

Electricity Specification 400E5

Issue 7 April 2023

Installation, Commissioning and Repair of Underground Cables Operating at 33kV and 132kV



Amendment Summary

ISSUE NO. DATE	DESCRIPTION
Issue 4 January 2022	New template applied throughout. Document updated to reflect latest version of ENA TS 09-2 Prepared by: P Howell Approved by: Policy Approval Panel and signed on its behalf by Steve Cox, DSO Director
Issue 5 April 2022	Addition of trench section dimension drawings in Appendix B Prepared by: P Howell Approved by: Policy Approval Panel and signed on its behalf by Steve Cox, DSO Director
Issue 6 June 2022	Correction of Header Title in Appendices Addition of example trench section with three cables in one duct for 33kV circuits Prepared by: P Howell Approved by: Policy Approval Panel and signed on its behalf by Steve Cox, DSO Director
Issue 7 April 2023	Addition of Section 6.2 on storage of accessories Addition of Section 6.4 covering joint bays Prepared by: P Howell Approved by: Policy Approval Panel and signed on its behalf by Steve Cox, DSO Director

Contents

1	Foreword	5
2	Scope	5
3	Definitions	5
4	General Requirements for Approvals and Testing	7
	4.1 Introduction	7
	4.2 Third Party Certification	8
	4.3 Installers' Own Codes of Practice to be Available	8
	4.4 As Constructed Records	8
	4.5 Confirmation of Conformance	9
5	Technical Particulars for Installation, Commissioning and Restoration of Excavated Areas.	9
	5.1 General	9
	5.2 Purchaser's Specification	9
	5.3 Design Specification	9
	5.4 Installation Code of Practice	9
6	Technical Particulars for Cable Joints and Terminations	12
	6.1 Specification	12
	6.2 Packaging and Storage	12
	6.3 Installation Procedure	13
	6.4 Joint Bays	13
7	Technical Particulars for Repairs to Cable Systems	14
	7.1 Scope	14
	7.2 General	14
	7.3 Repair Work	14
	7.4 Handover	14
8	Documents Referenced	15
9	Keywords	17
	Appendix A – Specification References	18
	Appendix B – Example Trench Layout Drawings	19
	Appendix C – Conformance Declaration	24

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1 Foreword

This document has been compiled to enable Electricity North West Limited, hereinafter referred to as Electricity North West, to obtain installation and repair services for 33kV and 132kV cables from a variety of sources.

2 Scope

This document specifies the criteria by which the Works described below will be accepted as complete and fit for service on the 33 kV and 132 kV cable systems operated by Electricity North West under the auspices of the Electricity Safety, Quality and Continuity Regulations and other relevant legislation, that is to say:

- All New installed underground cable systems.
- All New installed cable joints or terminations.
- All Newly repaired underground cable systems.
- All Newly reinstated areas.

It is based largely on the requirements of ENA TS 09-02 Issue 6 2016, which should be read in consultation with this Specification. Where there is a difference between the information given in this document (ES400E5) and ENA TS 09-2 Issue 6 2016, the information in this document (ES400E5) shall take precedence.

Note that this specification does not cover commissioning or commissioning tests on cables. (For information on commissioning, refer to CP319.)

3 Definitions

Approval	Sanction by the Electricity North West Circuits Policy Manager that specified criteria have been satisfied
Authorised Agent	Electricity North West's Engineer to Contract and/or authorised delegated representative to act or give decisions on Electricity North West's behalf.
Authorised Person	As defined in the Distribution Safety Rules.
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.
Contractor	The person or person's firm or company, including personal representatives, successors and permitted assigns, who's Tender has been accepted by Electricity North West.
Design, Established	Design Works accepted by Electricity North West.

Design, Unestablished	New design Works not yet accepted by Electricity North West.
Engineer	Electricity North West Circuits Policy Manager or their successor or such person specifically nominated on their behalf.
General Conditions of Contract	This phrase as quoted in ENA TS 09-02 shall be read as: complying with the specific definitions given below, and/or compliance with this Specification, and compliance with Electricity North West's general conditions of Contract, and any Contract-specific conditions.
Good Agricultural Land	Arable land and pastureland which is not permanent.
High Risk	Designated as High Risk in Electricity North West Code of Practice 403 Section 11.
Installer	The person or persons or any company body, corporate or otherwise, carrying out Works for Electricity North West in accordance with this specification.
Manufacturer	The person or persons or any company body corporate or otherwise whose apparatus has been accepted by Electricity North West for incorporation in the Works.
Normal Risk	Designated as Normal Risk in Electricity North West Code of Practice 403 Section 11.
Other Land	Permanent pasture (i.e. land not suitable for ploughing), paths, farm roads, hard standing etc.
Permission	Authority given by an Electricity North West's Authorised Person or Senior Authorised Person as appropriate working in accordance with Electricity North West's Distribution Safety Rules.
Site	The lands and buildings, over, upon, under and in which the work is to take place together with so much of the area surrounding and said land and buildings as the Installer shall with the consent of an Authorised Agent actually use in connection with the Works otherwise than merely for the purpose of access to the said land and buildings.
Solid Cable	A cable with a dielectric of impregnated paper or polymeric compound operating without the assistance of hydraulic or pneumatic pressure.
Specification	The Specifications and schedules (if any) agreed by the parties for the purpose of the Contract.
Street	The whole or any part of the following, irrespective whether they are thoroughfares: <ul style="list-style-type: none"> • Any highway, road, lane, footway, alley or passage. • Any square or court. • Any land laid out as a way whether it is for the time being formed as a way or not.

