

1 SCOPE

This document details ScottishPower EnergyNetworks' (SPEN) technical requirements for the handling and installation of power cables up to and including 33kV onto the Company network.


2 ISSUE RECORD

This is a maintained document and is subject to review as defined in section 4 below.

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3 ISSUE AUTHORITY

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4 REVIEW

This document shall be reviewed as required by changes in policy and technology, regulatory or statutory requirements.

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6 RELATED DOCUMENTS

6.1 Legislation

Electricity Safety, Quality and Continuity (ESQC) Regulations

6.2 National Specifications and Guidance

| | |
|-------------|--|
| BS 2484 | Specification for straight concrete and clayware cable covers |
| ENATS 12-23 | Polyethylene protection tape for buried electricity supply cable |
| ENATS 97-1 | Special backfill materials for buried electric cables |
| HS(G)47 | Avoiding danger from underground services |
| HSG185 | Health and Safety in Excavations |

6.3 SPEN Documents

| | |
|-------------|--|
| BUPR-22-015 | Recording of electrical assets by contractors |
| CAB 03 028 | Specification for ducting for power cables |
| SMS 17 002 | Safe digging practice |
| SMS 17 003 | Safe excavations |
| SUB-02-613 | Electrical Insulation Testing of HV Equipment up to 33kV |

7 DEFINITIONS

For the purpose of this Specification the following definitions shall apply:

| | |
|-----------------------------|--|
| <i>Approved:</i> | Equipment which is approved in accordance with SPEN procedures for use or installation on the Company network. |
| <i>Company:</i> | Refers to SP Distribution Ltd and SP Manweb plc. |
| <i>Energisation:</i> | The application of Voltage to an item(s) of Equipment from the system. |
| <i>SPEN</i> | ScottishPower EnergyNetworks, the brand name for the division of ScottishPower group of Companies that encompasses SP Distribution Ltd, SP Transmission Ltd, SP Manweb plc and SP Power Systems Ltd. |
| <i>SP Distribution Ltd:</i> | The Distribution Licence Holder for the distribution service area formally known as ScottishPower. |
| <i>SP Manweb plc:</i> | The Distribution Licence Holder for the distribution service area formally known as Manweb. |
| <i>The Engineer:</i> | The person nominated by the Company to have responsibility for all matters relating to the execution of the works. |

8 GENERAL REQUIREMENTS

The Company reserves the right to change the data contained in this document without notification. Although specific network extensions may be designed and constructed by third parties, the Company retains the responsibility for the design and construction standards of the distribution system. Since the guidance cannot cover every eventuality, the Company reserves the right to apply other criteria where necessary and appropriate.

The installer is responsible for ensuring that they have all the relevant information required to undertake construction. Only installers who have the appropriate skills, training and experience shall use the data and guidance contained in this document. This document provides guidance, however, it is the installers responsibility to ensure that safe systems of work are employed on site.

9 INTRODUCTION

The document defines the limits prescribed by SP EnergyNetworks for each of the following parameters:-

- Maximum pulling tensions.
- Minimum static and dynamic bending radii.
- Depth of cover.
- Positioning of marker tapes and protection tiles.
- Multiple cable spacing.

The following sections detail the procedures which shall be followed when handling and installing power cables. These procedures are based on safe working practices and are designed to minimise the risk of damage to the cable being installed.

Attention is drawn to the requirements of the New Roads and Street Works Act (NRSWA) which must be complied with where appropriate.

10 AVOIDING DANGER

Attention is drawn to the requirements and recommendations contained in Health and Safety Executive guidance notes HSG47 "Avoiding Danger from Underground Services" and HSG185 "Health and Safety in Excavations". Further guidance is provided to SPEN staff in SP EnergyNetworks documents SMS 17 002 "Safe digging practice" and SMS 17 003 "Safe excavations" which are included in the SPEN "General Health, Safety and Environmental Instructions Handbook".

11 MATERIALS

All cables and associated materials for installation on the Company network shall be New and Approved.

11.1 Cable bedding and surround materials

Cables shall be bedded in and surrounded by appropriate materials as defined in section 19.2 "Bedding materials".

11.2 Cable Sealing Caps

| Cable Diameter | Cold Applied Cap (SAP Code) |
|----------------|-----------------------------|
| Up to 17mm | 30980544 |
| 17mm to 30mm | 30980545 |
| 30mm to 45mm | 30980546 |
| 45mm to 95mm | 30980547 |

11.3 Marker Tape and Protection tiles

Marker tape and protection tiles shall be Approved and shall be marked in accordance with EATS 12-23.

