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Electricity Specification 400 C8

Issue 8 October 2023

LV Service Cables

Amendment Summary

ISSUE NO. DATE	DESCRIPTION
Issue 7 **October 2021**	Restructure and reformatting to the new Model Electricity Specification template. Update of technical and constructional information to the latest versions of British Standards. Addition of the following cable types: • Cables with LSOH sheath • 3 x 25cu SWA cables for over ground unlooping Prepared by: P. Howell Approved by: Policy Approval Panel and signed on its behalf by Steve Cox, Engineering and Technical Director
Issue 8 **October 2023**	Updated format of ES document with General Requirements now in ES001 Addition of the following cable types; • 16mm^2 Cu SCNE / PVC sheath • 3x35mm^2 AL CNE / PVC sheath • 3x35mm^2 AL SCNE / PVC sheath Prepared by: Philip Howell Approved by: Policy Approval Panel and signed on its behalf by Paul Turner, PAP Chairperson

Contents

1 Scope

This specification comprises general and technical requirements for LV Service cables used on the electricity distribution network (Network) owned by Electricity North West Limited, as Distribution Licensee.

2 Definitions

Approval	Sanction by the Electricity North West Limited Underground Circuits Manager that specified criteria have been satisfied
BASEC	British Approvals Service for Electric Cables
Contract	The agreement between Electricity North West and the Contractor for the execution of the Works including therein all documents to which reference may properly be made in order to ascertain the rights and obligations of the parties under the said agreement.
CNE	Concentric Neutral Earth
ENWL	Electricity North West Limited
LSOH	Low Smoke Zero Halogen
PVC	Poly Vinyl Chloride
SCNE	Separate (or Split) Concentric Neutral (&) Earth
Specification	The Specifications and schedules (if any) agreed by the parties for the purpose of the Contract.
Supplier	Any person or person's firm or company who supplies goods to Electricity North West or to its Contractor.
Tender	An offer in writing to execute work or supply goods at a fixed price.
Tenderer	The person or person's firm or company, including personal representatives, successors and permitted assigns, invited by Electricity North West to submit a Tender.
XLPE	Cross-Linked Polyethylene.

3 General Requirements for Approvals and Testing

3.1 Product not to be Changed

Compliance with this clause shall be in accordance with ES001.

3.2 Electricity North West Limited Technical Approval

Compliance with this clause shall be in accordance with ES001.

3.3 Quality Assurance

Compliance with this clause shall be in accordance with ES001.

3.4 Formulation

Compliance with this clause shall be in accordance with ES001.

3.5 Identification Markings

Compliance with this clause shall be in accordance with ES001.

3.6 Minimum Life Expectancy

The minimum life expectancy of all products covered by this Specification is 60 years.

3.7 Product Conformity

Compliance with this clause shall be in accordance with ES001.

3.8 Confirmation of Conformance

The Tenderer shall complete the conformance declaration sheets in Appendix C.

Failure to complete these declaration sheets may result in an unacceptable bid.

4 Requirements for Type and Routine Testing

Compliance with this clause shall be in accordance with ES001.

4.1 Requirement for Type Tests at Suppliers Premises

Compliance with this clause shall be in accordance with ES001.

4.2 Requirement for Routine Tests at the Supplier's Premises

Compliance with this clause shall be in accordance with ES001.

5 Conditions of Installation

Cables specified in this Specification will be pulled or laid into open trenches, pulled into ducts or installed in air.

During storage and after installation cables can be expected to be subjected to the full range of climatic conditions encountered in the UK.

Cables may be surrounded by ground water for most of their operating life. Where cables are installed in ducts, flooding of ducts can occur resulting in permanently wet sections along the cable route.

Cables installed above ground will be supported by means of cleats either vertically or horizontally and these cables may be exposed to direct sunlight for significant periods.

All cables must be compatible with all Approved solvent cleaning wipes and other materials used in installing and jointing of them. Accessories used on these cable types may require application of heat and joints will be encapsulated in resins as specified in ES400R10.

6 Conditions of Operation for LV Service Cables

The following are the general conditions under which power cables purchased in accordance with this Specification are required to operate:

- Nominal system voltage 400/230.
- The working voltage of any part of the system does not normally exceed the normal system voltage by more than 10%.
- Nominal system frequency: 50Hz.

7 Cable Design

Appendix A lists the range of conductor cross sections and configurations currently used by ENWL.