Sub-Contractor	Any person (other than the Contractor) named in the Contract for any part of the Works or any person to whom any part of the Contract has been sub-let with the consent in writing of the Electricity North West Circuits Policy Manager, and the legal representatives, successors and assigns of such person.
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.
Works	All materials, labour and actions required to be provided or performed by the Contractor under the Contract.

4 General Requirements for Approvals and Testing

4.1 Introduction

The general requirements included in this section are supplementary/additional to those given in ENA TS 09-2 Issue 6 2016, and shall be treated as such, i.e. they are not alternatives.

It is a general requirement that all Works will be carried out strictly in accordance with the provisions of all relevant legislation and standards.

It is a requirement of working for Electricity North West that certain contractors' staff will need to be trained and formally accepted as Authorised Persons in accordance with Electricity North West Code of Practice 605.

All contractors' staff shall abide by the requirements of HS(G)47 for safe excavation techniques.

In order to satisfy regulatory requirements and the expectations of customers, Electricity North West operate the distribution network with a standard of reliability better than 99.9% and is actively seeking to improve on this figure. This is related to assets having anticipated operational lives well in excess of forty years. Whilst no quantitative assessment can be imposed at the time of commissioning which will demonstrate the ability of any new or modified installation to achieve such targets, Installers shall note that the Works will be assessed by Electricity North West Engineers with these qualitative criteria in mind.

All works shall comply with all aspects of the New Roads & Street Works Act, and all associated Codes of Practice and Regulations. In particular, the Signing Lighting & Guarding shall comply with the requirements of the Act. Contractors shall be able to demonstrate their method of complying with the need to monitor excavations to ensure the safety of the public at all times.

The Contractor shall pay all charges for non-compliance with Section 74 of the New Roads & Street Works Act and any other charges relating to street works.

4.2 Third Party Certification

Prior to the commencement of the Works, the Installer shall submit certificates from accredited third parties to Electricity North West that confirms that the Works all conform to the relevant standard and will satisfy the requirements of the Specification. (It is anticipated that Installers not currently accredited under ISO 9000 will avail themselves of this facility when obtaining components, materials and assemblies from companies accredited under ISO 9000.)

A minimum requirement for complying with the above paragraph is that Installers shall have current certificates from Lloyds Register confirming that they are accredited for Cable Installation Work. Such certification will be required whether or not any other accreditation is offered.

All Installer's craftsmen engaged in cable jointing shall be and shall pass a trade test, if applicable, before commencing work on Electricity North West's network.

4.3 Installers' Own Codes of Practice to be Available

Installers shall submit for inspection prior to the commencement of the Works, evidence in Writing which shows that the Works will be carried out having regard to the following particular requirements:

- Code of Practice for safety, health and welfare of the workforce (which shall comply with the Health and Safety at Work Act and the Control of Substances Hazardous to Health Regulations).
- Code of Practice for ensuring the skill and competency of the workforce.
- Code of Practice for quality assurance of work.
- Code of Practice for ensuring safety of workforce working on or in the vicinity of live electrical conductors and requiring absolute compliance with Electricity North West Distribution Safety Rules and Codes of Practice 605 and 606.

4.4 As Constructed Records

Unless otherwise instructed, the Installer shall (during the progress of the Works) record on a set of plans and cross section drawings, such particulars as will allow an accurate record to be made on Electricity North West's mains record. The drawing shall show, amongst other data, the exact position of every cable, cable joint, cable box, earth electrode, and all connections thereto, and particulars of the route and depth of cables installed, the arrangement of existing and new cables and existing and new joints and the position of all major obstructions and any unidentified apparatus revealed during the course of the Works. In addition, the following cable information shall be included:

- Year and month of cable manufacture.
- Batch number (if provided).

It is imperative that all such drawings are completed in detail whilst the installed equipment and other apparatus is still visible, and before blinding and backfilling takes place.

The "As Constructed Records" shall also include a list of other drawings applicable to the Works and, where applicable, the following information:

- Technical description of the cables.
- Schematic diagram of bonding connections.
- Straight line diagram

Unless otherwise agreed prior to the commencement of the Works, these records shall conform to the requirements of Electricity North West Code of Practice 012.

Unless otherwise specified beforehand, all "As Constructed Records" shall be submitted to the designated premises of Electricity North West within forty-eight hours of the Works being installed in all areas of Electricity North West apart from Lakeland, where seventy-two hours shall be allowed. In all cases, the "As Constructed Records" shall be in the possession of Electricity North West prior to the circuit being made live.

4.5 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.

5 Technical Particulars for Installation, Commissioning and Restoration of Excavated Areas.

5.1 General

Refer to ENA TS 09-2 Issue 6 2016, with the exceptions as stated in [Section 2](#) Scope of this document (ES400E5).

All cables installed at any Works shall be of a type and installed in such a manner so that the fault level, rated current and voltage regulation (if specified) and operational life are achievable between the designated nodes on the System.

All Cable Drums shall be stored and handled on site according to CP410 Chapter 4

Apr 23

5.2 Purchaser's Specification

Refer to ENA TS 09-2 Issue 6 2016, Section 5.

(This section comprises the key design parameters.)

5.3 Design Specification

Refer to ENA TS 09-2 Issue 6 2016, Section 6.

(This section comprises the Specification for the Tenderers' proposed designs.)

