UV stable, HV rated, insulating shrouds that do not compromise the performance of the LV bushings but do provide protection against HV to LV voltage transfer.

Where both terminations are mounted on the tank cover then the design shall take particular account of insulation compromise as result of snowfall and the resulting accumulation of snow on and around the bushings and tank cover.

The bushing arrangements and associated features shall not compromise any performance criteria of the unit and shall not compromise the physical performance, or the ergonomic considerations, of the HV and LV connections. The 'as installed' design of bushings and associated parts shall be the arrangement used when subjecting the transformers to type tests and special tests.

3.3.2. G78 Transformers

Northern Powergrid requires a small number of transformers that will be used to provide Low Voltage supplies to mobile phone base stations with antennae on High Voltage structures and these transformers shall comply with the requirements of Energy Networks Association Engineering Recommendation G78-4.

G78 installations in Northern Powergrid are designed to withstand a 29kV 50Hz rise of earth potential (ROEP).

G78 transformers shall be supplied equipped with surge arrestors between the HV connections and the transformer tank. The surge arrestors shall provide the following characteristics: -

SURGE ARRESTOR CHARACTERISTICS	For use on 11kV network	For use on 20kV network
Rated Voltage	36kV	41kV
Line Discharge	Class 2	Class 2
Nominal Discharge Current	10kA	10kA
Minimum Transient Overvoltage	36kV	41.5kV
Maximum Residual Voltage (when subjected to a 10kA 8/20µs lightning current impulse)	100kV	140kV

G78 transformers shall be supplied equipped with an external electrical bond between the neutral terminal and the transformer tank earth connection. This bond shall have a minimum cross section of 70mm² copper, or equivalent.

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For G78 transformers some of the electrical characteristics specified in ENA TS 35-1 – Part 4 clause 5.1, Table 3 shall be enhanced to the following minimum insulation levels:

	LV (<1kV)	12kV	24kV
Rated lightning impulse withstand (LIC)	---	125kV	175kV
Rated 1 min power frequency wet withstand	3kV	36kV	50kV

3.3.3. 33kV, 6.6kV and 3.3kV Transformers

Northern Powergrid utilises a number of Pole-Mounted Transformers on its 33kV, 6.6kV and 3.3kV networks.

These shall comply with the principles and requirements of this NPS specification and ENA TS 35-1 Parts 1 & 4.

33kV, 6.6kV and 3.3kV transformers shall also have the following characteristics:

	3.3kV nominal	6.6kV nominal	33kV nominal
Rated lightning impulse withstand (LIC)	40kV	75kV	200kV
Rated 1 min power frequency wet withstand	10kV	20kV	70kV

3.3.4. Transformers for Special Applications

Transformers for special applications where there is an unacceptable risk of fire, environmental sensitivity or environmental risk shall be supplied with high flash point fluid, in accordance with NPS/003/019 - Technical Specification for Electrical Insulating Fluids for use in Plant and Switchgear.

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4. References

4.1. External Documentation

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

Reference	Title
BS EN ISO 780	Packaging. Distribution packaging. Graphical symbols for handling and storage of packages
EN ISO 12944-2	Paints and varnishes. Corrosion protection of steel structures by protective paint systems. Classification of environments
ENA ER G78 Issue 4: 2018	Recommendations for Low Voltage Supplies to Mobile Phone Base Stations with Antennae on High Voltage Structures
ENA TS 35-1 Part 1: 2020	Distribution Transformers - Part 1 Common Clauses
ENA TS 35-1 Part 4: 2022	Distribution Transformers - Part 4 Pole Mounted Transformers
ENA TS 98-1	Environmental classification and corrosion protection of structures, plant and equipment
IEC 60076 – 1	Power Transformers. General

4.2. Internal Documentation

Reference	Title
IMP/001/103	Code of Practice for the Methodology of Assessing Losses
NPS/003/019	Technical Specification for Electrical Insulating Fluids for use in Plant and Switchgear

4.3. Amendments from Previous Version

Reference	Description
3.2.3. Variation and Clarifications to ENA TS 35-1 Part 4 – Additional Requirements for Pole Mounted Transformers	Not added to stating that Transformers with weights in excess of 400kg shall not be supplied with a bracket that would allow single bolt fixing.
4.1 External Documentation	New referenced documents added
6.0 Authority for Issue	Authorisation list updated

5. Definitions

Term	Definition
None	

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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
Deb Dovinson	Governance Administrator	27/03/2024

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	
No	Period: 7	Reason: Update will be dictated by contact renewal date or any significant changes in the specification or documents referenced
Should this document be displayed on the Northern Powergrid external website?		Yes
		Date
Steven Salkeld	Policy and Standards Engineer	24/06/2024

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
Ged Hammel	Lead Policy and Standards Manager	27/03/2024

6.4. Authorisation

Authorisation is granted for publication of this document.

