NPS/003/041 – Technical Specification for 11kV & 20kV Pad Mounted Transformers

1. Purpose

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

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

Reference	Version	Date	Title
NPS/003/041	1.0	Dec 2016	NPS/003/041 – Technical Specification for 11kV & 20kV Pad Mounted Transformers

2. Scope

This specification covers the technical requirements for 11kV & 20kV Pad Mounted Transformers utilised on the Northern Powergrid distribution networks, including the requirement for suppliers to provide periodic inspection and maintenance information.

The attached appendices form part of this technical specification.

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.

2.1. Contents

3. Technical Requirements

3.1. Overview

The requirement is for Self-Cooled, Pad-Mounted-Type Transformers to be utilised on the 11kV and 20kV distribution networks of Northern Powergrid.

There are occasional requirements for other primary voltages (6.6kV, 3.3kV, etc.) for use on legacy parts of the networks. Pad Mounted Transformers required for use on these networks shall comply with relevant parts of this specification.

Pad-mounted transformers used on the Northern Powergrid network shall incorporate:

- Two or three wire HV input via one set of HV bushings
- A "Dead Front" concept as defined in *ENA ERRep5 Pad-Mounted Transformers*
- HV fuse(s) that provide overload and fault protection for the HV and LV active parts of the transformer and for the LV PENDA elements
- A transformer with a rating between 25kVA and 200kVA
- Two to four wire; single, split (250-0-250) or three phase LV output
- Between one and three LV outgoing distributor unit fuse ways
- Fixed sockets for the connection of a mobile generator

Note – In the UK it is mandatory that all distribution substations incorporate LV Fuses to protect and control each phase of all outgoing LV cables. So every pad mounted transformer must incorporate a PENDA (LV fuseboard)

Northern Powergrid's concept of, and base requirements for, a pad-mounted transformer align with ENA *"ERep5 Pad-Mounted Transformers".* Pad-mounted transformers for use on the Northern Powergrid network shall not contain any HV circuit switching devices.

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

Any subsequent changes in the relevant International Standards, British Standard Specifications and (ENA TS) documents which result in a variation from this specification shall be incorporated by suppliers, subject to a technical evaluation by the Northern Powergrid Policy & Standards Section and instruction in writing.

The equipment shall comply with the latest versions of all relevant UK, European and International legislation at the time of supply.

3.2. Technical Specification

3.2.1. General

The pad-mounted transformer shall be supplied equipped with the following:

- A steel divider between high-voltage and low-voltage compartments, with HV on the left and LV on the right when viewed from the front of the unit.
- Removable sills to ease installation of the HV and LV cables
- An inbuilt base/foundation pad (only applies to some variants - refer to Appendix 1)
- Tank bases to allow skidding or rolling in any direction
- Proof of surface finish and longevity of all components for 30 years without maintenance, including painting.
- Padlockable hinged doors on the HV and LV compartments.
  The design shall be such that access to the LV and HV compartments is gained in this sequence:
  Access to the LV compartment, after unlocking and removing an externally accessible padlock.
  Access to the HV compartment, only after access has been gained into the LV compartment and then after a non-externally mounted padlock has been unlocked and removed.

The doors on the HV and LV compartments shall have door stays to securely hold the doors open in three positions: 90°, 120° and 150°.

- External surfaces and interfaces designed so that they do not retain water.

3.2.1.1. Environmental Conditions.

In addition to the environmental conditions specified in the ENA TS 35-1 Part 4 and 37-2 the pad- mounted transformer shall be designed and tested for the following conditions:

- Wind loading in accordance with BS EN 1991-1-1 NA applying basic wind speed up to 23 m/s.
- Snow loading up to 0.8kN/m2
- Distributed loading of 1.0kN/m2
- Solar gain of 1,000W/m2

3.2.1.2. Security

The pad-mounted transformer might be accessible to the public, so it is essential that the units have integral and inherent security features.

