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# NPS/003/043 – Technical Specification for Outdoor 33kV Switchgear

## 1. Purpose

This document is the technical specification for 33kV outdoor switchboards for use on the distribution networks of Northern Powergrid.

This is the first iteration of this specification.

## 2. Scope

This specification covers the technical requirements for outdoor 33kV overhead conductor connected circuit breakers for use on the distribution networks of Northern Powergrid and includes a requirement for suppliers to provide periodic inspection and maintenance information.

It will also be necessary to consider and include any project specific requirements as detailed in:  
Appendix 2: Addendum to Supplier Requirements.

The following appendices form part of this technical specification.

- Appendix 1: Technical Specification Sheet
- Appendix 2: Addendum to Supplier Requirements
- Appendix 3: Pre-Commission Testing, Routine Inspection and Maintenance Requirements
- Appendix 4: Technical Information Check List

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### 3. Technical Requirements

#### 3.1. Compliance with other Specifications and Standards

Where reference is made within this specification to any International Standard, British Standard, Energy Networks Association Technical Specification (ENA TS) or any other standard, this shall be to the latest version of that standard current at the time of supply.

#### 3.2. Overview

All switchgear shall comply fully with the requirements of the Energy Networks Association Technical Specification (ENA TS) 41-36 and all associated specifications, standards and regulations to which ENA TS 41-36 refers.

Switchgear shall preferably have been assessed by the ENA Switchgear Assessment Panel (SAP) and been awarded an ENA Notice of Conformity. Any variations in the specification of the switchgear offered to that described in the ENA Notice of Conformity or to any previously supplied to Northern Powergrid shall be highlighted.

The insulating and current interrupting medium shall not be oil.

Variations from, or enhancement to ENA TS 41-36 are described in 3.3

The options selected within ENA TS 41-36 are listed in Appendix 1 of this document.

The CT specifications for specific schemes shall be provided by NPg in appendix 2.

#### 3.3. Variations and Enhancements to ENATS 41-36

1.4.4.1: The rated Normal Current ( $I_n$ ) shall be as shown in Tables 1 and 2 of this section as expanded in Appendix 2.

1.5: Design and Construction: Circuit breakers shall be outdoor, ground mounted and connected by overhead conductor.

1.5.1: Circuit breakers shall be of a non-oil design.

1.5.4: Auxiliary Equipment: Secondary Wiring Terminals: Terminal blocks shall be rail mounted, spring loaded or cage clamp design. Those used for SCADA wiring shall be of the knife disconnecting type and be equipped with 2.3mm test sockets. CT secondary terminals shall be of the spring loaded or cage clamp design, or spring washer on stud design. Secondary terminals for CT bus wiring shall have a shorting/disconnecting facility.

1.5.4: Auxiliary Equipment: Secondary Wiring Terminals: Terminals which cannot be made dead by removing the panel fuses and links, shall be shrouded to protection IPXXD as specified in BS EN 60529:1992 to prevent electric shock by accidental contact.

1.5.4: Auxiliary Equipment: Fuses and links shall be in accordance with ENA TS 50-18 (GEC type RS 20 or equivalent) having labels mounted above to the relevant fuse or link. The label inscription shall include the fuse current rating.

1.5.4: Auxiliary Equipment: Termination of multicore and multipair cables: Following initial commissioning of the circuit breaker, it shall be possible to safely install and terminate additional cables without the need to make the busbars dead.

1.5.4.4.5.1: All internal wiring shall comply with ENA TS 50-18. In addition, all internal wiring shall have a minimum cross-section area of 2.5mm and all internal wiring colours shall meet the requirements of BS 7671, specifically:

- The insulation of 3 phase wiring shall be coloured brown, black and grey for the phase conductors and blue for the neutral.
- The insulation of 230V single phase wiring shall be coloured brown for the phase conductor and blue for the neutral.

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- The insulation of 110V ac and 110V dc shall be white in colour.