5.4 Installation Code of Practice

Refer to ENA TS 09-2 Issue 6 2016, Section 7, with the following additions:

- Only cables supplied by an Approved Supplier that are manufactured at an Approved production facility shall be used. See Appendix A for details on cable specifications and approvals.
- Cables shall be installed at the appropriate depth, as indicated in Table 5.4.1
- Inter-circuit separation of cable laid in a common trench shall be as detailed in Table 5.4.2
- Protection and warning devices shall comply with Table 5.4.3
- Jointing and termination procedures shall be in accordance with Section 6
- Cables shall pass the commissioning tests given in CP319.
- Reinstatement materials shall comply with Electricity North West Specification ES400R5.

5.4.1 Table showing 33 kV and 132 kV Cable Minimum Laying Depths

System Voltage	Environment	Minimum Depth ⁽¹⁾ ± Tolerance ⁽²⁾
33kV	Footway/verge ⁽⁴⁾	0.75m -0.0m, + 0.3m
33kV	Carriageway ^{(4) (5)}	0.75m -0.0m, + 0.3m
33kV	Good Agricultural Land ^{(3) (5)}	0.91m -0.0m, + 0.3m
33kV	Other Land ^{(3) (5)}	0.75m -0.0m, + 0.3m
33kV	Railway Land ⁽³⁾	1.25m* -0.0m, + 0.3m
132kV	Footway/Verge ⁽⁴⁾	0.90m -0.0m, + 0.3m
132kV	Carriageway ^{(4) (5)}	0.90m -0.0m, + 0.3m
132kV	Good Agricultural Land ^{(3) (5)}	0.91m -0.0m, + 0.3m
132kV	Other Land ^{(3) (5)}	0.90m -0.0m, + 0.3m
132kV	Railway Land ⁽³⁾	1.25m* -0.0m, + 0.3m

Notes:

* measured from the top of the rail to the top of the cable and also no cable should be closer than 2m measured horizontally to any rail of the track.

(1) Depth to be measured to top of the uppermost cable, joint or duct.

(2) Applies to necessary variations in depth of installation deeper than minimum depth.

(3) Refer to Definitions below.

(4) Minimum cover can be reduced to 600mm minimum using Approved non-coilable, HDPE, high-strength, red, 9.5mm wall thickness ducting (see ES400 D4).

(5) Where, due to other restrictions it is not possible to achieve the minimum specified depth of cover then the installation shall normally be made by installation in Approved non-coilable, HDPE, 9.5mm wall thickness ducting (see ES400 D4).

Definitions:

Agricultural land: Cables in agricultural land shall be installed in accordance with the requirements of the ENA ER G29 and ENA ER G57 and the reasonable requirements of the land owner and/or occupier of the land. Field drains, fences, walls and gates disturbed or dismantled during the progress of the Works will be promptly reinstated).

Other private land: Cables in private land not specifically referred to in any other clause shall be installed having due regard to the use of the land and the reasonable requirements of the owner and /or occupier. Appropriate measures, including the provision of route marker posts, shall be taken to avoid, as far as reasonably practical, the incidence of danger or damage arising from third party activities during the life of the installation. All features of the landscape disturbed or dismantled during the progress of the Works shall be reinstated to the standard specified by the Engineer.

Rail or Tramway Land: Cables in land under the operational control of railway or tramway companies shall be installed in accordance with their reasonable requirements and the recommendations from ENA ER G56.

Verge: A strip of land which may form part of the public highway alongside a carriageway or footway, which may contain services (NJUG Vol 1 Issue 8 Oct 2013).

5.4.2 Table showing Inter-Circuit Separation of Cables Laid in a Common Trench

	Separation to achieve no electrical de-rating	2 Circuits: where separation is < 450mm to touching Impact of de-rating
3 core single core cables ducted	450mm	10%
3 single core cables laid in trefoil, laid direct	450mm	10%
3 single core cables laid flat, laid direct	450mm	10%

Notes:

- (1) Separation is measured between the outer sheaths of the adjacent cables or ducts and not between the centres of the cable.
- (2) Where the specified separation cannot be achieved the impact of de-rating on each circuit will need to be calculated and agreed in advance of any work commencing, by the Engineer.
- (3) Where the specified separation cannot be achieved The Engineer will specify prior to the commencement of work, whether any addition mechanical protection shall be required to be installed in order to prevent inadvertent damage being cause to one circuit if it is required to excavate around the other one.

5.4.3 Table showing Protection and Warning Devices for 33 kV and 132kV buried cables

System	Environment	Device	Specification
33kV	Trenched – Direct Buried	Protection Tape†	Electricity North West ES400TT1
33kV	Trenched – Ducted	Tape†	Electricity North West ES400D4 and Electricity North West ES400TT1
33kV	Trenchless – HDPE Directional Drilled Duct	None	Electricity North West ES400D4.
132kV	Trenched – Direct Buried	Tile†	Electricity North West ES400TT1.
132kV	Trenched – Ducted	Protection Tape†	Electricity North West ES400D4 and Electricity North West ES400TT1.
132kV	Trenchless – HDPE Directional Drilled Duct	None	Electricity North West ES400D4

Notes

† Protective tiles and other means of protection or warning shall be placed in rows longitudinally along the cable(s) a minimum of 100mm above the topmost cable. The placing of the rows shall be such that the edge(s) overlap the underlying cables by at least 50mm.

Refer to Appendix B for example trench sections.

Where deemed necessary by the Engineer consideration may be given to the use of additional protection such as steel plates, extra tiles, steel ducts etc. in areas such as bridges, joint positions, utility crossings etc...

