

Electricity Specification 346

Issue 2

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132kV Connectors, Insulators and Conductors for Open Terminal Substations

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Approved for issue by the Technical Policy Panel

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Amendment Summary

Amendment No. Date	Brief Description and Amending Action
<p>0 01/07/05</p>	<p>Issue 1 First Issue Prepared by: G Bryson / D Horsman Approved by the Technical Policy Panel and signed on its behalf by:</p>
<p>0 26/11/15</p>	<p>Issue 2 Template updated and outdated specifications updated. Section 4 - Insulators section updated to include composite documents. Section 4.1.2 – Creepage updated. Section 4.2.15 added. Section 9 updated due to above changes. Prepared by: M A Kayes Approved by the Technical Policy Panel and signed on its behalf by: Steve Cox, Head of Engineering.</p>

132 kV CONNECTORS, INSULATORS AND CONDUCTORS

1. SCOPE

This Electricity Specification (ES) covers the supply, delivery and off loading of 132kV connectors, insulators and conductors for use on a 50Hz, solidly earthed, three phase system of nominal voltage 132kV and highest voltage 145kV operated by Electricity North West Limited, hereinafter referred to as Electricity North West.

Schedules of information included in Appendix A and the Self Certification Conformance Declaration in Appendix B of this document shall be completed by the Tenderer and returned to Electricity North West as part of the Tender documentation.

2. GENERAL REQUIREMENTS FOR APPROVALS AND TESTING

2.1 Product not to be changed

No change in the product, packaging or labelling shall be made after Approval has been granted without prior notice to the Electricity North West Plant Policy Manager, and receipt of agreement from the Electricity North West Plant Policy Manager, in writing to the proposed change.

2.2 Electricity North West Technical Approval

2.2.1 The Tenderer shall submit, with this Tender, proposals for testing which will demonstrate, to the satisfaction of the Electricity North West Plant Policy Manager, compliance with this ES. Such tests shall be carried out without expense to Electricity North West.

2.2.2 Alternatively, the Tenderer may submit technical reports and other data, in addition to the conformance schedules in Appendix B, that he considers will demonstrate, to the satisfaction of the Electricity North West Plant Policy Manager, compliance with this specification. Acceptance of this evidence shall be at the discretion of the Electricity North West Plant Policy Manager but will not be unreasonably withheld.

2.2.3 Approval shall be 'factory specific' and is not transferable to another factory without the written Approval of the Electricity North West Plant Policy Manager.

2.2.4 The supplier and product shall comply with all the relevant requirements of Electricity North West ' documents EPD311 and CP311.

2.3 Quality Assurance

2.3.1 The Tenderer shall confirm whether or not Approval is held in accordance with a Quality Assurance Scheme accredited under ISO 9000. If not, he shall submit a statement of the quality assurance procedures employed to control the quality of the product, including the performance of suppliers and sub-contractors.

2.3.2 The right is reserved for the Electricity North West Plant Policy Manager to require, from time to time, the repeat of such tests as he may deem to be reasonably necessary to demonstrate continued compliance with this ES.

2.3.3 The right is reserved for the Electricity North West Plant Policy Manager to make, from time to time, such inspections of the tenderer's facilities as he may deem to be reasonably necessary to ensure compliance with this ES and any contract of which it forms a part.

- 2.3.4 The Tenderer shall submit, with his tender, such details of product packaging disposal, as will enable Electricity North West to comply with the requirements of BS EN ISO 14001: 1996 – Environmental Management Systems.

2.4 Formulation

The Tenderer shall submit, with his Tender, such details of the formulation and use of the product and associated substances as will enable Electricity North West to comply with the obligations of the Health and Safety at Work Act 1974 and the Control of Substances Hazardous to Health Regulations 2002, in the use, storage and disposal of the product. The Tenderer may stipulate, prior to submission of such information, that he requires it to remain confidential and the Electricity North West Plant Policy Manager will, if requested, confirm his agreement to this prior to receipt of the information.