1.5.15: Gas and vacuum tightness: SF6 gas pressure monitoring: SF6 gas interrupting medium: The SF6 gas pressure of circuit breaker interrupters shall be monitored in two stages. Stage 1 shall initiate a Stage 1 alarm. Stage 2 shall initiate a Stage 2 alarm and inhibit circuit breaker operation, except in the case of bus section circuit breakers which will auto-open.

1.5.15: Gas and vacuum tightness: SF6 gas pressure monitoring: SF6 insulation: The SF6 gas pressure in each segregated compartment shall be monitored separately. Falling pressure in any compartment shall initiate an alarm.

1.5.10.101: Labelling: In addition to the requirements of ENA TS 41-36, all handles and other devices supplied shall be clearly labelled with their function.

1.5.10.101: Labelling: Circuit numbers: In addition to normal circuit labels specified in section 1.5.10.101 of ENATS 41-36, a label stating the circuit number shown on the Circuit Diagram of Connections and Protection shall be applied to each circuit breaker. The label shall be circular and the number black on a white background. The label shall be secured by non-rusting screws to the left-hand side of the fixed portion, clear of the circuit label to avoid confusion.

1.5.13.2: The control cabinet with the doors closed shall have a minimum degree of protection of IP45.

1.5.103.2: Switchgear shall be non-oil.

1.10: Transport, storage, installation, operation, maintenance and disposal: Maintenance: The unit shall be designed as far as practical to be low maintenance or zero maintenance. Operation and maintenance procedures shall be provided at tender stage to allow evaluation. Suppliers shall provide details of the recommended periodic inspection and maintenance requirements to be undertaken during the lifetime of their product. Detailed inspection and maintenance instructions shall be also be provided.

2.4.101: Rated Short Circuit Breaking Current: The rated short circuit breaking current ( $I_{sc}$ ) shall be as shown in Tables 1 and 2, as expanded in Appendix 2 of this document.

2.4.103: Rated Short Circuit Making Current: For installations requiring a specification of 120ms time constant: The rated peak short circuit make current shall be 2.7 x the r.m.s value of the a.c. component of the rated short circuit breaking current.

**Table 1: Normal Current, Short Circuit Breaking, and X/R Ratings for 33kV switchgear typically for use at 132/33kV and 66/33kV substations**

	Normal Current ( $I_r$ ) (A)	Short Circuit Breaking Current ( $I_{sc}$ ) (kA)
Busbar	2000	31.5kA @ X/R 14 (45ms)  AND  20kA @ X/R 37 (120ms)
Incomer	2000	
Bus Section	2000	
Feeder	1250	

**Table 2: Normal Current, Short Circuit Breaking, and X/R Ratings for 33kV switchgear typically for use at 33/20kV and 33/11kV substations**

	Normal Current ( $I_r$ ) (A)	Short Circuit Breaking Current ( $I_{sc}$ ) (kA)
Busbar	1250	31.5kA @ X/R 14 (45ms)  AND  20kA @ X/R 37 (120ms)
Incomer	1250	
Bus Section	1250	
Feeder	800 OR 1250	

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2.4.104: Rated operating sequence: The circuit breaker operating mechanism shall meet the operating cycle., (0-0.3s-CO-15s-CO).

2.4.104: Rated operating sequence: To ensure correct operation of all equipment in an auto re-closing scheme, the circuit breaker auxiliary switches should operate together without prolonged contact bounce. To achieve this practically, the time between the first switch commencing movement and the settling of the last switch shall not exceed 40ms.

2.5.202 The bushing terminals shall withstand the cantilever load stated in BS EN 60137:2017 Insulated bushings for alternating voltages above 1000 V Clause 4.5, Table 1.

3.5.14: The minimum creepage distance for outdoor bushings shall be 900mm.

10.2 Current transformers: Current transformers will be provided as specified in appendix 2 of this document or as specified at the time of ordering.

10.2.1: Current Transformers: General. CTs shall have the same characteristics as the primary circuit (including thermal rating, short time withstand, etc.)