LV Service cables shall comply with relevant parts of BS 7870 or BS5467. Where any requirement of this Specification differs from the Standard, the requirements of this Specification shall apply.

If a Tenderer is unsure regarding any requirement of this Specification, clarification shall be sought in writing from ENWL Underground Circuits Policy Manager.

8 Manufacturing Location

At the time of Tender, the Tenderer shall provide details of manufacturing location(s) for each cable offered.

No compounds or processes shall be changed without the prior approval from the ENWL Underground Circuits Policy Manager

Any Approval granted will be site specific and will not be transferable to any other site without the prior written agreement of the ENWL Underground Circuits Policy Manager.

9 Reliability

Reliability is paramount. When any Tender for LV service cables is evaluated, preference will be given to proven established designs.

LV Service Cables shall be available for continuous operation at their stated design loading for 365 days a year, 24 hours per day. A service life of up to 60 years is expected.

The Supplier shall demonstrate reliability for the offered design of the cable by providing evidence of satisfactory service life and Type test reports as detailed in Section 11.1

10 Cable Constructions

10.1 SCNE Single Phase Spilt Concentric Polymeric Insulated Cables

Single core plus split concentric neutral and earth 600/1000 volt cable; phase conductor, XLPE insulation; helical concentric layer of blue polymeric covered copper wires (neutral) and bare copper wires (earth).

PVC sheathed cables to comply with BS 7870-3.21 and LSOH sheath cables to comply with BS 7870-3.22

- **Conductor Types :** Depending on specific cable detailed in Appendix A, the conductor shall be either;
    - $4mm^2$ stranded plain annealed copper – Class 2 in accordance with BS EN 60228
    - $16mm^2$ stranded plain annealed copper – Class 2 in accordance with BS EN 60228
    - $25mm^2$ stranded plain annealed copper – Class 2 in accordance with BS EN 60228
    - $35mm^2$ circular solid aluminium phase conductor – Class 1 in accordance with BS EN 60228

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- **Insulation :** XLPE Type DIX 3 conforming to the requirements given in BS 7870-1 annex B.

- **Concentric Conductors :** Concentric neutral and earth conductor: blue polymeric covered solid copper neutral wires and solid plain annealed copper earth wires.
  To distinguish the neutral conductor from the earth continuity conductor, each wire shall be covered by extrusion with a blue polymeric compound, conforming to the requirements of BS 7870-3.21 section 17.3, to a diameter approximately the same as that of the individual wires in the earth continuity conductor. The covered neutral wires shall be easily separated for stripping whilst jointing.
  The concentric layer shall be applied with a right-hand direction of lay. The wires forming the neutral conductor and earth continuity conductor shall be applied in individual groups over the insulation with non-hygroscopic string separators.
  Either one or two non-hygroscopic string separator(s) shall be located on either side of the group of bare copper wires to separate it from the group of covered wires.

- **Oversheath :** The oversheath shall be applied so that there is no internal protrusion of the oversheath material between or around the Neutral or Earth wires.Depending on specific cable detailed in Appendix A, the oversheath material shall be either;
    - Black PVC Type DMV 23 conforming to the requirements given in BS 7870-1 annex B.
    - Orange LSOH Compound Type DMZ 4 conforming to the requirements given in BS 7870-1 annex B.

10.2 CNE Single Phase Polymeric Insulated Cables

Single core 600/1000-volt cable, XLPE insulation; helical concentric copper wires,PVC sheathed cables to comply with BS 7870-3.11

- **Conductor :** Depending on specific cable detailed in Appendix A , the conductor shall be either ;
    - 4mm^2 stranded plain annealed copper – Class 2 in accordance with BS EN 60228
    - 25mm^2 stranded plain annealed copper – Class 2 in accordance with BS EN 60228
    - 35mm^2 circular solid aluminium phase conductor – Class 1 in accordance with BS EN 60228
- **Insulation :** XLPE Type DIX 3 conforming to the requirements given in BS 7870-1 annex B.
- **Concentric Conductor :** Concentric combined neutral and earth conductor: solid plain annealed copper wires
- **Oversheath :**The oversheath shall be applied so that there is no internal protrusion of the oversheath material between or around the Neutral /Earth wires.
  The oversheath material shall be Black PVC Type DMV 23 conforming to the requirements given in BS 7870-1 annex B.