The pad-mounted transformer shall have a case/housing that:

- Is intruder resistant, preferably tested and certified to Security Rating Classification 1, or above, of Loss Prevention Certification Board LPS 1175.
- Has hinged doors or lids with hinge pins (minimum 8mm diameter) & barrels and locking arrangement made of stainless steel or equivalent.
- Has continuous steel baffling on all edges of the hood and sill, without the use of welded or bolted parts.
- Does not have exposed fastenings that can be externally loosened or removed.
- Has physical protection of cooling fins, or a substantial arrangement that does not require protection.
- Has facilities, inside the housing, to bolt down the unit to an external base
- Provides protection against ingress of solid foreign objects of 12.5mm diameter or above and against the ingress of spraying water. Complete enclosures shall provide an IP rating of IP3 in accordance with IEC 60529

3.2.1.3. IK code (IEC 62262)

The pad-mounted transformer enclosure shall have an IK code of at least IK09.

A single sample of a complete pad-mounted transformer shall be tested in accordance with IEC 60068-2-75, with the following criteria below. Clause references in brackets refer to IEC 60068-2-75: -

Impact energy (3.2.2) shall be 10J.

Number of impacts (3.2.3) shall be:

- At least ten impacts to every facet and door (see item 3.6.1 below), plus
- Six impacts to every: locking point, vent (excluding vents less than 100mm wide), generator cable entry point and visible hinge.

Type(s) of test apparatus to be used (3.3.1):

- Tests on the roof facets shall be done with a vertical hammer.
- Tests on the locking points shall be downward impacts at 45 degrees to the vertical and applied with a spring hammer, or as agreed with the Company.
- All other tests shall be done with a pendulum hammer.

Method of mounting (3.3.2): The enclosure shall be secured, using the manufacturer's recommended standard fixing arrangement for that housing, and during and on completion of the tests the housing shall not have moved more than 6mm as a result of the tests.

Preconditioning (3.4): Is not required.

Initial measurements (3.5): Are not required.

Attitude and impact locations (3.6.1):

Impact locations on the facets and doors shall be chosen to test the weakest point of the facet; but as default shall include impacts in each of the following locations:

- The mid-point of every join in the facet material.
- Two diagonally opposite corners, 150mm in from each facet edge.
- The mid-point of two adjacent sides, 300mm in from each facet edge.
- The centre of the facet.

Impacts on the locking points shall be applied equally along the top of the locking points.

Securing of bases, covers and similar components (3.6.2) - see item d) above.

Operating mode and functional monitoring (3.6.3) is not required.

Acceptance and rejection criteria (3.6.3 and 3.8): the housing shall have passed the test if:

Impacts into facets/areas associated with HV compartments shall not have penetrated more than 10mm.
Impacts into facets/ areas associated with any other compartment shall not have penetrated more than 20mm.
Conditions for recovery (3.7) are not applicable.

Final measurements (3.8):

- The following shall be measured, photographed and recorded: Impact penetration, facet edge flex/movement, cracks in the outer surface of the facet, and visibility of daylight through any gaps.
- The IP rating testing shall be carried out on the same sample enclosure used before the impact testing and shall be carried out again after the impact testing, as recommended in Appendix B of IEC 60068-1.

3.2.2. HV Bushing Arrangements

Pad-mounted transformers shall be provided with externally clamped and removable bushing wells equipped with HV bushings suitable for screened, load break, separable connectors rated at 200A and compliant with IEEE 386-2001.

The pad-mounted transformer shall be supplied equipped with the following in the same chamber as the HV bushings:

(i) Fully rated copper earth bars for the connection of three grounding elbow lead clamps and the cable earth screens.

(ii) Parking stands for stand-off plugs for the HV Cable connections. These shall be designed and located, with sufficient electrical clearance, to allow the following procedures to be followed in an ergonomically acceptable manner using hot stick tools:

(ii) a Earthing the incoming cables.

- Install one horizontal insulated feed-thru parking bushing per phase into the parking stand
- Fit one insulating cap onto each insulated feed-thru parking bushing
- Connect the clamps of three grounding elbows to the earth bar(s).
- Unplug one HV cable and plug the HV cable onto an insulated feed-thru parking bushing.
- Fit an insulating cap onto the exposed bushing on the transformer.
- When all phases are safety transferred to these parking bushings; remove one insulating cap, insert a test rod into the exposed bushing and test for the presence of voltage with a live line tester. Remove the test rod and connect the grounding elbow to the tested transformer bushing. Repeat for all other transformer bushings, until all incoming HV cables are earthed.

