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NSP/007/006 – Guidance on Substation Design: Transformer Transport, Delivery and Installation

1. Purpose

The purpose of this document is to provide guidance on the installation of CER (Continuous Emergency Rated) and CMR (Continuous Maximum Rated) Transformers.

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

Reference	Version	Date	Title
NSP/007/006	2.0	Feb 2019	Guidance on Substation Design: Transformer Transport, Delivery and Installation

2. Scope

This document applies to all CER and CMR transformer installations on the Northern Powergrid network.

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3. Installation Requirements

3.1. Preliminary Works

Prior to delivery of the transformer, the transformer manufacturer and their installation contractor(s) shall visit site to assess access, off-loading, skidding and installation arrangements.

Prior to delivery of the transformer, Northern Powergrid will mark the centre lines on the transformer and cooler plinths.

3.2. Transport

An impact recorder in a tamperproof box (recording impact magnitude against time) shall be fitted to the main tank during transport.

Radiators and pipework shall be filled with dry air and sealed against moisture ingress

3.3. Cooler Bank Installation

The transformer installer shall drill the concrete plinth and bolt down the cooler bank. Anti-vibration pads are not required on the cooler bank.

3.4. Top-Up Oil

Top-up oil shall comply with NPS/003/019.

New transformers shall be topped-up with unused mineral insulating oil complying with BS EN 60296.

Existing transformers may be topped-up with reclaimed mineral insulating oil complying with BS148.

Top up oil shall preferably be delivered by oil tanker. If oil is to be delivered to site in oil drums then they shall be stored in a temporary bund to be provided by the oil supplier. The oil supplier shall also provide a spill-kit and produce a spillage risk assessment and method statement.

Oil tests shall be undertaken on every oil container to be used for topping-up the transformer.

Top-up oil complying with the required moisture content and breakdown strength shall be pumped via a filter unit into the completed transformer installation, usually via the conservator. There must be no risk of forcing air into the transformer.

On completion of the transformer installation, the oil shall be tested as required in Section 3.4 (vi) below, to ensure compliance with NPS/003/019. If the oil does not meet the moisture content or breakdown strength requirements then it shall be processed using a processing/filtration unit.

3.5. Site Testing

After installation, the following tests shall be carried out on the assembled transformer. The tests shall be witnessed by Northern Powergrid and the results recorded:

- 1) The insulation resistance of each winding in turn to all other windings, core and frame or tank connected together and to earth.
- 2) The insulation resistance of all secondary circuits.
- 3) Check on calibration of winding temperature indicator(s) including heater current injection
- 4) Operation of gas-and-oil actuated relays (alarm and trip floats and flow vane trip) from ground level by injection of air. Release air on completion of test.
- 5) Operation of forced cooling equipment from marshaling kiosk. Check fans blowing air into radiator bank. Carry out single phase starting test with one phase link removed motor protection shall operate.

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Single phase running test, prove that removal of one phase fuse during running causes motor protection to operate Check pump pumping oil into the transformer. Check valve handles are in the correct direction for open/closed. Check for mal-operation of gas-and-oil actuated relay.

- 6) Operation of tap-changer through the range and functioning of limit switches.
- 7) Dielectric breakdown strength, moisture content and dissolved gas analysis on oil samples from main tank (top and bottom), tap-changer, cooler bank and auxiliary transformer.
- 8) Frequency Response Analysis tests on 66kV and 132kV transformers
- 9) Prove Polarity, Ratio and Mag curve all CTs provided by the transformer manufacturer.
- 10) Prove vector group connection of windings.
- 11) Voltage ratio and magnetising current check at all tap positions.
- 12) Voltage ratio and polarity test of any in tank voltage transformers (in tank NVD?)
- 13) Check arcing horn gaps

132kV	970mm (ENATS 35-3)
66kV	540mm (ENATS 35-3)
33kV	315mm (ENATS 35-3)
20kV	38mm with duplex gap (ENATS 35-1)
11kV	25mm with duplex gap (ENATS 35-1)
6.6kV	25mm with duplex gap (ENATS 35-1)
- 14) Check bushings are not damaged.
- 15) Check operation of the pressure relief alarms

3.6. Health and Safety

The transformer installer shall submit Risk Assessments and Method Statements in accordance with Northern Powergrid Contract Management Procedure CMP(PL)PT Section 3.4

If a crane is to be used then a lifting plan shall be provided.

Plant operatives shall be in possession of a current competency certificate. These shall be in English. At least one person in the working party shall be able to understand and speak English.

3.7. Tools and Equipment

Current test certificates shall be provided for all plant and equipment. Steel tape measures and aluminium ladders are prohibited on Northern Powergrid sites.

Power tools shall not operate at a voltage above 110V.

Torque wrenches shall be used on bolted connections on all oil tight gaskets. Tightening of these bolts shall be witnessed by Northern Powergrid.

3.8. Paintwork

On completion of the installation, all chipped paintwork shall be repaired. The transformer installer shall supply a pot of touch-up paint for future paintwork repairs

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3.9. Working at Height Regulations

The transformer installer shall comply with The Work at Height Regulations. Working methods complying with NPS/003/012 Section 13.1 or NPS/003/021 Section 15.1.1 or alternative methods shall be submitted with the Risk and Method Statements.

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4. References

4.1. External Documentation

Reference	Title
ENATS 35-1	Technical Specification: Distribution transformers
ENATS 35-2	Technical Specification: Emergency Rated System transformers 33/11.5kV Delta/Star and Star/Star Connected
ENATS 35-3	Technical Specification: Continuous Maximum Rated (CMR) System Transformers (for use on systems up to 132kV)
HSE INDG401	The Work at Height Regulations
BS EN 60296	Fluids for electrotechnical applications. Unused mineral insulating oils for transformers and switchgear
BS148	Reclaimed mineral insulating oil for transformers and switchgear. Specification

4.2. Internal Documentation

Reference	Title
CMP(PL)PT	Power Transformer Contract Management Procedure – Enquiry to Handover
NPS/003/012	Technical Specification for Continuous Emergency Rated (CER) Transformers
NPS/003/019	Specification for electrical insulating fluids for use in Northern Powergrid plant and switchgear
NPS/003/021	Technical Specification for CMR Transformers

4.3. Amendments from Previous Version

Reference	Title
NSP/007/006	Guidance on Substation Design: Transformer Transport, Delivery and Installation
NSP/007/006	Minor formatting
NSP/007/006	Minor formatting & cross references within the document updated

5. Definitions

Reference	Title
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
Liz Beat	Governance Administrator	29/05/2024

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
Mark Thompson	Major Projects Specification and Design Manager	30/05/2024

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
Peter Steadman	Major Projects Specification and Design Engineer	27/06/2024

6.4. Authorisation

Authorisation is granted for publication of this document.

		Date
Dave Sillito	Head of Major Projects	30/05/2024