6 Technical Particulars for Cable Joints and Terminations

6.1 Specification

All joints and terminations shall be of an approved type and installed in such a manner so that the designated fault level, rated current and operational life is achievable between the designated nodes on the System.

All joints and terminations shall be fully tested and conform to the requirements of the appropriate standards as described in [Appendix A](#).

6.2 Packaging and Storage

All joints, terminations and ancillary items shall be stored on site in the original manufacturers packaging and in accordance to the recommended storage conditions stated on the packaging and/or in the manufacturers literature.

Any product packaged in cardboard cartons shall be stored in an inside dry secure area. Products packaged in sealed wooden crates shall ideally be stored inside in a dry area if possible, or at the minimum, with a waterproof protective tarpaulin fully covering the crates.

Packaging should be left unopened until immediately prior to commencement of jointing, but if it is necessary to open boxes to check kit contents, then they should be repackaged and fully sealed if they are not going to be used immediately.

Electricity North West reserve the right to reject any product if it is deemed to have been incorrectly stored on site and there is a risk of premature failure due to moisture ingress or other contamination or degradation.

6.3 Installation Procedure

All joints and terminations shall be installed in accordance with the following procedures detailed in following table.

Cable type	Procedure
33kV solid insulation	Electricity North West CP412
33kV gas-assisted	Electricity North West CP414
33kV fluid-assisted	In accordance with manufacturers installation instructions
132kV	In accordance with manufacturers installation instructions

6.4 Joint Bays

The photograph shows an example of a well prepared 33kV joint bay.

Joint bays shall be constructed to ensure there is adequate working room to install the joints, including the length required to park tubes or joint bodies along the cable during preparation. A typical joint bay for 33kV cables can be estimated at 4metres x 2metres, but the overall length may have to be extended up to 5metres depending on cable size and the joint(s) to be used.

Where specified, joint bays shall have close board timbered shuttering and suitable hard standing shall be provided by use of concrete flag stones/concrete base or composite grid bases, all laid level and flat with no trip hazards to the entire joint bay area.

Where water persists to enter the working area, a sump hole shall be dug in the lowest corner to enable the water to be bailed or pumped out at intervals.

If a canopy is specified, this shall be constructed to provide adequate protection for operatives working in the joint bay and be capable of withstanding wind loads and other climatic conditions typically expected in the North West of England. The canopy shall have a waterproof sheet securely tied to a suitable tubular frame scaffold fixed rigidly to the joint bay sides.

A suitable means of access and egress shall be provided.



All 33kV joints laid at a depth of 750mm shall be totally encapsulated by resin. Any 33kV joints laid at a depth of minimum 900mm, or within a secure Electricity North West compound (e.g. substation site) may use a reinforced heat shrink wraparound sleeves for outer protection in place of the standard resin encapsulation.

All cables to be jointed shall be positioned substantially straight and level, and adequately supported from the floor of the joint bay to support the weight of the joint

7 Technical Particulars for Repairs to Cable Systems

7.1 Scope

This section refers to the repair of Electricity North West cable systems operating at voltages of 33kV and 132kV, whether placed underground, in air or in ducts.
(Repairs are not covered in ENA TS 09-2 Issue 6 2016.)

7.2 General

All repairs shall be of a type and installed in such a manner so that the designated fault level, current rating and operational life is achievable between the designated nodes on the System.

- All repairs shall be carried out in such a way as to satisfy the requirements of Sections 1 to 6 of this Specification.
- All repairs shall be carried out having regard to the operational procedures and other requirements of Electricity North West Code of Practice 606, Sections B and G, with the exception that references to Electricity North West Code of Practice 412 shall be deemed to include the Specification for joints and terminations approved under Section 6 of this Specification.
- Refer to CP416 for repairs to Gas filled cable systems.

7.3 Repair Work

On receipt of Permission from Electricity North West's Senior Authorised Person to commence work, a Permit To Work shall be received, the cable in question shall be exposed at the point specified, then restored to operational condition in accordance with methods and requirements of [Sections 5 & 6](#) of this Specification.

7.4 Handover

On completion of the work, the Working Party shall be withdrawn from the working area, the Electricity North West's Senior Authorised Person shall be informed immediately, and the Permit to Work shall be cancelled by the Electricity North West's Senior Authorised Person.

8 Documents Referenced

All references to documents listed below are to the latest versions, unless stated otherwise.

DOCUMENTS REFERENCED	
Health and Safety at Work Etc Act.	
The Electricity Safety, Quality and Continuity Regulations	
Control of Substances Hazardous to Health Regulations 2002	
New Roads and Streetworks Act (including Codes of Practice and Specifications)	
Electricity North West Distribution Safety Rules.	
NJUG Volume 1 issue 8:	Recommended Positioning of Utilities' Mains and Plant for New Works.
ENA TS 09-2: Issue 6 2016:	Specification for the supply, delivery & installation of power cables with operating voltages in the range 11 kV to 400 kV and associated auxiliary cables
BS EN ISO 9000:	Quality management systems.
HS(G)47:	Health & Safety Executive Guidance Document: Avoiding Danger from Underground Services
ENA TS 12-24:	Plastic Ducts for Buried Electric Cables.
ENA TS 12-23 2013:	Code of Practice on the marking of High Voltage Cable Routes.
ENA ER G29 1997:	Farm Hygiene: Precautions to prevent spread of Poultry and Animal Disease

