NPS/003/009 - Technical Specification for 11kV, 20kV, 33kV, and 66kV Neutral Earthing Resistors

1. Purpose

The purpose of this document is to define the technical performance specification of neutral earthing resistors (NER) for use on the Northern Powergrid distribution networks.

This document supersedes the following documents, all copies of which should be removed from circulation.

Ref	Version	Title
NPS/003/009	5.1	Technical Specification for 11kV, 20kV, 33kV, and 66kV Neutral Earthing Resistors

2. Scope

This document includes the technical performance requirements for 11kV, 20kV, 33kV and 66kV neutral earthing resistors for use with primary and grid transformers on the Northern Powergrid distribution network. This specification includes both cable and busbar connected units and places a requirement on suppliers to provide information on inspection and maintenance requirements.

This document does NOT include neutral earthing resistors utilised as an integral component of arc suppression coil products; these are covered by a separate specification.

It will also be necessary to consider and include any project specific requirements as detailed in Appendix 4 Addendum to Supplier Requirements.

The following Appendices form part of this technical specification.

Appendix 1: Technical Specification Sheet
Appendix 2: Technical Schedules to be completed by the manufacturer
Appendix 3: Self Certification Conformance Declaration
Appendix 4: Addendum to Supplier Requirements
Appendix 5: Pre-commission testing, Routine Inspection and Maintenance requirements
Appendix 6: Technical Information Check List

2.1. Contents

3. Technical Requirements

3.1. Compliance with other Specifications and Standards

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.

3.2. General

Neutral earthing resistors (NERs) shall be designed, manufactured and tested to IEEE-32 as clarified or modified in this document and the conditions listed below.

Equipment shall also comply with BS EN 61000-6-3: Electro Magnetic Compatibility: Radiated Electric Field Emissions.

Appendix 1 contains the detailed technical specifications for the range of NERs used by Northern Powergrid.

Appendix 2 contains a schedule of technical parameters relating to each type of NER specified which must be completed by the tenderers.

Appendix 3 contains a self-certification conformance declaration which must be completed by the tenderers for each NER or each family of NERs where the content is true for all types.

Appendix 4 contains details of any project specific requirements which will be provided at the time of the order.

Appendix 5 contains a requirement for tenderers to identify and record any pre-commissioning testing, inspection or maintenance requirements for the products.

Appendix 6 contains a technical information check list which should be completed by tenders to ensure that they have include all necessary documentation in support of the products included in their tender.

3.3. Enclosure

The NER shall be a free-standing, naturally air-cooled unit and suitable for outdoor use.

It shall be designed and constructed to be maintenance free for at least 30 years, taking into account the heating effects of the resistors.

The enclosure/housing and all external fastenings and lifting points shall be unpainted, grade 304 stainless steel.

It shall provide a minimum protection rating of IP33 to IEC 60529 and shall be designed and constructed such that rainwater will freely run off and cannot collect at any point.

All panels shall be securely fastened and shall not be removable without the use of tools.

All NERs shall be designed to ensure that the bottom of the NER enclosure/housing is a minimum of 600mm above ground level and to mitigate potential damage due to flooding to this level.

Top mounted eyebolts shall be fitted for lifting the unit.

3.4. Base Elevation Stands

All NERs with external, air insulated bushing primary connections shall provide a minimum height to the live terminal of 2.9m.

3.5. Rating Plate

A rating plate shall be securely fitted at eye level on the outside of the enclosure giving the following minimum information:

Manufacturers name and serial number

Date of manufacture

Nominal rated service voltage

Current rating

Time rating

Resistance value at 20oC and +/- tolerance

Enclosure IP rating

3.6. Earth Connections

A low voltage bushing and stud shall be provided through the enclosure wall for the resistor earth connection. This bushing shall be rated with a voltage class of 1.2kV, providing a minimum BIL of 30kV.

Two separate M12 studs shall be provided at diagonally opposite corners for the purpose of earthing the enclosure. These terminals shall be as close as practicable to ground level so as to minimise the length of earth conductor which will be exposed when the resistor is installed in position.