2.5 Identification Markings

- 2.5.1 The Tenderer shall submit, with his tender, details of markings which it is proposed to apply to the product or packaging to identify manufacturing batches or items. The forms and content of such markings shall be subject to the Approval of the Electricity North West Plant Policy Manager, and shall in all cases include the Electricity North West Approved Description and Commodity Code Number.
- 2.5.2 The Tenderer shall submit, with his tender, such details of marking gross weight on components, assemblies and packages, as will enable Electricity North West to comply with the Health and Safety Manual Handling Operation Regulations 1992, for components, assemblies and packages supplied with a gross weight over 1kg. The forms and content of such markings shall be subject to the Approval of the Electricity North West Plant Policy Manager.

2.6 Minimum Life Expectancy

The minimum life expectancy of all products covered by this ES is 40 years.

2.7 Product Conformity

Preference will be given to those suppliers who can provide suitable Product Conformity Certification to a recognised or specified standard, or an equivalent certification.

3. REQUIREMENTS FOR TYPE AND ROUTINE TESTING.

The Specifier shall set out the requirement of the following tests to be carried out by the supplier at the suppliers' cost.

3.1 Requirement for type tests at the suppliers' premises

These are a series of one-off type tests, which are carried out to ensure the satisfactory performance of the product design, under extremes of operating stresses, and of endurance, as may be appropriate, to be determined by the Specifier.

These may or may not be destructive tests.

Type tests shall be as specified in the standards listed in this ES. Suitable type test certificates may be submitted in lieu of type tests.

3.2 Requirement for routine tests at the suppliers' premises

These tests may be required to be carried out on every individual unit or component, as specified, or at some regular frequency to be determined by the specifier.

The results of these tests may be required to be supplied to Electricity North West with each unit purchased.

Routine tests shall be as specified in the standards listed in this ES.

4. TECHNICAL AND PERFORMANCE REQUIREMENTS

Except where modified by requirements specified elsewhere in this document, equipment shall be designed, manufactured and tested to comply fully with the requirements of:

General

BS EN 60694 1997 'Common specification for high-voltage switchgear and controlgear standards'.

BS EN 60865-1 2002 'Short Circuit Currents. Calculation of effects. Definitions and calculation methods.'

BS 159:1992 'Specification for high voltage busbars and busbar connections'

BS 7354:1990 'Code of Practice for design of high-voltage open-terminal stations'

ENA TS 41-11 Issue 2 1982 ' Tubular Aluminium Busbars, Connection and Terminal Fittings for 132kV Outdoor Substations'

BS 6399-2:1997 'Loading for Buildings. Code of Practice for Wind Loads'

Insulators

BS 3288 'Insulators and conductor fittings for overhead power lines'

IEC / TR 60815 'Guide for the selection of insulators in respect of polluted conditions'

IEC 60273:2001 'Characteristics of Indoor and Outdoor Post Insulators for Systems with Nominal Voltages greater than 1000V'

IEC 61109 'Insulators for Overhead Lines – composite suspension and tension insulators for a.c systems with a nominal voltage greater than 1000V – definitions, test methods and acceptance criteria.'

IEC 61462 'Composite Insulators – Hollow insulators for use in Outdoor and Indoor Equipment.'

IEC 62231:2006 'Composite station post insulators for substations with a.c. voltages greater than 1000V upto 245kV - definitions, test methods and acceptance criteria.'

BS EN 60137:2008 'Insulated Bushings for alternating voltages above 1000V'.

Conductors

IEC 60105 'Recommendation for commercial-purity aluminium busbar material'.

IEC 60114 'Recommendation for heat-treated aluminium alloy busbar material of the aluminium –magnesium-silicon type'

4.1 Insulators

4.1.1 General

Substation insulators for 132kV substations shall be of the composite type.

For Turnkey Substation contracts post insulators shall be selected so as to withstand the static and dynamic forces within the substation. Calculations shall be submitted to Electricity North West for review. Safety factors in line with the manufacturer's guidelines shall be applied to the post insulator cantilever load rating.

Insulators shall comply with the requirements of IEC 60815 be suitable for a pollution severity of "Heavy" as defined in IEC 60815 and insulators shall have a minimum phase to earth creepage distance appropriate to this pollution severity. Ice coating may be assumed not to exceed 10 mm. Wind pressure may be assumed not to exceed 700Pa.