(ii)b Earthing the transformer.

- Install one horizontal insulated feed-thru parking bushing per phase into the parking stand
- Fit one insulating cap onto each insulated feed-thru parking bushing

- Connect the clamps of three grounding elbows to the earth bar(s).
- Unplug one HV cable and plug the HV cable onto an insulated feed-thru parking bushing.
- Fit an insulating cap onto the exposed bushing on the transformer.
- When all phases are safely transferred to these parking bushings; remove one insulating cap from a transformer bushing, insert a test rod into the exposed bushing and test for the presence of voltage with a live line tester.
  Remove the test rod and connect the grounding elbow to the tested phase.
  Repeat for all other phases, until all phases of the transformer are earthed.

3.2.3. HV Protection

Each pad-mounted transformer HV winding shall be protected by a current limiting back-up fuse in accordance with the requirements of IEC 60282-1.

A Bay-O-Net current sensing fuse (or similar subject to formal approval by Northern Powergrid) shall be connected in series with each current limiting back-up fuse.

Both types of fuse shall be located within the transformer tank and suitably co-ordinated to ensure that: -

- the current limiting fuse only operates for a failure within the transformer tank'
- the Bay-O-Net current sensing fuse operates for any HV over current including a secondary fault that is not cleared by the LV fuse
- grading is achieved with the LV fuses and with Northern Powergrid's upstream network protection.

The selection of the high-voltage fuse links for the transformer shall otherwise be generally in accordance with the guidance in IEC TR 60787. The selection of the fuse ratings is to be formally agreed with Northern Powergrid. There shall be facilities to replace the Bay-O-Net current sensing fuses without removing the transformer lid. Removal of these fuses shall be achieved by using 'hot stick' equipment. Similar facilities to remove the current limiting fuse on site are not required.

Sealed transformers shall be fitted with a pressure relief device that can be manually operated prior to removing the Bay-O-Net current sensing fuses. This shall equalize the pressure inside the tank with atmospheric pressure to prevent insulating oil being expelled.

The Bay-O-Net fuse assembly shall be designed to minimise any insulating oil spillage when the fuses are removed. If necessary, there shall be provision beneath each Bay-O-Net fuse holder to collect any droplets of insulating oil that may fall from the fuse during removal.

There shall be suitable space/provision to store Bay-O-Net fuses that need to be removed temporarily and retained on site to be re-installed later.

3.2.4. The Transformer Active Parts

The active parts of the Pad Mounted Transformer shall comply with the Energy Networks Association Technical Specification "*ENA TS 35-1 Distribution Transformers Part 1 Common Clauses"*, unless varied by this specification; in which case this specification shall take precedence.

3.2.4.1. Variations and Clarifications to ENA TS 35-1 Part 1

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

ENA TS 35-1 Part 1 Common Clauses

35-1 Part 1 – Clause 5.1.2 Preferred values of rated power

The rated power shall be rated in accordance with Appendix 1 of this NPS document.

35-1 Part 1 – Clause 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.

35-1 Part 1 – Clause 5.4.1 Rated voltage

The rated voltage shall be in accordance with Appendix 1 of this NPS document.

35-1 Part 1 – Clause 5.4.2 Rated frequency

The rated frequency shall be 50Hz.

35-1 Part 1 – Clause 6.2 Tapping voltage

Clause 6.2 of ENA TS 35-1, tapping voltage variation category, does not apply.

35-1 Part 1 – Clause 6.4.Specifications of tappings

To help Northern Powergrid manage the potential over-voltages resulting from distributed generation, etc. 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 -2.5%, 0%, +2.5%, +5% and +7.5%.

With respect to the tappings, switch position No1 shall correspond to the +7.5% tapping position. Unless specified otherwise all transformers shall be supplied with the tap changer set at tap position 3 i.e. +2.5%.

A tapping range of -5%, -2½ %, 0, +2½ %, +5 % will be considered by Northern Powergrid but only if the offset tapping range is not available practically.