		Date
Paul Black	Head of System Engineering	03/06/2024

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Appendix 1 – Declaration of Compliance with IEC 60076, ENA TS 35-1 Parts 1 & 4 and NPS/003/034

The supplier/manufacturer/tenderer shall declare clause-by-clause conformance or otherwise, using the codes given below and shall describe how the conformance with each clause is achieved, or why it is only partly achieved, or why it is not achieved.

The number of copies of this declaration completed can be minimised by aggregating similar units into groupings and completing one declaration table for each grouping, but each declaration table must clearly state which units are included.

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			<ul style="list-style-type: none"> ALL blank cells require completion/information entering. In the Remarks/Details column; describe how the clause compliance is achieved. E.g., state values/colours, give examples of type test evidence, state make/type of insulating fluids, etc. In the Remarks column; when Cs2 or Cs3 is entered, give details of the non-conformance. Supplementary sheets may be supplied if more detail is required. 				
Make/Reference/Rating range of units included in this declaration table:							
IEC/ENATS Clause	Clause Subject	Conformance Code IEC 60076-1	Conformance Code ENA TS 35-1 Part 1	Conformance Code ENA TS 35-1 Part 4	Conformance Code NPS/003/034	Evidence Reference	Remarks / Comments
1	Scope						
2	Normative references						
3	Definitions						
3.1	General / Overview						
3.2	Terminals and Neutral Point						
3.3	Windings						
3.3.1	HV & LV Bushing Arrangements						
3.3.2	G78 Transformers						
3.3.3	33kV, 3.3kV & 6.6kV Transformers						
3.4	Rating						
3.5	Tappings						
3.6	Losses and No-load Current						
3.7	Short-circuit Impedance and Voltage Drop						
3.8	Temperature Rise						

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3.9	Insulation						
3.10	Connections						
3.11	Kinds of Tests						
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5	Rating and General Requirements						
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5.1	Rated power						
	Dielectric Test levels						
5.1.2	Preferred values of rated power						
5.1.3	Minimum power under alternative cooling modes						

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5.6	Highest voltage for equipment Um and dielectric test levels								
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5.7.2	Winding connection and number of phases								
5.7.3	Sound Level								
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5.8	Components and Materials								
6.0	Requirements for transformers having a tapped winding								
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6.2	Tapping Voltage – tapping Current, etc.								
6.3	Tapping Power – full power tapplings – reduced power tapplings.								

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6.4	Specification of tappings in enquiry and order					
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6.6.1	Dual ratio Transformers					
7	Connection and phase displacement symbols					
8	Rating Plate					
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8.2	Information to be given in all Cases					
8.3	Additional information to be given when applicable					
9	Safety, environment and other requirements					
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9.2	Dimensions of neutral connections					
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9.5	Centre of Gravity					
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11	Tests					
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11.3	Measurement of winding ration and phase displacement				
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11.11	Vacuum tightness test on site for liquid immersed transformers				
11.12	Check of core and frame insulation				
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13	High Frequency switching transients				
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14.1	Number of Phases				
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14.3	Position and Marking of terminals				
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14.5.1	Plain breathing device				
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14.5.3	Earthing Terminals				
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15.1	Drawings					
15.2	Assembly, operations and maintenance instructions					
15.3	Test Data					

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Appendix 2 –Schedule of Requirements