Protection tiles shall be supplied and installed with a pin interlocking system and shall meet the impact requirements of BS 2484.

12 PRECAUTIONS IN COLD WEATHER

To avoid damage to the oversheath and/or insulation of cables in cold weather, PVC sheathed cables (Waveform, service, multicore and multipair cables) shall be maintained above 0°C and Polyethylene sheathed cables (11kV and 33kV xlpe insulated cables) shall be maintained above -5°C for a minimum of 24 hours before laying or otherwise bending.

13 SETTING UP DRUM PRIOR TO CABLE PULLING

13.1 General safety principals

- Carry out site specific risk assessment
- Always wear appropriate PPE.
- Always push drums in the direction of travel.
- Never pull drums with back to the direction of travel.
- Push squarely on the flanges and watch for any projecting nails in wooden drums.
- Always use approved equipment for handling drums, never use improvised equipment.
- Never allow a drum to move in an uncontrolled manner.
- Never position or store a drum underneath an overhead line.

13.2 Positioning the cable drum

Always observe the correct direction of roll indicated by the “roll this way” arrow on the drum flange. Position the drum so that the pull from the drum to the trench is as straight as possible, in any case, the lead in angle of the cable to the trench shall not be greater than 30°. A lead in roller shall always be used to guide the cable into the trench.

When pulling a cable into a duct the drum shall be positioned above the duct so that the cable leaves the drum and enters the duct in a smooth curve. The drum shall be rotated by hand during the installation to ensure that the cable does not become tight between the drum and the duct mouth.

Cable drums should be arranged such that the “A” end of one length is positioned for jointing on to the “Z” end of the next length.

13.3 Using drum jacks

Check that the jacks and spindle are adequate for the size and weight of the cable drum, the gross weight of the cable drum will be marked on one flange.

13.4 Removing battens & lagging

Battens or other drum protection should be removed carefully to ensure that any nails or tools do not damage the cable. Care should be taken when removing any metal strapping used to secure lagging, this strapping may be under considerable tension and can spring with some force when cut. Ensure that no nails are left protruding from the drum flanges as these may result in injury when moving or handling the drum. Ensure correct Disposal of any excess materials.

13.5 Checking cable details and sealing cap integrity

The end of the cable should be freed and inspected to ensure that:-

- The cable is of the correct size and type.
- The cable sealing cap is intact and undamaged.
- On a new drum the length marking on the oversheath agrees with the details marked on the cable drum.

14 PREPARATION OF TRENCH AND DUCTS

- The trench bottom shall be as level as possible and any change in gradient or level shall be made as gradually as possible.
- The trench bottom shall be free of stones and other sharp objects and the edges of the trench shall be cleared of any stones, tools or objects which may fall into the trench and damage the cable.
- Ducts shall be cleaned out prior to cable installation by pulling through a cleaning pig of suitable diameter.
- Duct entries shall be fitted with split bell mouths to prevent damage to the cable and to the duct entry. The Bell mouth shall be fitted so that the cable does not run on the split during installation to avoid the risk of damage to the cable oversheath.
- A shallow pit shall be dug at duct entry positions to ensure that stones etc are not dragged into the duct.

15 CABLE PULLING

15.1 Installation parameters

Requirements for depth of cover, maximum pulling tensions, minimum bending radii, minimum cable spacings and position of marker tapes and protection tiles detailed in Appendix 1 shall be complied with.

15.2 Drum control during pulling

At all times during the pulling operation, at least one member of the team shall be stationed at the drum to control its rotation and monitor the stability of the drum and jacks.

15.3 Winches

Where a winch is used to pull in cables, the winch shall be fitted with a suitable dynamometer. The dynamometer shall be continuously monitored to ensure that the maximum pulling tension is not exceeded at any time. In all cases an appropriate swivel eye shall be fitted between the pulling bond and the pulling attachment on the cable.

15.4 Cable guides and rollers

15.4.1 Straight horizontal run

The cable shall be supported on free running cable rollers which have no projections or sharp edges.

Rollers shall be placed in the trench to prevent the cable from dragging on the trench bottom or in mud. The roller spacing required to achieve this will depend on the cable type being installed and the pulling tension along the route.

A leading roller shall be used to support the cable over the entire drum width immediately before being fed into the trench.

15.4.2 Bends in route

Vertical corner rollers shall not be used as they may damage the cable by causing excessive side wall pressure. Skid plates of a radius greater than the cable's minimum dynamic bending radius shall be used on all bends.