3.7. Enclosure Mounting

The neutral earthing resistor shall be capable of being mounted on a concrete plinth.

3.8. Cable Boxes

Cable connected NERs shall be equipped with outer cone separable connection arrangements to allow termination in compliance with the following specifications:

NPS/002/015 Technical Specification for 11kV and 20kV Joints and Terminations

NPS/002/016 Technical Specification for 33kV Joints and Terminations

The outer cone separable connection arrangements shall be housed in an earthed metal enclosure that:

(i) When installed provides physical protection, tested to 5J impact at the most vulnerable point on all exposed sides and at the vulnerable point on each exposed edge.

(ii) Provides a minimum IP rating of IP21B in accordance with IEC 60529. For the purposes of this test the unscreened insulation is to be classed as a hazardous part that requires 20mm clearance from the end of the IP21B test probe

Terminations shall be capable of accepting XLPE insulated cables designed in accordance with NPS/002/020 Technical Specification for 11 & 20kV Power Cables or NPS/020/021 Technical Specification for 33kV Power Cables, with cable sizes up to 400sq mm and shall be provided preferably on the longest side of the NER. A gland plate shall be removable, pre-drilled with an 88mm diameter hole and fitted with a suitable heat shrink cable gland.

Where specified the cable box shall be capable of accommodating two ring core type current transformers (CT). In this case the CT secondary wiring shall be terminated on a 6 way terminal block and an un-drilled gland plate shall be provided for outgoing multi-core cables.

Terminal blocks shall be spring loaded insertion types incorporating hook type crimped connectors. IPC or cage clamp designs will be accepted if they have been granted an ENA Notice of Conformity.

3.9. External, Air Insulated HV Bushing Primary Connections

HV bushings provided to allow NERs to be busbar connected shall be supplied and tested in accordance with BSEN 60137 with rated impulse withstand voltages (BIL) and Power Frequency withstand voltages in accordance with BSEN 60137 Table 4.

Normally busbar connected NERs have the associated protection CTs installed directly onto the busbars between the transformer and the NER, however in the case of replacement installations these CTs are not always suitable for continued use.

To accommodate for this situation, bushing connected NERs shall be provided with a CT mounting enclosure box installed over the outgoing LV bushing to provide an alternative current measuring site. The enclosure box shall be provided with an undrilled gland plate to satisfy the future requirement for the outgoing multicore secondary cables and the CT secondary wiring shall be terminated on a 6 way terminal block.

The terminal blocks shall be spring loaded insertion types incorporating hook type crimped connectors. IPC or cage clamp designs will be accepted if they have been granted an ENA Notice of Conformity.

3.10. Resistor Element

Resistor elements shall be manufactured from a high temperature resistance alloy, preferably stainless steel, capable of withstanding wide temperature excursions whilst retaining mechanical strength. Ceramic insulators shall be used throughout.

The temperature coefficient of resistance of the element material shall be such that the increase in resistance over the operating temperature range, when carrying rated current for the rated time, shall not exceed 18%.

The tolerance on the nominal resistance at 20oC shall not be greater than +/- 10%.

3.11. Current Transformers (CTs)

Where manufacturers are requested to supply CTs to be supplied with the NERs they shall be designed and manufactured in accordance with the requirements of BS EN 61869-2 with the CT ration and class defined by the project engineer at the time of order placement.

Where the NER is cable connected the CTs shall be positioned above the gland plate in the HV cable box using the HV insulation of the incoming HV cable to achieve the voltage class required. If the connection to the NER is via a roof mounted bushing then an additional cable box shall be provided to cover the outgoing LV bushing and to allow the CTs to be mounted above the gland plate. In both cases the CT secondary connections shall be taken to terminals in a separate LV terminal box.

The CTs shall normally be LV ring core type tape wound (or equivalent) units manufactured to provide a maximum voltage rating of 0.72kV and have a 60 second power frequency withstand value of 3.0kV.