		Commodity code	Description	HV Voltage	HV system	LV Voltage	LV system	Load Rating
20kV	1 Phase	382056	20kV pole mounted transformer 25kVA single phase (250V) 2 wire HV and 2 wire LV	20kV	2 wire	250V	2 wire	25kVA
	Combined 1 Phase or Split Phase	382060	20kV pole mounted Tx 50kVA 1ph (250V) 2 wire HV & 2 wire LV, OR 25kVA per phase Split Phase 2 wire HV & 3 wire LV (250-0-250V)	20kV	2 wire	250V or 250-0-250V	2 wire or 3 wire	50kVA or 25kVA/ph
		382075	20kV pole mounted Tx 100kVA 1ph (250V) 2 wire HV & 2 wire LV, OR 50kVA per phase Split Phase 2 wire HV & 3 wire LV (250-0-250V)	20kV	2 wire	250 or 250-0-250V	2 wire or 3 wire	100kVA or 50kVA/ph
		382076	20kV pole mount Tx 200kVA 1ph (250V) 2 wire HV & 2 wire LV, OR 100kVA per phase Split Phase 2 wire HV & 3 wire LV (250-0-250V)	20kV	2 wire	250 or 250-0-250V	2 wire or 3 wire	200kVA or 100kVA/ph
	3 Phase	381689	20kV pole mounted transformer 50kVA three phase (433/250V)	20kV	3 wire	433/250V	4 wire	50kVA
		381693	20kV pole mounted transformer 100kVA three phase (433/250V)	20kV	3 wire	433/250V	4 wire	100kVA
		381725	20kV pole mounted transformer 200kVA three phase (433/250V)	20kV	3 wire	433/250V	4 wire	200kVA

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		Commodity code	Description	HV Voltage	HV system	LV Voltage	LV system	Load Rating
		381726	20kV pole mounted transformer 315kVA three phase (433/250V)	20kV	3 wire	433/250V	4 wire	315kVA
		Commodity code	Description	HV Voltage	HV system	LV Voltage	LV system	Load Rating
11kV	1 Phase	380934	11kV pole mounted transformer 25kVA single phase (250V) 2 wire HV and 2 wire LV	11kV	2 wire	250V	2 wire	25kVA
	Combined 1 Phase or Split Phase	380915	11kV pole mount Tx 50kVA 1ph (250V) 2 wire HV & 2 wire LV, OR 25kVA per phase Split Phase 2 wire HV & 3 wire LV (250-0-250V)	11kV	2 wire	250V or 250-0-250V	2 wire or 3 wire	50kVA or 25kVA/ph
		380900	11kV pole mount Tx 100kVA 1ph (250V) 2 wire HV & 2 wire LV, OR 50kVA per phase Split Phase 2 wire HV & 3 wire LV (250-0-250V)	11kV	2 wire	250 or 250-0-250V	2 wire or 3 wire	100kVA or 50kVA/ph
		380916	11kV pole mount Tx 200kVA (100kVA per phase) Split Phase 2 wire HV & 3 wire LV (250-0-250V)	11kV	2 wire	250-0-250V	3 wire	100kVA/ph
		381000	11kV pole mounted transformer 50kVA three phase (433/250V)	11kV	3 wire	433/250V	4 wire	50kVA
		381015	11kV pole mounted transformer 100kVA three phase (433/250V)	11kV	3 wire	433/250V	4 wire	100kVA
		381034	11kV pole mounted transformer 200kVA three phase (433/250V)	11kV	3 wire	433/250V	4 wire	200kVA
	3 Phase							

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		Commodity code	Description	HV Voltage	HV system	LV Voltage	LV system	Load Rating
		122481	11kV pole mounted transformer 315kVA three phase (433/250V)	11kV	3 wire	433/250V	4 wire	315kVA

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		Commodity code	Description	HV Voltage	HV system	LV Voltage	LV system	Load Rating
20kV	G78 - 3 Phase	381880	20kV pole mounted transformer G78 sites 50kVA three phase (433/250V)	20kV	3 wire	433/250V	4 wire	50kVA
		381881	20kV pole mounted transformer G78 sites 100kVA three phase (433/250V)	20kV	3 wire	433/250V	4 wire	100kVA
		381882	20kV pole mounted transformer G78 sites 200kVA three phase (433/250V)	20kV	3 wire	433/250V	4 wire	200kVA
11kV		380290	11kV pole mounted transformer G78 sites 50kVA three phase (433/250V)	11kV	3 wire	433/250V	4 wire	50kVA
		380291	11kV pole mounted transformer G78 sites 100kVA three phase (433/250V)	11kV	3 wire	433/250V	4 wire	100kVA
		380292	11kV pole mounted transformer G78 sites 200kVA three phase (433/250V)	11kV	3 wire	433/250V	4 wire	200kVA

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Appendix 3 – Addendum to Suppliers Requirements

Losses

Lifetime costs shall be calculated, for every design variant, using the formula below and the latest Northern Powergrid capitalisation figures. The Northern Powergrid loss £/kW figures incorporate utilisation factor and time span. The maximum £/kW losses are detailed in IMP/001/103, clause 3.3.3 and Appendix 5

Lifetime Cost = Purchase price + (No load loss kW x No load £/kW) + (Load loss kW x Load loss £/kW)

The tenderer shall supply details of each element of this calculation, in addition to the answer.
The tenderer shall declare the maximum guaranteed loss figures for each design variant.