15.4.3 Roller Adjustment and Protection of Other Services

Prior to commencement of pulling, initial tension should be taken up to take the slack out of the bond wire. The rollers along the route should be checked and adjusted to line up with the taut bond and a final check should be made to ensure that other services which may be rubbed or abraded by the cable during installation are suitably protected.

When final roller positions are confirmed and all other services are suitably protected the pull can be started.

15.5 Single core xlpe cables

15.5.1 Configuration

Where single core cables are laid direct in the ground to form one three-phase circuit, they shall, unless otherwise instructed by the Engineer, be laid in touching trefoil. They shall be bound together using nylon cable ties at intervals of one metre. The nylon cable ties shall have a smooth internal surface and have a minimum loop tensile strength of 54kg.

15.5.2 Ducted single core installations

Where single core cables are to be installed in ducts to form a three-phase circuit, they shall, unless otherwise instructed by the Engineer, be installed with each core in an individual duct and with the ducts laid in touching trefoil. The duct groups shall be bound together using nylon cable ties at intervals of one metre. The nylon cable ties shall have a smooth internal surface and have a minimum loop tensile strength of 54kg.

It is acceptable to install three single core cables in a single duct for short lengths such as road crossings. In this case all 3 cores must be pulled in simultaneously.

15.6 Completion

When installation is complete, all cut cable ends must be sealed by capping in accordance with approved procedures. All unused cable must be capped before returning to stores.

The loose end of the cable remaining on the drum shall be rewound tightly onto the drum by means of a length of rope tied around the cable end and secured to the drum.

After securing the cable end lower the drum jacks keeping the drum level. Remove, clean and store the spindle and drum jacks.

15.7 Cable Sealing

All cut ends of cables, including cable left on the drum, shall be sealed immediately and not left exposed to the atmosphere. This applies whether the cables are cut at stores, in the yard or on site.

All end caps, including factory fitted end caps, shall be examined after laying and any cap found to be damaged shall be removed and the cable resealed immediately.

15.7.1 Cables with Lead Sheath

For cables with lead sheaths the sealing cap shall be applied directly onto the lead sheath.

Measure the diameter over the lead sheath and select the appropriate size of sealing cap.

Expose the lead sheath for a distance equal to the length of the sealing cap plus 50mm from the cut cable end. Clean the exposed lead sheath using approved cable degreasing solvent wipes.

Install the sealing cap in accordance with the instructions provided with each cap.

15.7.2 Cables without lead sheath

For cables without lead sheaths the sealing cap shall be applied directly onto the PVC or MDPE cable oversheath.

Measure the diameter over the PVC/MDPE oversheath and select the appropriate size of sealing cap.

Clean and abrade the cable oversheath.

Install the sealing cap in accordance with the instructions provided with each cap.

16 ALTERNATIVE INSTALLATION TECHNOLOGIES

The requirements specified in this document apply in general to all underground cable installations irrespective of the installation method used.

Installation shall be carried out by experienced teams with a thorough understanding of the risks specific to the installation methods being used.

The installation design, equipment and techniques shall be designed to:-

- Minimise pulling forces on cables.
- Cause no damage to cable sheaths during handling and installation.
- For single core cables, be capable of reliably installing the cables in touching trefoil formation.
- For single core cables in ducts, be capable of reliably installing the ducts in touching trefoil formation.

The following gives some clarification and guidance.

16.1 Ducted Installations

Ducted installations shall be installed to meet the same requirements for surround materials depth of cover and warning tapes/tiles as apply for direct buried cables.

16.2 Trenchless installations

Cables shall not be installed directly by trenchless means. Trenchless installation shall be achieved by installation of a duct which the cable(s) can be subsequently pulled into. In this situation it is not possible to install warning tapes/tiles and the markings on the duct in conjunction with the presence of the specified surround material are considered to provide the warning required by the ESQC Regulations. In certain situations it may be necessary to install additional warning such as marker posts or signs depending on the location and depth of cover.

16.3 Installation by Plough or Trenching Machine

Cables or ducts may be installed using ploughing or trenching techniques. The requirements for surround materials and depth of cover remain unchanged for this type of installation. Standard 11kV and 33kV warning tape/tiles are not suitable for installation by these methods and an Approved and appropriate warning tape shall be used. In certain situations it may be necessary to install additional warning such as marker posts or signs depending on the location.

The capabilities of Ploughing and Trenching Contractors must be fully assessed by SP EnergyNetworks prior to Approval to carry out installation work.

17 BLINDING OF CABLES AND JOINTS

The following points are recognised as good practice and should be followed where reasonably practicable:-

- Blinding shall be completed immediately following the installation of sections of new cable, with the exception of joint bays.
- Joint bays shall be opened for as short a time as possible prior to commencement of jointing.
- All 11kV and 33kV joints and associated cables shall be blinded before the Joints leaves site.
- LV joints and associated cables shall preferably be blinded before the Joints leaves site and by the next day at the latest.

18 CABLE TESTING AND COMMISSIONING

Cables shall be tested in accordance with SUB-02-613 prior to Energisation.

19 APPENDIX 1 - REQUIRED INSTALLATION PARAMETERS

19.1 General

The requirements of this section must be complied with for all cables, up to and including 33kV, which are installed with the intention that they will become part of the Company's network.

19.2 Bedding Materials

All cables and ducts shall be bedded and blinded as defined below

19.2.1 Definitions

Soft finefill material.

Soft finefill material shall be of consistent composition under all conditions of humidity and temperature and shall not contain any readily visible foreign matter such as pieces of clay or organic detritus. The material shall not contain any sharp stones or flints.

Selected sand backfill.

Selected sand backfill shall be of consistent composition and shall not contain any readily visible foreign matter such as pieces of clay or organic detritus. Not less than 95% by weight of the material shall pass through a British Standard 5mm sieve. The material shall not contain any sharp stones or flints.

The Dry relative density of the Selected sand backfill shall not be less than 1.6 when determined in accordance with Appendix A of EATS 97-1.

19.2.2 LV Cables

All LV cables shall be surrounded by a minimum of 50mm of soft finefill material.

19.2.3 11kV Cables

All 11kV cables shall be surrounded by a minimum of 75mm of either soft finefill material or selected sand backfill.

19.2.4 33kV Cables

All 33kV cables shall be surrounded by a minimum of 75mm of selected sand backfill.

19.3 Maximum Pulling Tensions

Maximum permissible pulling tensions for each cable type are given below. These tensions must not be exceeded under any circumstances. Efforts should always be made to achieve lower figures by careful setting out of the work and positioning of the cable drum.

LV & 11kV Cables

| | Maximum pulling tension (kN) | | | | |
|-----------------------------------|------------------------------|--------|--------|--------|--------|
| Conductor size (mm ²) | 95 Al | 185 Al | 240 Al | 300 Al | 300 Cu |
| 3-phase waveform | 2.89 | 7.78 | 8.67 | 9.79 | - |
| 11kV 1-core xlpe | 2.85 | 5.55 | - | 9.0 | 15.0 |
| 11kV 3-core xlpe | 3.91 | 6.36 | - | 9.79 | - |

33kV Cables

| | Maximum pulling tension (kN) | | | | |
|-----------------------------------|------------------------------|-----|-----|------|------|
| Conductor size (mm ²) | 150 | 240 | 400 | 500 | 630 |
| Aluminium Conductor | 4.0 | 5.5 | 8.0 | - | - |
| Copper Conductor | 5.5 | 8.0 | - | 14.6 | 18.0 |

19.4 Minimum Bending Radii

MINIMUM bending radii to which cables in new condition may be bent are given below for the installation conditions stated.

The following installation conditions apply:-

Dynamic – When cables are being pulled in.

Static – When cables are bent in-situ adjacent to joints or terminations.

Under no circumstances must the minimum dimensions given below be infringed, as damage will be caused to the cable's insulation and screening systems resulting in premature failure.

| Cable Type | | Conductor size (mm ²) | | | | | | | |
|----------------------|----------------|-----------------------------------|-----|-----|-----|-----|------|------|------|
| | | 95 | 150 | 185 | 240 | 300 | 400 | 500 | 630 |
| | | Minimum Bending Radius (mm) | | | | | | | |
| Three phase waveform | <i>Dynamic</i> | 500 | - | 650 | 850 | 850 | - | - | - |
| | <i>Static</i> | 240 | - | 400 | 540 | 540 | - | - | - |
| 11kV 1-core xlpe | <i>Dynamic</i> | 560 | - | 650 | - | 750 | - | 900 | - |
| | <i>Static</i> | 420 | - | 490 | - | 560 | - | 680 | - |
| 11kV 3-core xlpe | <i>Dynamic</i> | 600 | - | 750 | - | 900 | - | - | - |
| | <i>Static</i> | 500 | - | 600 | - | 750 | - | - | - |
| 33kV 1-core xlpe | <i>Dynamic</i> | - | 900 | - | 950 | - | 1050 | 1150 | 1250 |
| | <i>Static</i> | - | 650 | - | 700 | - | 750 | 850 | 950 |

19.5 Depth of Cover

Cables and ducts shall be installed so as to provide the minimum depth of cover detailed below.

| Surface Type | Voltage | | |
|-------------------------------------|-----------------------------|------|-------------|
| | 33kV | 11kV | Low Voltage |
| | Minimum Depth of Cover (mm) | | |
| Unmade ground, footways & footpaths | 775 | 600 | 450 |
| Roads | 775 | 700 | 600 |
| Cultivated ground inc. gardens | 775 | 700 | 600 |
| Agricultural land | 910 | 910 | 910 |

On railway property, other than across or near railway track, normal depth of cover shall be used subject to a minimum depth to comply with the standard railway wayleave agreement.

In certain situations it may not be possible to achieve the minimum cover detailed above. In these cases, it will be necessary to:-

- Minimise the length over which minimum depth is not attained.
- Install additional mechanical protection as appropriate for the location and circumstances.
- Install additional warning, for example in the form of posts or signs, appropriate to the location and circumstances.
- Ensure that the cable records clearly detail the depth and extent of the shallow section of cable.

19.6 Position of Marker Tapes and Protection Tiles

Approved marker tapes shall be installed 200mm above all low voltage cables and joints.

Approved marker tapes shall be installed 250mm above all 11kV cables and joints. Where an 11kV cable is installed directly below another cable, its protection tape shall be installed immediately below the higher cable.

Approved protection tiles shall be installed 75mm above all 33kV cables and 33kV joints.

Where existing warning markers on any cable are disturbed or removed during excavation, these markers shall be replaced or renewed as appropriate.

Where existing cables without warning markers are uncovered during the course of excavation, new marker tape or tile shall be installed over the complete exposed section of the existing cables. **This is necessary to comply with guidance on the ESQC Regulations.**

19.7 Multiple cable spacing

Minimum allowable spacing between adjacent cables is as shown below:-

| | |
|------------|-------|
| 33kV | 450mm |
| 11kV | 300mm |
| LV main | 250mm |
| LV service | 100mm |

These spacings are the minimum required to allow for future access and jointing works. They do not take into consideration any ratings requirements. The actual minimum spacing requirement may be greater than those given above depending on ratings requirements and the proximity of other cables or sources of heat.

19.8 Joint Bay Dimensions

Minimum required joint bay dimensions are shown below:-

| | Joint bay minimum dimensions (length x width x depth) (mm) | SP EnergyNetworks Drawing Number |
|--|---|-------------------------------------|
| 33k 3 x 1-core straight joints | 2000 x 1100 x 1400 | 00304585 |
| 33kV Other joints (trifurcating transition joint, 1-core breach joint etc) | 3500 x 1400 x 1400 | 00304586 |
| 11kV | 2000 x 1100 x 900 | 00304599 |
| LV | 1200 x 900 x 700 | 00304600 |

19.9 Ducts

All ducts shall be of an approved type and shall comply with the requirements of CAB 03 028 "Specification for ducting for power cables".

Where ducts are specified the minimum internal diameters are as shown below.

| Cable Type | Minimum diameter of duct (mm) |
|------------|-------------------------------|
| 33kV | 150 or 100 |
| 11kV | 100 |
| LV | 100 |

Where single core cables are to be installed in individual ducts the ducts shall be installed in touching trefoil arrangement. In this situation the use of ducts of a larger diameter than necessary should be avoided in order to minimise de-rating of the installed cables due to sheath circulating currents.

After installation of ducts the installer shall:-

- Confirm that they are correctly aligned by pulling through a mandrel of a diameter slightly less than that of the duct.
- Clean them by drawing through a suitable cleaning pig.
- Install a non-perishable draw rope.
- Seal the duct mouths temporarily until they are required for cable installation.

Where additional ducts are to be left empty for future use, they shall be identified by laying polythene marker tape through the duct. In unmade ground the ends of the marker tape shall be brought out above ground level.

Where cables enter a building via ducts the duct entry, both internal and external to the duct wall, shall be sealed against the ingress of gas and moisture by an approved method.

19.10As Laid Records

Where appropriate, as laid records shall be provided in accordance with the requirements of SP EnergyNetworks document BUPR-22-015.