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
ANSI/ IEEE Std 32	IEEE Standard Requirements, Terminology, and Test Procedure for Neutral
ENATS 41-36	Distribution Switchgear For Service Up To 36 kV (Cable and Overhead
ENATS 41-37	Switchgear For Use On The 66kV And 132kV Distribution Network
BS EN 61000-6-3	Electro Magnetic Compatibility: Radiated Electric Field Emissions
IEC 60529	Degrees of protection provided by enclosures (IP Code) - Modified by NF EN
BS EN 60137	Insulated bushings for alternating voltages above 1000V
BS EN 61869-2	Instrument transformers. Additional requirements for current transformers

4.2. Internal Documentation

Reference	Title
IMP/001/913	Code of Practice for the Economic Development of the EHV System
NPS/002/015	Technical Specification for 11kV and 20kV Joints and Terminations
NPS/002/016	Technical Specification for 33kV Joints and Terminations
NPS/002/020	Technical Specification for 11kV and 20kV Cables
NPS/002/021	Technical Specification for 33kV Cables

4.3. Summary of Changes

External references updated.

5. Definitions

Term	Definition
BIL	Basic Insulation Level

6. Authority for issue

6.1. CDS Assurance

I sign to confirm that this document has been assured for issue on to the DBD system

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
Kelvin Thom	CDS Administrator	Kelvin Thom	11/08/17

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: 5 Years	Reason: No change in technology or NPg requirements anticipated.
Should this document be displayed on the Northern Powergrid external website?		Yes

		Sign	Date
Ged Hammel	Senior Policy and Standards Engineer	Ged Hammel	11/08/17

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
Joe Helm	Senior Policy and Standards Engineer	Joe Helm	11/08/17

6.4. Authorisation

Authorisation is granted for publication of this document

		Sign	Date
David Gazda	Policy and Standards Manager	David Gazda	23/08/17

Appendix 1: Technical Specification Sheet

	6.6kV	11kV					20kV		33kV					66kV		
	Type 12 B & C *	Type 1 B & C *	Type 2 B & C *	Type 3 B & C *	Type 4 B & C*	Type 14 B*	Type 5 B & C *	Type 6 B & C *	Type 13 B & C *	Type 7 B & C *	Type 8 B & C *	Type 16 C*	Type 15 B*	Type 9 B *	Type 10 B *	Type 11 B *
NPG Commodity Code (Cable Conn)	-	219660	219661	219662	219664	-	219666	219668	-	219670	219672	219681	-	-	-	-
NPG Commodity Code (Busbar Conn)	219677	-	-	219663	219665	219679	219667	219669	219678	219671	219673	-	219680	219674	219675	219676
Application		Urban	Rural													
Current Rating (A)	1800	560	1500	600	1200	1500	600	1200	1000	600	1200	1000	1050	600	800	1000
Rated Voltage (kV)	6.6	11.5	11.5	11	11	11	20	20	33	33	33	33	33	66	66	66
Line Neutral Voltage (kV)	3.81	6.64	6.64	6.35	6.35	6.35	11.54	11.54	19.05	19.05	19.05	19.05	19.05	38.1	38.1	38.1
Rated Time (s)	10	10	10	17	13	10	17	13	10	10	10	10	10	10	10	10
Continuous Current (A)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Resistance @25°C (Ohm)	2.1	11.34	4.23	10.6	5.3	4.23	19.3	9.6	19.05	31.8	15.9	14.8	18.1	63.5	47.6	38.1
Max Element Temp Rise (°C)	1000°C	1000°C	1000°C	1000°C	1000°C	1000°C	1000°C	1000°C	1000°C	1000°C	1000°C	10000C	1000°C	1000°C	1000°C	1000°C
Max increase in resistance at max temp.	+18%	+18%	+18%	+18%	+18%	+18%	+18%	+18%	+18%	+18%	+18%	+18%	+18%	+18%	+18%	+18%
Basic Impulse Level (IEC 60137 table 4 (kV)	60	75	75	75	75	75	125	125	170	170	170	170	170	250 **	250 **	250 **
Power Frequency withstand IEC60137 table4 (kV)	20	28	28	28	28	28	50	50	70	70	70	70	70	95 **	95 **	95 **
Ground clearance to bushing top connector (m)	2.9	-	-	-	-	-	2.9	2.9	2.9	2.9	2.9	2.9	2.9	-	-	-
Ground Clearance to base of insulator (m)	-	-	-	-	-	-	-	-	2.52	2.4	2.4	2.4	2.4	2.4	2.4	2.4