10.3 SCNE Three Phase Spilt Concentric Polymeric Insulated Cables

Three-core split neutral and earth 600/1000-volt cable, XLPE insulation; helical concentric layer of blue polymeric covered copper wires (neutral) and bare copper wires (earth).

PVC sheathed cables to comply with BS 7870-3.21 and LSOH sheath cables to comply with BS 7870-3.22

- **Conductor Types :** 25mm^2 or 35mm^2 circular solid aluminium phase conductor – Class 1 in accordance with BS EN 60228
- **Insulation :**XLPE Type DIX 3 conforming to the requirements given in BS 7870-1 annex B.
- **Insulation Phase colours:** The cores shall be laid up with a right-hand direction of lay in the sequence Brown, Black, Grey.
- **Concentric Conductors:** Blue polymeric covered solid copper neutral wires and solid plain annealed copper earth wires.
  To distinguish the neutral conductor from the earth continuity conductor, each wire shall be covered by extrusion with a blue polymeric compound, conforming to the requirements of BS 7870-3.21 section 17.3, to a diameter approximately the same as that of the individual wires in the earth continuity conductor. The covered neutral wires shall be easily separated for stripping whilst jointing.
  The concentric layer shall be applied with a right-hand direction of lay. The wires forming the neutral conductor and earth continuity conductor shall be applied in individual groups over the insulation with non-hygroscopic string separators.
  Either one or two non-hygroscopic string separator(s) shall be located on either side of the group of bare copper wires to separate it from the group of covered wires.

- **Oversheath :** The oversheath shall be applied so that there is no internal protrusion of the oversheath material between or around the Neutral or Earth wires.
  Depending on specific cable detailed in Appendix A, the oversheath material shall be either;

  - Black PVC Type DMV 23 conforming to the requirements given in BS 7870-1 annex B . or;
  - Orange LSOH Compound Type DMZ 4 conforming to the requirements given in BS 7870-1 annex B.

10.4 CNE Three Phase Polymeric Insulated Cables

Three-core plus concentric copper wire conductor ,600/1000-volt cable, PVC sheathed cables to comply with BS 7870-3.11.

- **Conductor :** 25mm^2 or 35mm^2 circular solid aluminium phase conductor – Class 1 in accordance with BS EN 60228
- **Insulation :** XLPE Type DIX 3 conforming to the requirements given in BS 7870-1 annex B.
- **Insulation Phase colours:** brown, black, grey
- **Concentric Conductor:** solid plain annealed copper wires
- **Oversheath** : The oversheath shall be applied so that there is no internal protrusion of the oversheath material between or around the Neutral /Earth wires.
  The oversheath material shall be Black PVC Type DMV 23 conforming to the requirements given in BS 7870-1 annex B.

10.5 Three Core Steel Wire Armoured Polymeric Insulated Cables

Three-core 600/1000-volt cable; XLPE insulation; Galvanised Steel Wire Armouring, PVC oversheath conforming to BS 5467. These cables shall be BASEC approved.

- **Conductor** : 25mm^2 stranded plain annealed copper – Class 2 in accordance with BS EN 60228
- **Insulation :** XLPE Type GP8 according to BS 7655-1.3
- **Insulation Phase colours:** Brown, Blue , Green/Yellow*
- **Bedding Layer :**Compatable PVC compound
- **Armouring :** Galvanised round steel wire armours
- **Oversheath :** Black PVC Type 9 according to BS 7655-4.2.

  *Alternative 3 phase colours of Brown/Black/Grey may be considered for small requirements if the single phase colours are not available without a minimum manufacturing quantity

10.6 Oversheath Markings

In addition to the requirements detailed in the relevant specification for each cable supplied, a unique reference number shall be printed or embossed in the cable oversheath at regular intervals to allow traceability in case of any quality issues. This unique reference number will be used to identify all materials used within the manufacturing process.

All markings on the sheath shall be clearly legible.

11 Testing and Approval

11.1 Type Test Approval

Type tests shall be carried out to the requirements of the relevant parts of BS 7870 for CNE and SCNE cable types and BS 5467 for SWA types.
A type test certificate signed by the representative of a competent witnessing body, or a report by the manufacturer giving the test results and signed by the appropriate qualified officer shall be acceptable as evidence of type testing.
For Armoured cables to BS5467 , BASEC approval will be accepted in place of a Type Test Certificate.