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Appendix 4 – 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.

Detailed inspection and maintenance instructions shall also be provided.

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Appendix 5 – Summary of Test Requirements

IEC 60076-1	IEC 60076-3		ENATS 35-1	Northern Powergrid NPS	Northern Powergrid TEST REQUIREMENT
IEC 60076 - 10.1.1 Routine tests					
10.1.1.a		Measurement of winding resistance (10.2)	Routine		Routine
10.1.1.b		Measurement of voltage ratio and check of phase displacement (10.3)	Routine		Routine
10.1.1.c		Measurement of short-circuit impedance and load loss (10.4)	Routine		Routine
10.1.1.d		Measurement of no-load loss and current (10.5)	Routine		Routine
10.1.1.e		Dielectric routine tests (60076-3)	Routine		Routine
	Table 1	Lightning Impulse (LI) (clauses 13 & 14) - ENATS 35-1 requires LIC chopped wave	Type test (LIC)	LIC of 95kV for 11kV units	Type Test
	Table 1	Switching Impulse (SI) - Not Applicable (clause 15)			Not Applicable
	Table 1	Long Duration AC (ACLD) - Not Applicable (clause 12.4)			Not Applicable
	Table 1	Short Duration AC (ACSD) (clauses 12.2)	Routine		Routine
	Table 1	Separate source AC (clause 11)	Routine		Routine
	7.3	Tests to be done in sequence as set out in 60076-3			---
	12.2	Transformers $U_m < 72.5\text{kV}$ - partial discharge measurement not required			Not Required

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IEC 60076-1	IEC 60076-3		ENATS 35-1	Northern Powergrid NPS	Northern Powergrid TEST REQUIREMENT
	13.3.2	Impulse test on a neutral terminal - ENATS 35-1 Clause 19 = Special test	Special	Type test	Type test
10.1.1.f		Tests on on-load tap-changers, where appropriate (10.8)			Not Required
IEC 60076 - 10.1.2 Type tests					
10.1.2.a		Temperature-rise test (60076-2)	Type test		Type test
10.1.2.b		Dielectric type tests (60076-3) - see 10.1.1 above			---
IEC 60076 - 10.1.3 Special tests					
10.1.3.a		Dielectric special tests (60076-3) - see 10.1.1 above			see 10.1.1 above
10.1.3.b		Determination of capacitances windings-to-earth, and between windings.			Not Required
10.1.3.c		Determination of transient voltage transfer characteristics.			Not Required
10.1.3.d		Measurement of zero-sequence impedance(s) on three-phase transformers (10.7)			Not Required
10.1.3.e		Short-circuit withstand test (60076-5)		Type test	Type test
10.1.3.f		Determination of sound levels (60551)	Type test		Type test
10.1.3.g		Measurement of the harmonics of the no-load current (10.6)			Not Required
10.1.3.h		Measurement of the power taken by the fan and oil pump motors.			Not Required

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IEC 60076-1	IEC 60076-3		ENATS 35-1	Northern Powergrid NPS	Northern Powergrid TEST REQUIREMENT
10.1.3.i		Measurement of insulation resistance and/or dissipation factor ($\tan \delta$)			Not Required

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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	
Appendix 1 – Completed Self-Certification Conformance Declaration Against IEC60076 And ENA TS 35-1 parts 1 & 4 and NPS/003/034	
Appendix 2 – Schedule Of Requirements	
Appendix 3 – Addendum To Supplier Requirements	
Appendix 4 – Pre-Commissioning Testing, Periodical Inspection And Maintenance	
Appendix 5 – Summary Of Testing Requirements	
Appendix 6 – Completed Technical Information Check List	
Complete set of drawings for each variant, including General arrangement, rating and connection diagrams.	
The supplied information shall also include data on copper and iron losses, transformer weights and oil volume.	
Type test evidence	
Routine test plan (example)	
Packaging/delivery information	