B = Busbar connected

C = Cable connected

** Based on line voltage rather than system voltage to reduce enclosure size

Appendix 2: Technical Schedules to be completed by the manufacturer

	6.6kV	11kV					20kV		33kV					66kV		
	Type 12	Type 1	Type2	Type 3	Type 4	Type 14	Type 5	Type 6	Type 13	Type 7	Type 8	Type 16	Type 15	Type 9	Type 10	Type 11
Current Rating	1800A	560A	1500A	600A	1200A	1500A	600A	1200A	1000A	600A	1200A	1000A	1050A	600A	800A	1000A
HV Connection type (cable, busbar or both)																
Rated voltage (V)																
Rated time (s)																
Resistance and tolerance @ 25°C																
Continuous current (A)																
Max temperature rise @ rated time and current																
Element type																
Element material																
Temperature coefficient of resistance (% per deg C)																
Resistance change for 1000 °C rise (%)																
Total inductance (mH)																
HV bushing Voltage class (kV) BIL (kV)																
Power Frequency withstand (kV)																
LV bushing																

	6.6kV	11kV					20kV		33kV					66kV		
	Type 12	Type 1	Type2	Type 3	Type 4	Type 14	Type 5	Type 6	Type 13	Type 7	Type 8	Type 16	Type 15	Type 9	Type 10	Type 11
Current Rating	1800A	560A	1500A	600A	1200A	1500A	600A	1200A	1000A	600A	1200A	1000A	1050A	600A	800A	1000A
Voltage class (kV) BIL (kV) NER housing material Thickness (mm) Finish Ingress protection (IEC 529) NER Cable Boxes Cable Gland Type (where appropriate) HV Bushing connection ground clearance (m) HV Bushing base ground clearance (m) Overall dimensions (mm) Width Depth Height Weight (kg) Drawing No Compliance with EMC regulations (Yes/No)																

Appendix 3: Self Certification Conformance Declaration

Neutral Earth Resistors shall comply with the latest issues of the relevant international and British Standards.

The relevant BS, BS EN and ENA Technical Specifications are quoted to amplify and/or clarify the requirements of those Standards.
This check sheet identifies the particular clauses of the aforementioned Standards relevant to overhead line conductors.

The manufacturer shall declare conformance or otherwise, clause by clause, using the following levels of conformance declaration codes for each conductor.

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.

Instructions for completion

- When Cs1 code is entered the supporting information shall be referenced.
- When any other code is entered the reason for non- conformance shall be entered

Manufacturer:

Product Reference:

Name: **Signature:** **Date:**

IEEE 32			
Clause/Sub-clause	Requirements	Conformance Code	Remarks
Type tests			
14.1	Resistance Measurements		
14.2	Dielectric tests		
14.3	Impedance and loss measurements		
14.4	Temperature Rise tests		

BSEN 60137 - Bushings			
Clause/Sub-clause	Requirements	Conformance Code	Remarks
Type Tests			
8.1	Wet power Frequency Withstand test		
8.3	Dry Lightning impulse withstand test		
8.8	Verification of short-time current withstand tests		

Appendix 4: Addendum to Supplier Requirements

Packaging/delivery information

Details of how this product will be packaged and delivered shall be provided.

Project specific requirements

Any project specific requirements will be provided by Northern Powergrid for inclusion in this appendix.

Appendix 5: 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 be also be provided.

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 2 – completed technical schedules	
Appendix 3 – completed self-certification conformance declaration against ANSI/ IEEE Std 32	
Complete set of drawings for each variant	
Type test evidence	
Routine test plan (example)	
Pre-commissioning testing/inspection requirements	
Recommended periodical inspection and maintenance requirements	
Packaging/delivery information	