Once successfully completed, type approval tests on cables do not need to be repeated unless there is a fundamental change in the design, material or manufacturing process. However, preference will be made to type test reports less than 5 years old to ensure continuous validation of the cable design and process.

Where a company is, for example, international and comprises of several dispersed manufacturing locations, the Type Approval of one manufacturing unit shall not imply automatic Approval of the other units in the company.

11.2 XLPE Insulation Shrinkage

An insulation shrinkage test shall be performed on samples of all cable types and cross sections at 130°C for 6 hours and a then further test at 65°C for 24 hours.
The maximum shrinkage following the test should be shall be no more than 2%.

11.3 Routine and Sample Testing

Routine and Sample tests shall be carried out to the requirements of BS 7870 or BS 5467 as relevant to the cable design.

The ENWL Underground Circuits Policy Manager or their nominated representative reserves the right to be present and witness routine and sample tests. Where the ENWL Underground Circuits Policy Manager wishes to witness any such tests, the date and time of testing shall be mutually agreed.

12 Sealing, Drumming and Logistical Requirements

On completion of the specified routine and sample tests in the manufacturer's works, the cable shall be placed on timber drums or plywood reels as appropriate, taking care to prevent looseness of the cable and each end of the cable shall be firmly and properly secured to the drum or reel.

Each end of every length of cable shall be sealed in such a way as to prevent the ingress of water both during transit and on site.

The following details of the cable supplied shall be displayed on a label fixed on one flange of the drum or reel:

- ENWL commodity code (as stated on individual Purchase Order);
- Name of manufacturer;
- Supplied length;
- Manufacturing batch identifier or drum number for trackability;

- Size of conductor and type of conductor material ("Cu" or "Al");
- Rated voltage and abbreviated description of cable construction;
- Gross and Nett weights;
- The metre marking start and end values

Timber cable drums may be stored for long periods outdoors. All drum labels shall remain legible and durable under these conditions.

All timber drums shall be returnable. The Tenderer shall provide details of the procedure for arranging to collect empty drums from the company's normal delivery locations. In addition, the Tenderer shall advise if Plywood reels are returnable. ENWL encourages any initiative to recycle plywood materials where possible. Oct 23

Cable drum / reel lengths shall be 250m unless specified otherwise any specific Purchase Order.

13 Customer Support

The required minimum level of support is as follows:

- Contractual or technical advice is to be available, in English, by telephone during normal working hours.
- Attendance at site by the manufacturer, or the manufacturer's representative within 5 working days of any request made by ENWL following identification of a defect or other major issue relating to the cable.

Tenderers shall provide details of the support available including contact details of Technical Support operatives.

14 Samples

During the Tender period the Tenderer shall submit samples for Approval as required by the ENWL Underground Circuits Policy Manager. Such samples shall remain the property of ENWL.

15 Technical Information Required with Tender

TECHNICAL INFORMATION REQUIRED WITH TENDER
Manufacturers Data sheet including section drawing for each cable offered
Manufacturers' Safety Data Sheets (if applicable)
Type Test Reports
Insulation Shrinkage Test Report
Manufacturers' Routing and Sample Testing frequency summary
Evidence of reliability record
Details of Quality Management system

Details of Customer Support
Cable drums / reels details:
Completed Appendix B - Schedule of Technical Requirements
Completed Appendix C – Compliance Schedule

16 Documents Referenced

DOCUMENTS REFERENCED	
ES001	ENWL Main Specifications
CP311	Equipment Approval Policy and Process
BS EN 60228	Conductors of insulated cables
BS 5467	Electric cables. Thermosetting insulated, armoured cables for voltages of 600/1000 V and 1900/3300 V
BS 7655	Insulation and sheathing materials for cables
BS 7870-1	LV and MV polymeric insulated cables for use by distribution and generation Utilities Part 1: General
BS 7870 Part 3-11	LV and MV Polymeric insulated cables for use by distribution and generation utilities – XLPE insulated combined neutral and earth copper wire concentric cables with copper or aluminium conductors
BS 7870 Part 3-21	LV and MV Polymeric insulated cables for use by distribution and generation utilities – XLPE insulated split concentric cables with copper or aluminium conductors
BS 7870 Part 3-22	XLPE insulated split concentric cables with copper or aluminium conductors, having low emission of smoke and corrosive gases when affected by fire