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## 4. References

### 4.1. External Documentation

Reference	Title
ENA TS 41-36 Issue 3	Distribution Switchgear for Service up to 36kV (Cable and Overhead Conductor Connected)
ENA TS 50-18 Issue 4	Design and application of ancillary electrical equipment
BS 7671:2018	Requirements for Electrical Installations. IET Wiring Regulations
BS EN 61936-1	Power Installations Exceeding 1kV a.c
BS EN 50522:2010	Earthing of Power Installations Exceeding 1kV a.c
BS EN 60137:2017	Insulated bushings for alternating voltages above 1000 V
BS EN 60529:1992	Degrees of protection provided by enclosures (IP code)

### 4.2. Internal Documentation

Reference	Title
None	

### 4.3. Amendments from Previous Version

Reference	Description
NPS/003/043	Full document review

## 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.

		<b>Date</b>
Andy Leggett	CDS Administrator	07/01/2019

### 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: Update will be dictated by contact renewal date or any significant changes in the specification or documents referenced.
<b>Should this document be displayed on the Northern Powergrid external website?</b>		
Yes		

		<b>Date</b>
Joseph Helm	Senior Policy and Standards Engineer	07/01/2019

### 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.

		<b>Date</b>
Sunil Shrestha	Design and Specification Engineer	07/01/2019

### 6.3 Approval

Approval is given for the content of this document

		<b>Date</b>
David Blackledge	Senior Policy and Standards Engineer	07/01/2019

### 6.4 Authorisation

Authorisation is granted for publication of this document.

		<b>Date</b>
Greg Farrell	Head of System Strategy	11/01/2019

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## Appendix 1: Technical Specification Sheet

<b>MANUFACTURER</b>	
<b>CIRCUIT BREAKER TYPE REFERENCE</b>	

	ENATS 41-36 Ref	Specified Value	Declared Value
<b>PARTICULAR OF SYSTEM</b>			
Nominal Voltage		33 kV	
Frequency		50 Hz	
Number of Phases		3	
Neutral Earthing (See BS EN 50522 for more info)		Solid	
<b>CIRCUIT BREAKER CHARACTERISTICS</b>			
ENATS Certificate of Conformance		Manufacturer to state	
Number of poles		3	
Class – indoor/outdoor	1.2.1	Outdoor	
Insulation Medium		Not oil	
Arc extinguishing medium		Not oil	
Type reference of vacuum bottles (if applicable)		Manufacturer to state	
Type reference of interrupter (if applicable)		Manufacturer to state	
Rated voltage	1.4.1	36 kV	
Rated Insulation level. Lightning impulse voltage Power frequency voltage	1.4.2	170 kV (195 kV across isolating distance) 70 kV (80kV across isolating distance)	



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	ENATS 41-36 Ref	Specified Value	Declared Value
Rated Frequency	1.4.3	50Hz	
Rated Normal Currents	1.4.4	Refer to table 1 and 2 of this NPS document	
Rated Short-time withstand current	1.4.5	Shall equal the short circuit breaking current ( $I_{sc}$ )	
Rated peak withstand current ( $I_p$ )	1.4.6	2.7 x rated short time withstand current ( $I_k$ )	
Rated duration of short circuit	1.4.7	3 sec	
Rated supply voltage of closing and tripping circuits	1.4.8	110V DC	
Rated supply frequency of closing and auxiliary circuits.	1.4.9	110V DC Heaters 110V 50Hz	
Rated short-circuit breaking currents and X/R	2.4.101	Refer to Table 1 and 2, and Appendix 2 of this document	
Rated short-circuit making current as function of r.m.s value of the a.c. component of the rated short circuit breaking current	2.4.103	2.7 x r.m.s value of the a.c. component of the rated short circuit breaking current	
Rated operating sequence.	2.4.104	O – 0.3s – CO – 15s – CO	
Rated capacitive switching currents. Rated cable charging breaking current: Rated line charging breaking current:	2.4.107	50 A 10 A	
Classification of mechanical operations M1 or M2	2.4.110	M2	
Classification of electrical endurance  + tested for autoreclose duty?	2.4.111	Class E2 autoreclose	
Mechanism type	2.5.5 – 2.5.7	Manufacturer to state	