ENA ER G56: 2013:	Arrangements for Access by ENA Members to Network Rail Infrastructure
ENA ER C97 1997	Polyethylene Warning Tape, Polyethylene Protection Tape and Polyethylene Protection Tiles for Buried Electricity Supply cable.
CP319:	Applied High Voltage Tests.
CP402:	New Roads and Street Works Act
CP404:	Standard Mains Records.
CP410:	Underground Cable Systems.
CP410	Mains Practice up to and Including 132kV Underground Cable Systems
CP412	Jointing Procedures for 33kV Solid Cables.
CP414:	Jointing Procedures for 33kV Gas-Filled Cables.
CP416:	Underground Gas-Filled Cable Systems Operational and Maintenance
CP605:	System Operations.
CP606:	Operations Manual
ES400C10:	33 kV Distribution Cables
ES400C14:	132 kV Cables with Extruded XLPE Insulation
ES400CS132:	Cable Systems, Including Joints, Terminations, Associated Sealants and Components for use on 132kV Underground Networks (Um = 145kV)
ES400D4:	Plastic Ducts, Conduit & Accessories

ES400J33:	Joints Terminations Associated Sealants and Components for use on 33kV Underground Networks Um = 36kV
ES400R5:	Specification of Reinstatement Materials.
ES400TT1:	Polyethylene Warning Tape, Protection Tape and Protection Tiles for Underground Cables

9 Keywords

The following keywords (listed in alphabetical order) and keyword combinations appear in this document:

33kV; 132kV; Cable; Underground

Appendix A – Specification References

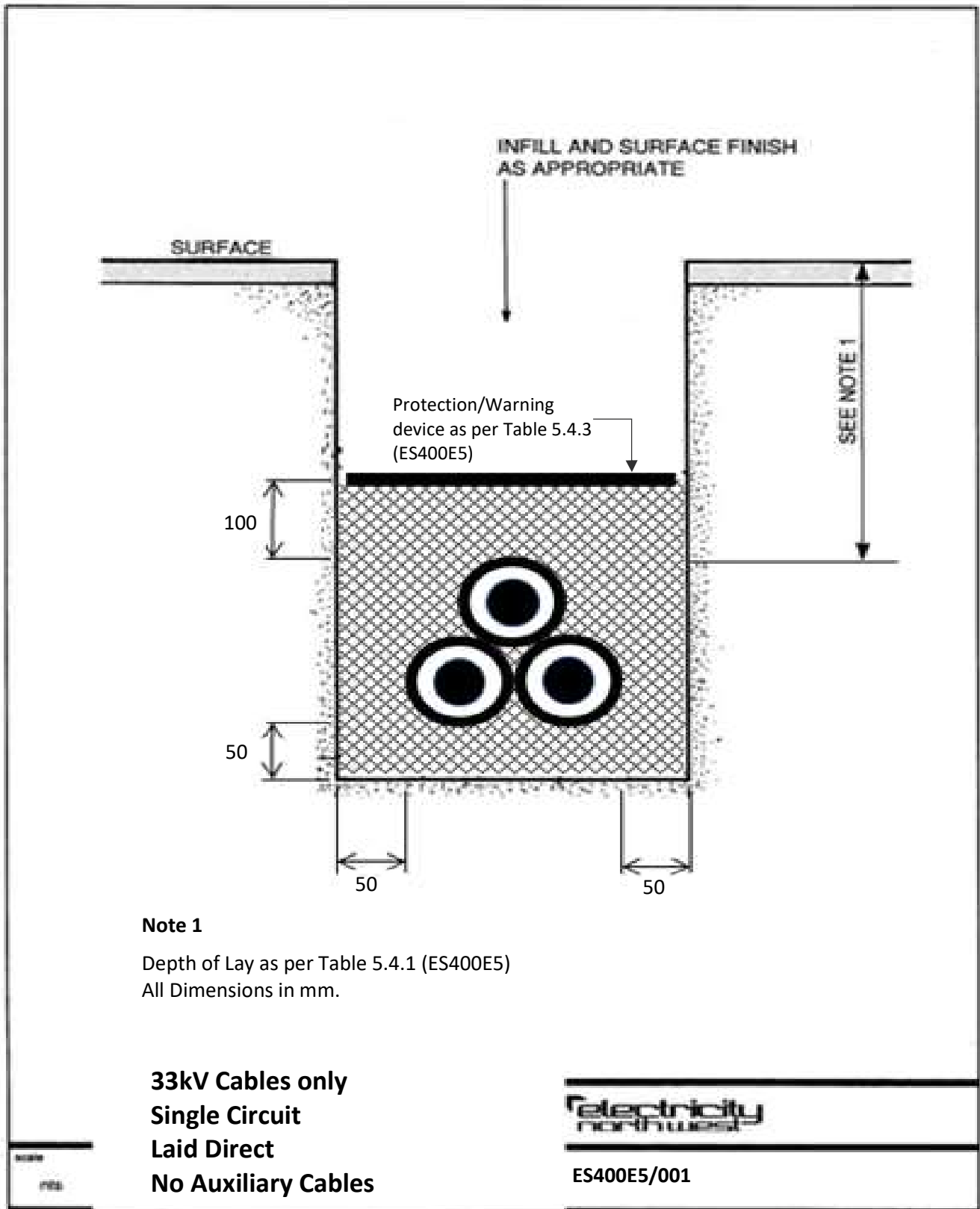
A1: Cables Specifications and Approved Suppliers