Insulators shall be provided with an alternate long and short shed profile.

4.1.2 Creepage Distance

Insulators shall have the creepage distances as defined in the contract specific requirements.

All insulators shall provide minimum creepage levels of 25mm/kV in accordance with BS EN 60137:2008 type 3.

However for all sites within 5Km of the coast 31mm/kV shall be used.

4.2 Connectors

4.2.1 Parts of current-carrying connectors which are in direct contact with the conductor shall be designed so that galvanic corrosion in the contact surface cannot occur. Solder and other materials which without protection can cause dangerous corrosion, shall be protected by the application of a corrosion-resistant layer. Any bi-metal joints shall meet the requirements of ENA TS 41-11.

4.2.2 All materials in the connectors shall be able to withstand temperatures from -20°C to +100°C (+250°C for short circuit) without becoming brittle or losing their mechanical or electrical properties.

4.2.3 Aluminium connectors shall be made of aluminium or aluminium alloy, free of copper with resistance to corrosion as near as possible to that of aluminium. Material subject to stress corrosion, layer-corrosion or grain pitting shall not be used.

4.2.4 The aluminium surface of the connector shall be factory made oxide-free by grinding, etching and application of a protective coating.

4.2.5 Internal threads on cast aluminium parts shall consist of a stainless steel insert thread.

4.2.6 All connectors between equipment shall be of the bolted type. Welding or compression joints that would be required at site are not acceptable without the prior Approval of Electricity North West. Connectors shall be either of the universal angle type allowing the angles to be altered on site to suite the switchgear heights, centres and civil tolerances, or of the flat type. The type of connector required will be specified in the contract requirements.

- 4.2.7 For turnkey substation contracts the contractor shall check that the mechanical loads on the busbar are within the limits specified for the switchgear. Calculations shall be submitted for review to Electricity North West.
- 4.2.8 Connectors shall be designed to allow uniform current distribution in the conductor through the shortest current path. The conductors shall be designed to minimise eddy current and hysteresis losses.
- 4.2.9 Connector sections shall be heavy enough to carry electrical loads, and to withstand the forces applied during transportation and installation as well as those developed under extreme service conditions of ice, short circuit, expansion and contraction, without suffering permanent deformation or breakage.
- 4.2.10 Contact surfaces shall be machine-finished with small tolerances and high accuracy and protected to prevent build-up of corrosion products.
- 4.2.11 Connector design shall avoid crevices in which moisture might accumulate, or through which corrosive atmosphere might penetrate.
- 4.2.12 The connectors shall not cause radio interference. Sharp edges shall be avoided in design.
- 4.2.13 Details of methods of surface preparation and connection shall be provided together with recommended number and types of tools and amount and types of material for surface preparation.
- 4.2.14 Bolts shall be used as clamping devices only and not as current carrying parts.
- 4.2.15 Any locking methods which need to be adopted shall be detailed.
- 4.2.16 Where required connectors shall be designed to allow a range of angles to be accommodated.

4.3 Conductors

4.3.1 Busbars

In general connections between equipment shall be made with rigid tubular aluminium or aluminium alloy busbar. In addition to the current carrying capacity the busbars shall be mechanically rated to allow the required length between connections. For turnkey substations the contractor shall design each connection to allow for thermal expansion of the busbars.

4.3.2 Flexible Conductors

Stranded Aluminium Conductor or Aluminium Conductor Steel Reinforced Conductor may be used. For these conductors greasing shall be Category 3 as detailed in Engineering Recommendation L38.

For turnkey substations the contractor shall submit rating calculations and details to Electricity North West for review.

4.4 132kV System Characteristics

The equipment shall be suitable for use on Electricity North West 132kV system, which has the following design parameters-

Maximum System Voltage	145kV
Power Frequency withstand voltage	275kV
Lightning Impulse withstand voltage	650kVpeak
Frequency	50Hz

Current carrying capacity and short circuit rating will be detailed in contract schedules.