35-1 Part 1 – Clause 6.6 Losses

Transformers shall comply with clause 6.6 and be optimised for lifetime costs which shall be calculated, by the supplier, using the formula in Appendix 3 of this specification and the latest Northern Powergrid capitalisation figures provided at the tender stage.

35-1 Part 1 – Clause 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.

35-1 Part 1 – Clause 11.1.1 (Tests) General

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

35-1 Part 1 – Clause 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.

35-1 Part 1 – Clause 11.1.4 Special Tests

Unless existing test evidence is available from identical (or similar) units and is formally accepted by Northern Powergrid, a short-circuit withstand test in accordance with clause 11.1.3 of ENA TS 35-1 (now IEC 60076-1 Clause 11.1.4) shall be performed on, at least, the first unit of a given type and rating from a production facility.

35-1 Part 1 – Clause 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 a subtle shade of fawn (similar to. BS381c-380 Camouflage Desert Sand or BS381c-420 Dark Sand) or mid grey (similar to RAL7004 Signal Grey) that blends into both rural and urban environments.

Other colours will be considered, but the surface finish and colour are subject to formal agreement by Northern Powergrid.

35-1 Part 1 – Clause 14.4 Cooling

Transformers that are not hermetically sealed shall be supplied equipped with a combined drain and sampling valve.

An oil level indicator (inside the cover of the pad-mounted transformer).

Hermetically Sealed transformers shall be supplied equipped with a device that indicates liquid loss and this device shall be incorporated into a pressure relief feature; which shall cater for excess pressure or vacuum and shall self-reseal after operation.
All other transformers shall have a liquid level indicator gauge, mounted externally or inside the LV compartment, that indicates normal liquid level at 15°C and provides an accurate display of the oil level over the temperature range of -10°C to 80°C. If mounted externally the gauge shall be included in the IK Code testing.

35-1 Part 1 – Clause 14.5.2 Tapping switch handle

The tapping switch handle shall be inside the cover of the pad-mounted transformer and shall be padlockable.

35-1 Part 1 – Clause 14.5.3 Earthing terminals

The earthing terminals shall be below the HV terminals, inside the cover of the pad-mounted transformer.

35-1 Part 1 – Clause 14.5.4 Lifting Fittings

Pad Mounted Transformers shall be designed and constructed to allow them to be lifted into position using soft slings attached to the lifting eye. The lifting eyes shall retain all their properties and functionality for the lifetime of the transformer and shall be painted yellow.

3.2.5. The Public Electricity Network Distribution Assembly

The LV PENDA features of the Pad Mounted Transformer shall comply with Energy Networks Association Technical Specification ENA TS 37-2 Issue 5 (2012) Public Electricity Network Distribution Assemblies, unless varied by this specification; in which case this specification shall take precedence.

The main features of the PENDA are specified in Appendix 1.

Where required in Appendix 1; the design of the pad-mounted transformer shall allow the PENDA to be in full service, with the door closed, whilst Kelvatec Bidoyngs are installed on all phases on all fuse ways of the PENDA. As a guide; this probably requires a minimum distance of 150mm from centre line of the barrel of an in-service HRC fuse, to the inner side of the door.

To allow current measurements to be made on each phase of each feeder; the design of the ASSEMBLY shall allow for the safe and practical use of a clip-on ammeter or CT.

3.2.5.1. Variations and Clarifications to ENA TS 37-2

The following variations, additions or clarifications to ENA TS 37-2 are referenced to the clause numbers used in ENA TS 37-2 Issue 5

37-2 – Clause 3.1.207 – Fuse Carriers

Fuse carriers shall NOT be made of porcelain
37-2 – Clause 6.1 – ASSEMBLY designation marking

Name plate to also include:

(vi) Normal current rating of the outgoing distributor units (cable feeder ways).

37-2 – Clause 8.5.3.a - Outgoing distributor units

Outgoing distributor units shall be single, split or three phase to align with the transformer type.

All phases of all fuse ways shall be supplied equipped with fuse carriers.

37-2 – Clause 8.5.3.a - Outgoing distributor units – Standard range

Outgoing feeder ways on transformers rated at 100kVA or above units shall be controlled by LV current-limiting "J" type fuse-links that comply with the performance and testing requirements of BS EN 60269 - 1: 2007+A1:2009.

They shall be full range breaking-capacity with the rated current prefixed with the letter "g" as detailed in BS EN 60269 – 1 Section 5.7.1. Dimensions shall be to BS 88 - 2: 2007, Figure 905, with L type tags.

The LV compartment shall be arranged to allow the use of Kelvatec Bidoyng units in any or all phases of all feeder ways, without affecting the rating of the LV PENDA and still allowing the doors to be closed and secured as normal.

37-2 – Clause 8.5.3.d – Maximum demand indicators

The PENDA is not required to be equipped with an MDI. But, the PENDA shall be arranged to allow the retrofitting of a measuring instrument(s) for metering or monitoring.

Where specified in Appendix 1 below; the incoming way of the PENDA shall be supplied equipped with a Class 5 CT on each incomer. CT output connections shall be terminated in a test block that permits an MDI, or similar, to be installed while the PENDA is live without open-circuiting the CTs, and permits the ready installation of connections to a new instrument.

37-2 – Clause 8.8 Terminals for External Conductors

The outgoing distributor units shall be designed to accommodate Single Phase service cables or 120mm² to 300mm² 3-core Combined Neutral Earth (CNE) or 4-core Separate Neutral Earth (SNE) Waveform to BS7870 3.40, as specified in the attached Appendices.

All outgoing distributer units shall be supplied equipped with suitable range taking mechanical shear bolt clamps for terminating the phase and neutral conductors.

37-2 – Clause 8.102.1 – Reserve Power

PENDAs shall be equipped to allow the connection of external devices, such as Northern Powergrid's mobile generators, via temporary leads equipped with ITT VEAM type connectors or equivalent.

There shall be four primary connection sockets per set and these shall be colour coded Brown (L1), Black (L2), Grey (L3) and Blue (N).

The Pad-Mounted unit shall be designed and manufactured to allow the door(s) of the PENDA to be closed and locked whilst generator leads are connected and in service.

Three phase and neutral test sockets as required by ENA TS 37-2 shall be provided, as specified in Appendix 1. The areas around all of these test sockets shall be insulated for a minimum distance of 13mm from the outside edge of every test socket in order to reduce the risk of a short circuit during lead insertion/removal, connection of crocodile clips, etc.

37-2 – Clause 8.201.a – PENDAs

The pad-mounted transformer shall be supplied with all distributor ways in the PENDA fully equipped.

37-2 – Clause 8.201.a – PENDAs - Phase reversal

Standard distribution transformers connected to Northern Powergrid's 20kV networks require the L1 and L3 phases transposing to allow interconnection with Northern Powergrid's standard LV networks.
Pad-mounted transformers with a 20kV input shall be supplied with:

(i) the L1 and L3 connections transposed between the transformer and the PENDA busbars and the connections to the reserve power sockets

OR

(ii) the phase markings shall be transposed and the requirement to carry out this transposition on the LV cables shall be very clearly labelled.

The connections to the reserve power sockets, and the colour coding of the reserve power sockets shall also be transposed and shall correspond to the busbar phasing.

The performance of the associated ASSEMBLIES shall not be compromised by this arrangement.

3.2.6. Other Legacy System Voltage Transformers

Northern Powergrid utilises a number of transformers on its legacy networks, which have nominal voltages other than 11kV and 20kV. The most common of these are;

7.2kV rated transformers for use on Northern Powergrid 5.25 - 6.6kV networks; the transformers shall comply with the requirements of this NPS specification and with ENA TS 35-1.

3.6kV rated transformers for use on Northern Powergrid 3kV networks; the transformers shall comply with the requirements of this NPS specification and with ENA TS 35-1 and shall have the following dielectric characteristics:

Rated lightning impulse withstand voltage (LI)	$40kV_{peak}$
Rated power frequency withstand	10kV

Table 3.6.2 – requirements for 3.6kV units

3.2.7. Transformers for Special Applications

Transformers for special applications where there is an unacceptable risk of fire, environmental sensitivity or environmental risk shall be supplied filled with an environmentally acceptable high flash point fluid. This fluid shall be in accordance with NPS/003/019 and shall have been assessed and formally approved by Northern Powergrid.

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
ENA TS 35-1, Part 1	Distribution transformers Part 1 (Common Clauses)
ENA TS 35-1, Part 4	Distribution transformers Part 4 (Pole Mounted Transformers)
ENA TS 37-2	Public Electricity Network Distribution Assemblies.
ENA TS 98-1	Surface preparation and coating systems for new plant and equipment
ENA ER5	Pad-mounted transformers
IEC 60076 series	Power Transformers
IEC 60529	Degrees of Protection Provided by Enclosures
BSEN 50180	Plug-in type bushings above 1kV up to 52kV and from 250A to 3,15kA for liquid filled transformers
IEC 60068-2-75	Environmental testing. Test methods
IEC 62262	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
BS EN 1991-1-1	UK National Annex to Eurocode 1. Actions on structures. General actions. Densities, self-weight, imposed loads for buildings
IEC 60068-1	Environmental testing. General and guidance
IEC TR 60787	Application guide for the selection of high-voltage current-limiting fuse-links for transformer circuits
EN ISO 12944-2	Paints and varnishes. Corrosion protection of steel structures by protective paint systems. Classification of environments
BS381C	Specification for colours for identification, coding and special purposes

4.2. Internal Documentation

Reference	Title
IMP/001/103	Code of Practice for the Assessment of Asset-Specific Losses
NPS/003/019	Northern Powergrid Specification NPS/003/019 – Technical Specification for Electrical Insulating Fluids for use in Plant and Switchgear.

4.3. Amendments from Previous Version

Reference	Description
3.1 Overview	Note added into this section to highlight the mandatory need for PENDA's (LV Fuseboards) to be incorporated into the design of these units
3.2.1 IK Code (IEC62262)	Additional guidance added into this section with respect to allowable levels of penetration

5. Definitions

Term	Definition
PENDA	Public Electricity Network Distribution Assemblies

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.

		Sign	Date
Andy Leggett	CDS Administrator	Andy Leggett	08/08/2018

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

		Sign	Date
Ged Hammel	Senior Policy & Standards Engineer	Ged Hammel	08/08/2018

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.

		Sign	Date
David Blackledge	Senior Policy & Standards Engineer	David Blackledge	08/08/2018

6.4. Authorisation

Authorisation is granted for publication of this document.

		Sign	Date
Greg Farrell	Head of System Strategy	Greg Farrell	29/08/2018

Appendix 1 - Schedule of Requirements.

The variants of pad-mounted transformers for use Northern Powergrid Networks are:

Description	Rating (kVA)	HV Input	LV output (Volts)	LV Incoming Transformer Unit (Tx disconnector)	LV Distributor Ways (Number of ways per phase)	LV cables Cable types and sizes	Generator Connections	4mm test sockets	Incomer MDI CTs	Inbuilt Foundation Pad Required	PENDA Door to Allow for Bidoyng	Notes
Pad-1ph-16 kVA	16	2 wire	250 1ph	No	1 (one)	35mm^2 single phase concentric service cable	No	No	No	Yes	No	
Pad-1ph-25 kVA	25	2 wire	250 1ph	No	1 (one)	35mm^2 single phase concentric service cable	No	No	No	Yes	No	
Pad-1ph-50 kVA	50	2 wire	250 1ph	No	1 (one)	4c Waveform 185mm^2	No	No	No	Yes	No	
Pad-2ph-25 kVA	50	2 wire	250-0-250	No	1 (one)	2 off 35mm^2 single phase concentric service cables	No	One set	No	Yes	No	12.5 kVA per LV phase
Pad-2ph-50 kVA	50	2 wire	250-0-250	No	1 (one)	4c Waveform 185mm^2	No	One set	No	Yes	No	25 kVA per LV phase
Pad-2ph-100VA	100	2 wire	250-0-250	No	1 (one)	4c Waveform 185mm^2	No	One set	No	Yes	No	50 kVA per LV phase
Pad-2ph-160 kVA	160	2 wire	250-0-250	No	1 (one)	4c Waveform 300mm^2	No	One set	No	Yes	No	80 kVA per LV phase
Pad-2ph-160 kVA (v.2)	160	2 wire	250-0-250	No	2 (two)	4c Waveform 300mm^2	Yes	Two sets	Yes	No	Yes	80 kVA per LV phase
Pad-2ph-200 kVA	200	2 wire	250-0-250	No	2 (two)	4c Waveform 300mm^2	Yes	Two sets	Yes	No	Yes	100 kVA per LV phase
Pad-3ph-25 kVA	25	3 wire	433 3ph	No	1 (one)	4c Waveform 185mm^2	No	No	No	Yes	No	
Pad-3ph-50 kVA	50	3 wire	433 3ph	No	1 (one)	4c Waveform 185mm^2	No	No	No	Yes	No	
Pad-3ph-100VA	100	3 wire	433 3ph	No	1 (one)	4c Waveform 300mm^2	No	One set	No	No	No	
Pad-3ph-100VA (v.2)	100	3 wire	433 3ph	No	1 (one)	4c Waveform 300mm^2	Yes	Two sets	No	No	Yes	
Pad-3ph-160 kVA	160	3 wire	433 3ph	No	1 (one)	4c Waveform 300mm^2	No	One set	No	No	Yes	
Pad-3ph-160 kVA (v.2)	160	3 wire	433 3ph	Yes	2 (two)	4c Waveform 300mm^2	Yes	Two sets	Yes	Yes	Yes	
Pad-3ph-200 kVA	200	3 wire	433 3ph	Yes	2 (two)	4c Waveform 300mm^2	Yes	Two sets	Yes	Yes	Yes	
Pad-3ph-315 kVA	200	3 wire	433 3ph	Yes	2 (two)	4c Waveform 300mm^2	Yes	Two sets	Yes	Yes	Yes	

Appendix 2 - Declaration of Compliance with IEC 60076, ENA TS 35-1 and NPS/003/XXX.

The supplier/manufacturer 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	• **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 and **Reference** and **Rating** of the range of unit(s) included in this declaration table:	

Clause or Sub-clause reference	Clause Subject	Conformance Code against NPS/003/011	COMMENTS, REMARKS AND DESCRIPTIONS ALSO INCLUDE Description of: How the compliance is achieved, including references to type test evidence certificate numbers, etc. ALSO INCLUDE Description of: Why and in what way(s)the compliance is NOT achieved ALSO INCLUDE Details of: The make and model of relevant component parts, fluids, etc.
3.2.1	Technical Specification – General		
3.2.1.1	Environmental conditions:		
	ENA TS 35-1 Part 4		
	ENA TS 37-2		
	Wind		
	Snow		
	Distributed Load		
	Solar Gain		
3.2.1.2	Security:		
	LPS 1175.		
	Hinge pins in stainless steel		
	Continuous steel baffling		
	No exposed fastenings		
	Protection of cooling fins		
	Has facilities to bolt down the unit		
	IP3 in accordance with IEC 60529		
	Protection against ingress of 12.5mm diameter and ingress of spraying water.		
3.2.1.3	IK Code:		
	IK09		
	10J Impact		
	10 impacts on every facet & door		
	6 impacts on every locking point		
	Less than 6mm movement		

Clause or Sub-clause reference	Clause Subject	Conformance Code against NPS/003/011	COMMENTS, REMARKS AND DESCRIPTIONS ALSO INCLUDE Description of: How the compliance is achieved, including references to type test evidence certificate numbers, etc. ALSO INCLUDE Description of: Why and in what way(s)the compliance is NOT achieved ALSO INCLUDE Details of: The make and model of relevant component parts, fluids, etc.
	Maximum penetration 10mm		
3.2.2	HV Bushings		
	Removable bushing wells		
	Bushings: screened, load break 200A		
	Earth Bars		
	Parking Stands to allow earthing and testing operations (a) and (b)		
3.2.3	HV Protection		
	Current Limiting Backup Fuse		
	Replaceable Bay-O-Net Fuse		
3.2.4	Transformer Active Parts - Compliance with ENA TS 35-1:		
	5.2 Cooling Fluid to NPS/003/019		
	5.4.2 50Hz		
	6.4 -2.5%-+7.5% Tappings		
	6.6 Losses – see Appendix 3		
	11.0 Testing		
	11.1.1 Dielectric Tests to ENA TS 35-1		
	11.1.4 Short Circuit Type Test		
	14.2 – Surface Finish:		
	• 30 Years EN ISO 12944-2 Cat C4		
	• Corrosion Protection to ENA TS 98-1		
	• Surface Finish Colour		
	14.4 Cooling:		
	• Oil level indicator		
	• Liquid Loss Indicator		
	14.5.2 Tapping Switch Handle is internal and lockable		
	14.5.3 Earthing Terminals below HV terminals		
	14.5.4 Lifting Eyes		
3.2.5	LV PENDA Compliance with ENA TS 37-2:		
	• Door Secured Closed with Bidoyngs in service		
	• Allows use of Clip-on Ammeter		
	3.1.207 Fuse Carriers NOT porcelain		
	6.1 Normal Current on Rating Plate		
	8.5.3.a All Fuse Carriers Supplied		
	8.5.3.a J Type Fuse Links to 60269-1		
	• Full Range Breaking		
	• Prefix ‘g’ per 60269-1 5.37.1		
	• Dimensions BS 88-2 Fig 905, L Type Tags		
	8.5.3.d Maximum Demand Indicator CTs and Terminals		
	8.8 Conductor Terminals		
	• Service Cable or 3c or 4c Waveform		
	• Equipped with range taking shear-bolt connectors		
	8.102.1 Reserve Power		
	• Litton Veam, or Equivalent connectors		
	• Doors can be secured closed with leads connected		

Clause or Sub-clause reference	Clause Subject	Conformance Code against NPS/003/011	COMMENTS, REMARKS AND DESCRIPTIONS ALSO INCLUDE Description of: How the compliance is achieved, including references to type test evidence certificate numbers, etc. ALSO INCLUDE Description of: Why and in what way(s)the compliance is NOT achieved ALSO INCLUDE Details of: The make and model of relevant component parts, fluids, etc.
	• Test sockets with additional insulation		
	8.201.a All ways Equipped		
	8.201.a L1 & L3 Transposition for 20kV Units		
	• Achieved on LV busbars OR		
	• NOT Achieved on LV busbars, but is clearly labelled		
3.2.6	Legacy Voltages Units with other HV input voltages are available		
3.2.7	Special Applications Units with appropriate cooling fluids are available		

Self Declaration completed by: As a representative of: Date:

Appendix 3 - Losses

Lifetime costs shall be calculated, for every design variant, using the formula below and the latest Northern Powergrid capitalisation figures, which will be provided at the tender stage.

The £/kW loss figures* incorporate utilisation factor and time span.

** Sourced from Northern Powergrid document IMP/001/103 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 also declare the maximum guaranteed loss figures for each design variant.

Appendix 4 - Pre-commission testing, Routine Inspection and Maintenance requirements

Tenderers shall provide details of the recommended pre-commission testing and inspection required.
Details of the Test Voltage Levels, duration, pass/fail criteria, etc. shall be included.

Tenderers shall state any maximum voltage that may be applied or any other limitations that may apply.

Tenderers shall provide information regarding detailed and periodic inspection and maintenance requirements to be undertaken during the lifetime of their product. This shall include including recommended spares and ancillary items that may reasonably be expected to require replacement, or be at higher risk of loss or damage, during operational use.

Appendix 5 - 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.

Provided (Y/N)	Requirement
	Full product descriptions and part number/reference
	Complete set of drawings for each variant
	Appendix 2 – completed self-certification conformance declaration
	Appendix 3 – Losses – details of losses for each unit and loss calculations for each
	Appendix 4 – Recommended commissioning test (values and pass/fail criteria)
	Appendix 4 – Recommended inspection and maintenance requirements
	Appendix 5 – This table
	Recommended periodical inspection and maintenance requirements
	Type test & special test listings and supporting evidence
	Routine test plan (example)
	Packaging/transport/delivery/handling/storage information