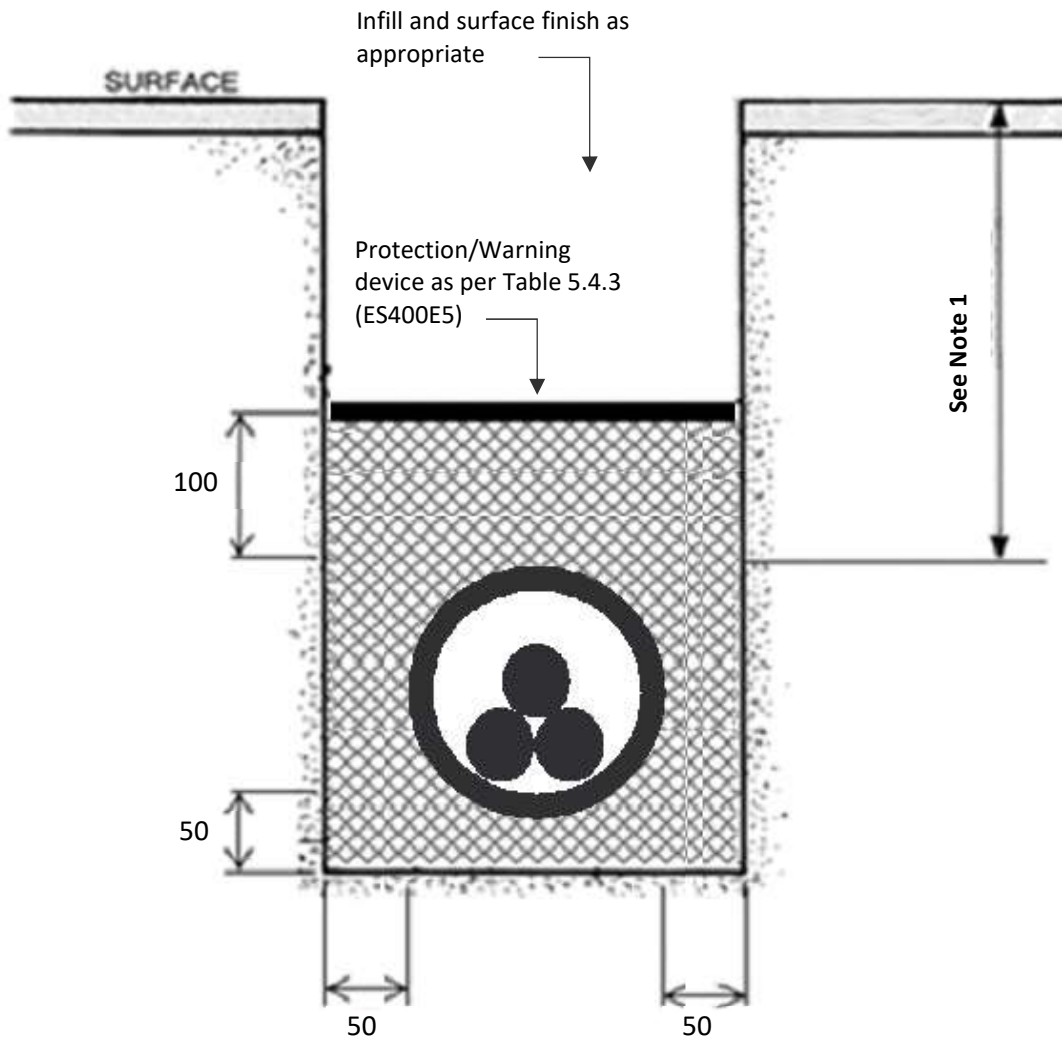
CABLE TYPE	ELECTRICITY NORTH WEST DOCUMENT REF
33kV Cables:	Electricity North West ES400C10 and CP410, Chapter 2
132kV Cables	Electricity North West ES400C14 and CP410, Chapter 2

A2: Cable Accessories Specifications

CABLE TYPE	ELECTRICITY NORTH WEST DOCUMENT REF
33kV Cables Accessories	Electricity North West ES400J33
132kV Cable Systems	Electricity North West ES400CS132