5. ERECTION AND SITE ASSEMBLY

The manufacturer shall include for delivery and offloading. Installation and commissioning is outside the scope of this specification.

6. DRAWINGS

Manufacturers standard versions of the following drawings shall be provided at the tender stage.

At contract plus 2 months, the following drawings shall be submitted for review.

(1) General Arrangement Drawings showing

- Full dimensions
- Weights
- Bolt Torque Values

For turnkey substations the contractor shall provide layout drawings with connectors labelled and cross referenced to a drawing showing a schedule of connections.

(2) Final records

- Two paper prints of each drawing and equivalent AutoCad (.dwg) and Adobe Acrobat (pdf) format files.

Notes on drawings and drawing format:

- (a) Orthographic drawings shall use metric units and be reproduced to a scale that is declared on each print. The scale for general arrangement drawings shall not be less than 1 to 50 and that for detail drawings shall not be less than 1 to 20.
- (b) Multi-page **is not** acceptable.
- (c) Drawings shall be submitted for Approval by Electricity North West on paper in duplicate. They shall also be accompanied by equivalent AutoCad .dwg format files on a CDROM.

7. OPERATIONAL LIFE, INSPECTION, MAINTENANCE AND TRAINING

7.1 Operational life

The equipment shall be designed and constructed for an operational lifetime of at least 40 years.

7.2 Operating and maintenance manuals

Details of the recommended schedules of inspection and maintenance shall be provided with the tender to allow Electricity North West to analyse the lifecycle costs.

All necessary operating and maintenance manuals for the equipment shall be provided within two months of the award of contract, including recommended schedules of inspection and maintenance.

Final versions of the manuals shall be provided in PDF format.

7.3 Training

The manufacturer shall provide on-site training in the operation and maintenance of the equipment to all project staff and selected Electricity North West maintenance staff as required.

8. VARIATIONS

The tender shall include using Schedule A attached, any variations from the foregoing Technical and Performance Specification, including those that in his opinion enhance the performance of the equipment.

9. DOCUMENTS REFERENCED

Health and Safety at Work Act 1974.

EC Directives:

'Management of Health, Safety and Welfare'.

'Manual Handling Regulations'.

'Workplace Health, Safety and Welfare'.

'Provision and Use of Work Equipment Regulations'.

Control of Substances Hazardous to Health Regulations 2002

Health and Safety Manual Handling Operation Regulations 1992

IEC 60105 'Recommendation for Commercial Purity Aluminium Busbar Material'.

IEC 60114 'Recommendation for Heat Treated Aluminium Alloy Busbar Material of the Aluminium – Magnesium Type.

IEC/Tr 60815 'Guide for the Selection of Insulators in respect of Polluted Conditions'

BS EN ISO 9000 'Quality Management and Quality Assurance Standards'.

- BS EN 14001:2004 'Environmental Management Systems'.
- BS EN 60694:1997 'Common specification for high-voltage switchgear and controlgear standards'.
- IEC 61109 'Insulators for Overhead Lines – composite suspension and tension insulators for a.c systems with a nominal voltage greater than 1000V – definitions, test methods and acceptance criteria.
- IEC 61462 'Composite Insulators – Hollow insulators for use in Outdoor and Indoor Equipment.'
- IEC 62231:2006 'Composite station post insulators for substations with a.c. voltages greater than 1000V upto 245kV - definitions, test methods and acceptance criteria.
- BS 159:1992 'Specification for High Voltage Busbars and Busbar Connections'.
- BS 3288-1:2004 'Insulators and Conductor Fittings for Overhead Power Lines'.
- IEC 60273:2001 'Characteristics of Indoor and Outdoor Post Insulators for Systems with Nominal Voltages greater than 1000V'.
- BS 6399-2:1997 'Loading for Buildings. Code of Practice for Wind Loads'.
- BS 7354:1990 'Code of Practice for Design of High Voltage Open Terminal Stations'.
- BS 60865-1:2012 'Short Circuit Currents. Calculation of Effects. Definitions and Calculation Methods'.
- BS EN 60137:2008 'Insulated Bushings for alternating voltages above 1000V'.
- ENA TS 41-11, Issue 2:1982 'Tubular Aluminium Busbars, Connections and Terminal Fittings for 132kV Outdoor Substations'.
- Engineering Recommendation L38 'Recommendation for the Protective Greasing of PVC-Covered Copper and Bare and PVC-Covered Aluminium Based Overhead Line Conductors'.
- Electricity North West EPD311 'Approval of Equipment'.
- Electricity North West CP311 'Equipment Approval Process'.