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	<b>ENATS 41-36 Ref</b>	<b>Specified Value</b>	<b>Declared Value</b>
Key interlock	2.5.11	Manufacturer to state	
Gas monitoring devices. 1 <sup>st</sup> Stage 2 <sup>nd</sup> Stage	1.5.9	1st stage – Alarm. 2 <sup>nd</sup> stage – Trip inhibit + alarm	
Voltage presence indicating system (VPIS) fitted	1.5.19.1	Manufacturer to state	
VPIS: location of capacitor bushing	1.5.19.1	Manufacturer to state	
Colour of Paint		Light Neutral Grey	
Power cable connection manufacturer / type		Manufacturer to state	
Degree of protection of the cabinet with the doors closed	1.5.13.2	IP45	
<b>OPERATING MECHANISM DETAILS</b>			
Manufacturer and Type Reference		Manufacturer to state	
Closing Coils Number Type reference Power consumption		Manufacturer to state	Number Type reference Power consumption
Trip Coil Number Type reference Power consumption		Manufacturer to state	Number Type reference Power consumption
Operating time – Close		Manufacturer to state	
Operating time – Open		Manufacturer to state	

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	ENATS 41-36 Ref	Specified Value	Declared Value
Closing spring recharge time (motor driven); if applicable		Manufacturer to state	
Closing mechanism power consumption and time of operation		Manufacturer to state	
Closing mechanism type (manufacturer to give details).		Manufacturer to state	
Maximum dynamic floor loading		Manufacturer to state	
<b>SF6 GAS DETAILS</b>			
Operating pressure of pressure relief device		Manufacturer to state	
Filling pressure at 20°C		Manufacturer to state	
Normal pressure at 20°C		Manufacturer to state	
Interrupter SF6 gas Stage 1 alarm pressure		Manufacturer to state	
Interrupter SF6 gas Stage 2 alarm and operation inhibit pressure		Manufacturer to state	
SF6 insulation gas alarm pressure		Manufacturer to state	
Quantity of gas (mass and volume) per compartment at normal pressure at 20°C		Manufacturer to state	
Quantity of gas (mass and volume) per compartment at Stage 1 alarm pressure at 20°C		Manufacturer to state	

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	ENATS 41-36 Ref	Specified Value	Declared Value
Method of monitoring pressure and temperature compensation		Manufacturer to state	
<b>BUSHING DETAILS</b>			
Creepage distance	3.5.14	Minimum distance of 900mm	
Terminal load	2.5.202	Minimum of 500N	
<b>INTERNAL WIRING DETAILS</b>			
3 phase wiring colours		Brown, black and grey for the phase conductors and blue for the neutral.	
230V single phase wiring colour		Brown for the phase conductor and blue for the neutral.	
110V ac and 110V dc wiring colour		White.	
<b>DIMENSIONS AND WEIGHTS</b>			
Variant		Manufacturer to state	Height Width Depth Mass

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## Appendix 2: Addendum to Supplier Requirements

Project specific requirements

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### **Appendix 3: Pre-Commission Testing, Routine Inspection and Maintenance Requirements**

Suppliers shall provide details of the recommended pre-commission testing and inspection required. They shall also provide information regarding periodic inspection and maintenance requirements to be undertaken during the lifetime of their product. Detailed inspection and maintenance instructions shall be also be provided.

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## Appendix 4: 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	
Complete set of drawings for each variant	
Completed Technical Specification Sheet (Appendix 1)	
Information detailing pre-commission testing, routine inspection and maintenance requirements (Appendix 3)	
Packaging/delivery information	
In the case of products that have <b>not</b> been assessed by the ENA and do not have a Notice of Conformity, the following additional information is required: <ul style="list-style-type: none"> <li>– Completed self certification conformance declaration against ENATS 41-36</li> <li>– Type test evidence</li> </ul>	