Appendix B – Example Trench Layout Drawings

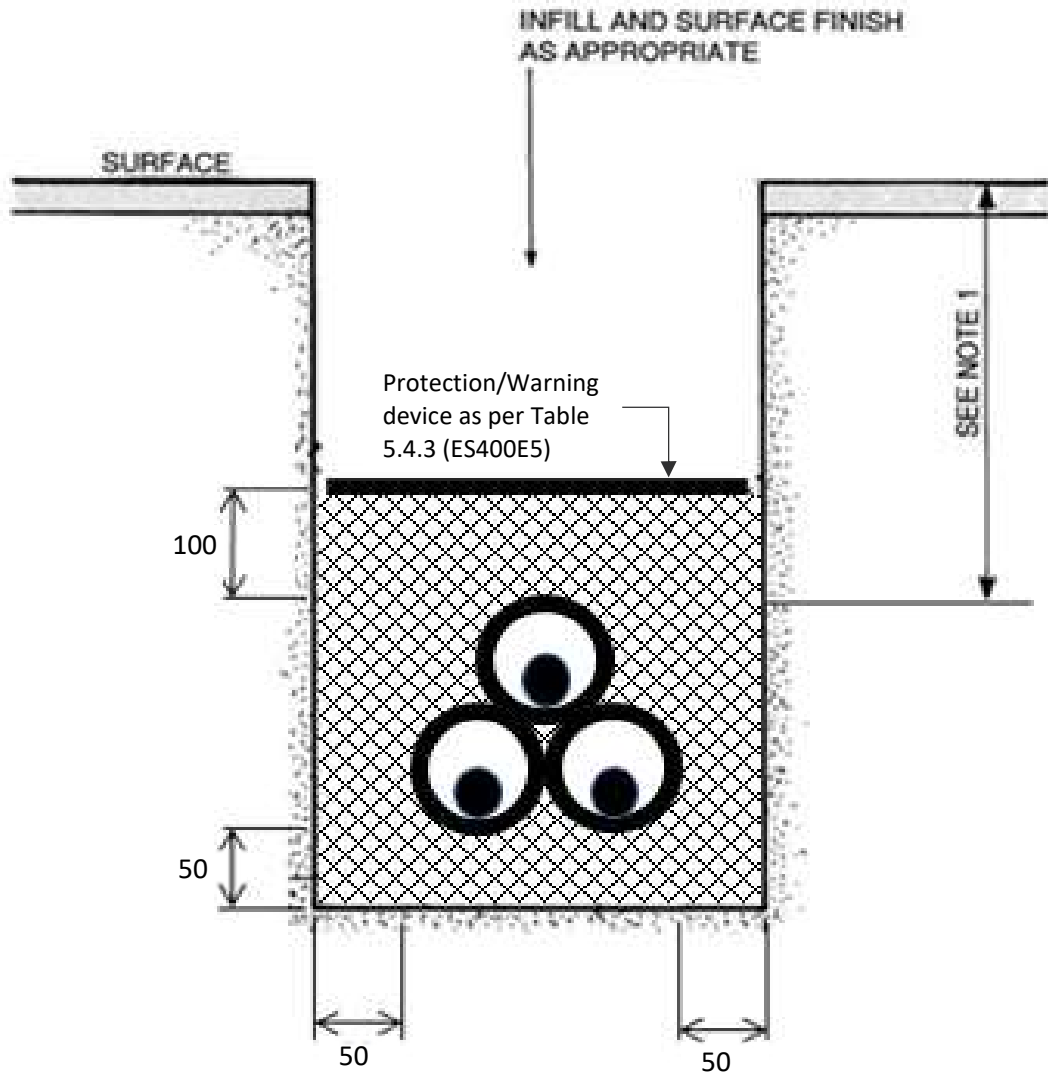




Note 1

Depth of Lay as per Table 5.4.1 (ES400E5)
All Dimensions in mm.

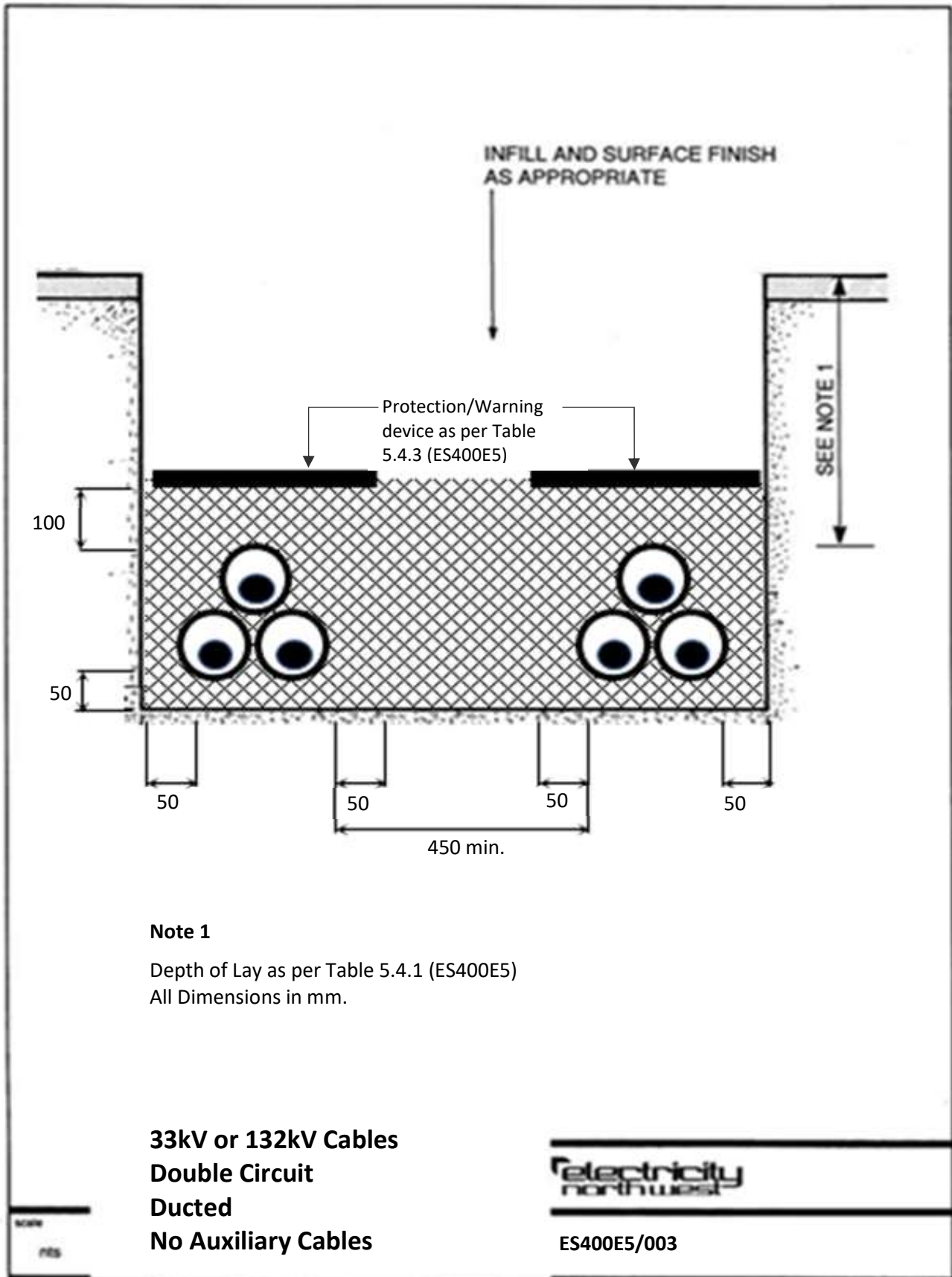
33kV Cables only
Single Circuit
Single Ducted
No Auxiliary Cables

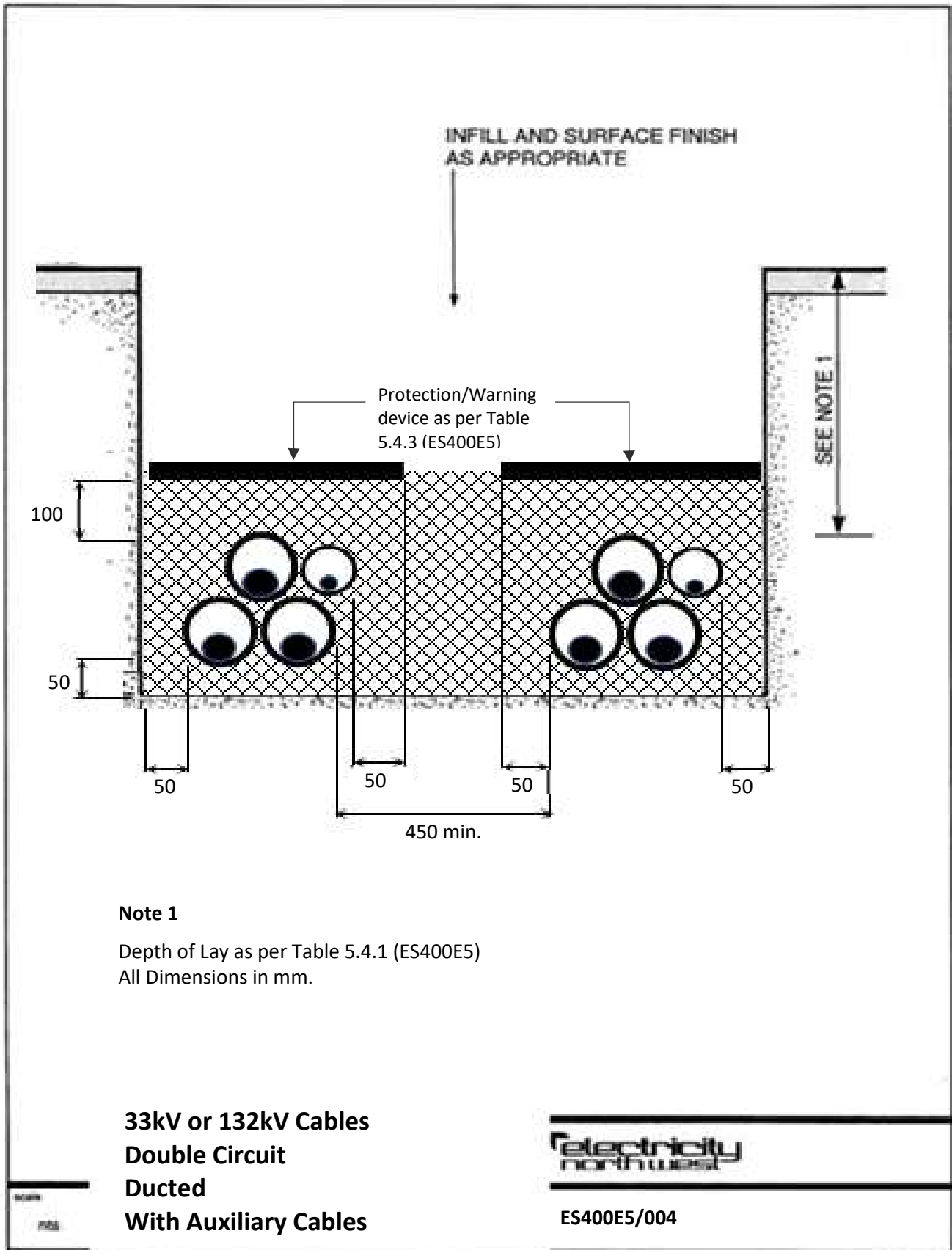


Note 1

Depth of Lay as per Table 5.4.1 (ES400E5)
All Dimensions in mm.

33kV or 132kV Cables
Single Circuit
Ducted
No Auxiliary Cables





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:

SECTION-BY-SECTION CONFORMANCE

Section	Section Topic	Conformance Declaration Code	Remarks * (must be completed if code is not C1)
4.1	General		
4.2	Third Party Certification		
4.3	Installers' own Codes of Practice to be available		
4.4	As Constructed Records		
4.5	Confirmation of Conformance		
5.1	General		
5.2	Purchasers Specification		
5.3	Design Specification		
5.4	Installation Code of Practice		
6.1	Specification		
6.2	Storage		
6.3	Installation Procedure		
6.4	Joint Bays		
7.1	Scope		
7.2	General		
7.3	Repair work		
7.4	Handover		

* Applicable specifications shall be stated in the Remarks column where alternatives are quoted within a section. The Remarks column shall also be used to indicate cases where the products or services exceed the quoted specifications.