17 Keywords

LV, Cable,Service; CE,SCNE, XLPE,PVC, LSOH

Appendix A – Schedule of Cables

ITEM NO.	ORDERING SPECIFICATION	SIZE (MM^2)	CC NO.	
A	SCNE single phase split concentric: XLPE insulated, PVC sheath to BS 7870-3.21	4Cu 16Cu 25Cu 35Al	000213 000337 000345 000299	Oct 23
B	SCNE single phase split concentric: XLPE insulated, LSOH sheath to BS 7870-3.22	4Cu 25Cu 35Al	000364 000367 000368	
C	CNE Single phase: polymeric insulated, PVC Sheath to BS 7870-3.11	4Cu 25Cu 35Al	000108 000353 000175	Oct 23
D	SCNE three phase split concentric: polymeric insulated, PVC sheath to BS 7870-3.21	25Al 35AL	002127 000369	
E	SCNE three phase split concentric: polymeric insulated, LSOH sheath to BS 7870-3.22	25Al	000371	
F	CNE three phase concentric: polymeric insulated, PVC sheath to BS 7870-3.11	25Al 35AL	002119 000373	Oct 23
G	Three core, polymeric insulated, steel wire armoured , PVC sheath to BS 5467 (BASEC Approved)	25Cu	TBA	

Appendix B – Schedule of Technical Particulars

This schedule is to be completed by the manufacturer at the time of tendering. The technical particulars entered shall be binding. No departures from these shall be permitted except with the written permission of ENWL Circuits Policy Manager.

NO	ITEM	VALUE	UNIT
1	Manufacturer		
2	Location and manufacturing line reference		
3	Voltage designation (U_o/U (U_m)		kV
4	Nominal cross-sectional area of conductor		mm^2
5	Conductor material / type		
6	Nominal overall diameter of completed cable		mm
7	Nominal weight of completed cable		kg/m
8	Maximum pulling tension		kN
9	Minimum installation temperature		^0C
10	Minimum radius of bend round which cable can be laid		
	10.1 Static		m
	10.2 Dynamic		m
11	Maximum dc resistance of conductor at 20ºC		μΩ/m
12	Maximum dc resistance of CNE or SCNE conductor(s) at 20ºC		μΩ/m
13	Maximum ac resistance of conductor at 90ºC		μΩ/m
14	Equivalent star reactance of three phase circuit at 50Hz		μΩ/m
15	Equivalent star capacitance in pF/km.		ρF/m
16	Zero sequence impedance R0 + jK0		μΩ/m
17	Maximum charging current per conductor per metre of cable		mA/m
	Maximum Continuous Current carrying capacity per phase based on depth of Cover to top of LV cables = 450mm.		
18	Laid direct with g = 1.2 K.m/W and T_g = 15 °C.		A
19	Laid direct with g = 0.9 K.m/W and T_g = 15 °C.		A

NO	ITEM	VALUE	UNIT
20	Drawn into a 32mm ID smooth wall plastic duct where g = 1.2 K.m/W and T_g = 15 °C.		A
21	Drawn into a 32mm ID smooth wall plastic duct where g = 0.9 K.m/W and T_g = 15 °C.		A
22	In Air where T_a = 25 °C.		A

Appendix C – Conformance Declaration

SECTION-BY-SECTION CONFORMANCE WITH SPECIFICATION

The Tenderer shall declare conformance or otherwise for each product/service or range of products/services, section-by-section, using the following 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:

Name:

Company:

Signature:

Date :

SECTION-BY-SECTION CONFORMANCE			
Section	**Section Topic**	**Conformance Declaration Code**	**Remarks * (must be completed if code is not C1)**
3	**General Requirements for Approvals and Testing**		
7	**Cable Design**		
8	**Manufacturing Location**		
9	**Reliability**		
10.1	**Constructional Requirements - SCNE Single Phase Concentric Cables**		
10.2	**Constructional Requirements - CNE Single Phase Concentric Cables**		
10.3	**Constructional Requirements - SCNE Three Phase Spilt Concentric Cables**		
10.4	**Constructional Requirements - CNE Three Phase Concentric Cables**		
10.5	**Constructional Requirements – Steel Wire Armoured Cables**		
10.6	**Oversheath Markings**		
11.1	**Type Tests**		
11.2	**XLPE Insulation Shrinkages**		
11.3	**Routine & Sample testing**		
12	**Sealing, Drumming and Logistical Requirements**		
13	**Customer Support**		
14	**Samples**		
15	**Technical Information Required with Tender**		