10. KEYWORDS

132kV; Conductor, Connector, Insulator

APPENDIX A - SCHEDULES OF INFORMATION

Schedule A – List of variations from the specification

Schedule B – Recommended Tools And Spare Parts

Schedule C – General Particulars of Definite Work

SCHEDULE A - LIST OF VARIATIONS FROM THE SPECIFICATION

No. of Clause	Details of item not in accordance with the Specification

Name of Tenderer _____

Note: Additional sheets may be inserted as required

SCHEDULE B – TOOLS AND SPARE PARTS

(1) List of tools recommended for use with each installation

DESCRIPTION	PRICE EACH £	TOTAL PRICE £

(2) Recommended spare parts, to be ordered at the discretion of the company

DESCRIPTION	PRICE EACH £	TOTAL PRICE £

SCHEDULE C – GENERAL PARTICULARS OF DEFINITE WORK

To Be Completed by The Purchaser

General

Substation Name	
Address	
Grid Reference	
Contact Name for Delivery	
Contact Phone Number	
Required Delivery Date	
Creepage Distance Required	

Post Insulators

Type	
Quantity	
Creepage Distance	
Cantilever Failing Load	
Height	

SCHEDULE C – GENERAL PARTICULARS OF DEFINITE WORK (CONTINUED)

To Be Completed by The Purchaser

Connectors

Connector	Connector Type (Flat /Universal Angled)	Quantity	From	From Connection Details	Fixed or Sliding	To	To Connection Details	Vertical Angle	Horizontal Angle	Current Rating

Note – ENA 41-11 connector designation to be included in columns 4 and 7 as required.

Jointing Compound to be supplied	Y/N
Short Circuit Current, kA	
Duration, Secs	

SCHEDULE C – GENERAL PARTICULARS OF DEFINITE WORK (CONTINUED)

To Be Completed by The Purchaser

Busbars

Quantity	Size – OD/Thickness, mm	Length, metres

APPENDIX B

SELF-CERTIFICATION CONFORMANCE DECLARATION

CLAUSE BY CLAUSE CONFORMANCE WITH SPECIFICATION

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

Conformance declaration codes

- N/A = Clause is not applicable/appropriate to the product/service
- C1 = The product/service conforms fully with the requirements of this clause
- C2 = The product/service conforms partially with the requirements of this clause
- C3 = The product/service does not conform to the requirements of this clause
- C4 = The product/service does not currently conform to the requirements of this clause, but the manufacturer proposes to modify and test the product in order to conform.

Manufacturer:

Product/Service Description

Product /Service Reference :

Assessor

Name:

Company

Signature

Date

Clause / Sub-clause		Requirement	Conformance Code	Remarks (Shall be completed if Conformance Code is not Cs1)
1		Scope		
2	1	Product not to be changed		
2	2	Electricity North West Technical Approval		
2	3	Quality Assurance		
2	4	Formulation		
2	5	Identification Markings		
2	6	Minimum Life Expectancy		
2	7	Product conformity		
3	1	Requirement for type tests at the suppliers' premises		
3	2	Requirement for routine tests at the suppliers' premises		
4		Technical and Performance Requirements		
4	1	Insulators		
4	1.1	General		
4	1.2	Creepage Distance		
4	2	Connectors		
4	3	Conductors		
4	3.1	Busbars		
4	3.2	Flexible Conductors		
4	4	132kV System Characteristics		
5		Erection and Site Assembly		
6		Drawings		
7		Operational Life, Inspection, Maintenance and Training		
7	1	Operational Life		
7	2	Operation and Maintenance Manuals		
7	3	Training		
8		Variations		
Schedule B		Tools and Spare Parts.		

Additional Notes: