

Document Reference:-	NSP/002/006	Document Type:-	Code of Practice			
Version:-	2.0	Date of Issue:-	March 2024	Page	1	of 12

NSP/002/006 – Guidance on Engineering Difficulty Trench Layouts

1. Purpose

The purpose of this document is to specify and give guidance on Northern Powergrid (the 'Company') requirements for; cable locations in trench layouts in the mass of earth for underground cable installations, when negotiating an engineering or environmental difficulty (the 'Difficulty').

This guidance communicates the options available, and the design process that must be followed, when it has been reasonably justified by the 'Installer' and agreed by the Company's Project Manager, that a Difficulty forces a deviation from normal Company policy.

The baseline installation requirements must be sought from the following key policy documents:

- ESQCR 'The Electricity Safety, Quality and Continuity Regulations'
- NSP/002 'Policy for the Installation of Distribution Power Cables'
- NSP/002/001 'Guidance Documents for the Installation of Fibre Optic Underground Cables'
- NSP/002/005 'Code of Practice for Cable Locations in Trench Layouts'

This document supersedes the following documents, all copies of which should be destroyed;

Document Reference	Document Title	Version	Published Date
NSP/002/006	Guidance on Engineering Difficulty Trench Layouts	1.0	Sept 2017

2. Scope

This document covers the functional layout, depth and position of an underground cable installation relative to the Difficulty and additional mitigation protection measures.

This document is only applicable when the requirements of NSP/002, NSP/002/001 or NSP/002/005 cannot be achieved, in relation to the formation and positioning of an underground cable installation.

This document applies to Company staff, their contractors and others (the 'Installer'), installing cable circuits (at voltage levels LV up to and including 132kV and their associated auxiliary circuits) on behalf of or to be adopted by the Company, for connection to the Company's network.

Deviation from normal Company policy (as listed above) and subsequent application of this document must be pre-approved by an appropriate member of the Company prior to site works. This will normally be a Company Project Manager or in some cases a Company Policy & Standards Engineer.

This document is designed to supplement and not replace or supersede any existing Company design, approval or quality assurance policies and procedures. Individual departments within the Company may continue to apply their existing suitable processes to ensure Difficulties are suitably identified and appropriate solutions are designed and delivered as agreed.

The Company reserves the right to refuse to connect or adopt a section of cable when it is deemed by an appropriate Company representative that a suitable procedure has not been followed, and therefore the final installation has not been deemed as approved.

Document Reference:- NSP/002/006		Document Type:- Code of Practice	
Version:- 2.0	Date of Issue:- March 2024	Page 2	of 12

2.1. Table of Contents

1. Purpose	1
2. Scope	1
2.1. Table of Contents	2
3. Requirements	3
3.1. Applications	3
3.2. Protection Requirements	4
3.3. Approval Process.....	6
4. References	7
4.1. External Documentation	7
4.2. Internal Documentation.....	7
4.3. Amendments from Previous Version	7
5. Definitions	7
6. Authority for Issue	8
6.1. CDS Assurance.....	8
6.2. Author	8
6.3. Technical Assurance.....	8
6.4. Authorisation	8
Appendix 1 – Application of Protection Table (LV)	9
Appendix 2 – Application of Protection Table (11 & 20kV)	10
Appendix 3 – Application of Protection Table (33 & 66kV)	11
Appendix 4 – Application of Protection Table (132kV)	12

Document Reference:- NSP/002/006		Document Type:- Code of Practice	
Version:- 2.0	Date of Issue:- March 2024	Page 3	of 12

3. Requirements

Difficulties can force a cable installation to deviate from standard Company policy in such a way that it increases the risk of damage or interference, intentional or otherwise potentially leading to injury to humans and animals. This could increase the risk of failure of an asset ultimately resulting in the loss of supplies to customers and the subsequent time and cost implications of repairing the damage.

Engineering difficulties may include; utility assets (cables, pipes, joints etc.), surface structures (bridges etc.), underground structures (tunnels, chambers etc.) watercourses, railway lines, trunk roads. Environmental [physical, social and natural] difficulties may include for example; ecological restrictions, contaminated land, emergency services requirements, council restrictions etc. The type of difficulty will determine the appropriate action however it must be stressed that; a Difficulty that can be reasonably and practicably mitigated prior to asset installation, shall be mitigated.

In order to reduce this risk, the following principles of Health & Safety Hierarchy of Control must be applied; Eliminate, Reduce, Isolate, Control and Protect.

The guidance is split into three key parts:

1. Applications: when to apply a particular trench layout, in a specified order of priority.
2. Protection Requirements: defining the level of protection required for varying depths.
3. Approval Process: approval process for application of trench layouts.

3.1. Applications

The following shall be considered when identifying the best method to negotiate an engineering difficulty (in order of priority):

1. Install around the difficulty (use an alternative cable route)
2. Remove/divert the difficulty
3. Split a multi-circuit trench (where trench width is the issue)
4. Install underneath the difficulty
5. Install above the difficulty and adjust the finished ground levels
6. Install above the difficulty with reduced cover

The following shall be considered when determining a suitable trench layout design for negotiating an engineering difficulty (in order of priority):

1. Standard depth (trefoil formation)
2. Standard depth (flat formation)
3. Standard depth (trefoil formation using smaller ducts)
4. Standard depth (flat formation using smaller ducts)
5. Deep (trefoil formation)
6. Deep (flat formation)
7. Deep (trenchless e.g., HDD or cable tunnel)
8. Shallow (trefoil formation)
9. Shallow (flat formation)

Document Reference:-	NSP/002/006	Document Type:-	Code of Practice			
Version:-	2.0	Date of Issue:-	March 2024	Page	4	of 12

'Standard depth' varies by voltage level and is defined as the depths specified in *NSP/002 Section 3.2.6 'Depths of Cables'*. 'Smaller ducts' refers to the use of smaller-than-standard ducts as specified in *NSP/002 Section 3.2.10 'Installation Medium and Positioning of Cables'*. The impact of the use of smaller ducts on an entire section of installation must be considered, in terms of increased cable pulling tensions and risk of damage to the outer-sheath (during installation). There should not normally be any gaps in a fully-ducted system; therefore the use of transition collars may be required, unless an entire section (between two joints) is replaced with a smaller duct size.

Duct 'formation' is only applicable when installing single cored cables in separate ducts, i.e., generally at 33, 66 and 132kV. See *NSP/002/005* for further guidance.

As described in Section 3.3 'Approval Process', the general order of priority must be followed when determining which trench layout to apply.

The as-built details of all installations, but more importantly non-standard installations covered in this guidance document, shall be suitably recorded on the appropriate Company asset information systems. Details of any installations on private land/assets must also be provided to the owner, such that they themselves are fully aware of the installation and can also provide the as-built information to any third parties that may wish to conduct works on the private land/asset.

3.2. Protection Requirements

3.2.1. Principles of Protection

The principles of protection employed in this guidance document are designed to provide an appropriate level of security to the cables and apparatus in order to protect them from both intentional and accidental interference/damage, thereby preventing property damage, system outages and most importantly injury to humans and animals. Administrative, visual and mechanical protection methods can be combined to achieve a suitable level of protection. Relying upon the electrical system monitoring and protection systems (i.e. protection relays and circuit breakers) is not acceptable.

Administrative measures include the use of both internal and external asset information systems that can be referred to by any persons planning excavation activities in the vicinity of the asset. This would normally include safe-dig plans, as-built drawings and structure designs which could be provided by the Company or an asset owner, but may also include verbal advice, licenses or watching briefs.

Visual measures include the use of marker blocks, marker posts (with labels) and standalone plates/labels which provide immediate on-site visual confirmation of the presence of an asset prior to the commencement of any works. This type of measure does not rely on a person applying for asset information from the relevant party which will typically be the case with most utility emergency repair works.

Mechanical protection measures provide a final level of protection against persons who have failed to identify the presence of the asset, not taken suitable steps to protect the known asset or from intentional attempted damage or theft, in line with the requirements of *HSG47 'Avoiding danger from underground services'*.

3.2.2. Protection Requirements

The requirements for protection are detailed in Appendix 1, Appendix 2, Appendix 3 and Appendix 4 in association with the following application notes:

1. 'Public land' covers all areas where a statutory undertaker could access without additional rights or permissions (other than council opening notices).
2. 'Private land' covers all areas where additional permission from a land owner would be required before entry.
3. 'Within bridges and structures' does not cover installations clipped/hung from the sides/bottom of a structure.

Document Reference:-	NSP/002/006	Document Type:-	Code of Practice			
Version:-	2.0	Date of Issue:-	March 2024	Page	5	of 12

4. Installations in arable land are not covered by this guidance and must be installed at standard depth as per *NSP/002*.
5. All installations not conforming to the Company standard are to be discussed and agreed with the appropriate Company Engineer or Project Manager.
6. All installations not conforming to standard are to be suitably recorded and then annotated on the applicable asset register(s), for example cross sections and depth markers on the Company asset recording system.
7. Auxiliary ducts shall follow the same protection methodology as the associated power circuits.
8. All steel plates shall be $\geq 5\text{mm}$ thick, positioned 75mm above the crown of the uppermost duct and be suitable for continuous installation in the ground for a minimum of 40 years.
9. Plastic tiles to be installed 75mm above the crown of the uppermost duct or immediately on top of steel plates (if present).
10. All plastic tiles and steel plates shall be suitably overlapped to provide full cover of the trench (with no gaps), overlapping all ducts on both sides by $\geq 50\text{mm}$.
11. A $\geq 75\text{mm}$ layer of duct surround material shall be installed above and below the ducts, and a $\geq 50\text{mm}$ layer between the ducts and trench sides. In some cases, the bedding layer of sand may be reduced to increase the depth of cover, however when laying cables direct a smooth surface must still be provided.
12. Marker blocks shall be placed at the ends of all trenchless duct runs (i.e., HDD's), particularly where they have been installed in advance of other works.
13. Where required, marker posts shall be placed at appropriate positions along the route (for example at the boundaries of land). Where posts are not suitable (e.g., bridges), marker labels or blocks can be installed.
14. Soil (specifically stone free soil), Sand (specifically Selected Sand), CBS (Cement Bound Sand) and Limestone Dust are cable/duct surround materials as specified in *NSP/002 Section 3.2.12 'Cable Trenches'*. Soil, Sand and Limestone Dust are acceptable for use at LV, 11kV & 20kV. Sand and CBS are acceptable for use at 33kV, 66kV and 132kV. Technical specifications for Selected Sand and CBS can be found in *ENA TS 97-1 'Special backfill material for cable installations'*.
15. Technical specifications for protection items stated above can be found in; *NPS/002/003 'Technical Specification for Protective Tile, Protective Tape and Cable Ducting'* and *NPS/001/011 'Technical Specification for Notice Plates and Signs'*.
16. In addition to the labels currently listed in *NPS/001/011*, there are also two labels available for underground cables; *C1058914 'UNDERGROUND ELECTRICITY CABLE WARNING NOTICE, NORTHERN AREA'* and *C1058915 'UNDERGROUND ELECTRICITY CABLE WARNING NOTICE, YORKSHIRE AREA'*.
17. All items within each appropriate cell within the table must be implemented, unless otherwise agreed with the Company Project Manager. A 'forward slash' within the table denotes an option, for example "Sand/CBS Surround" denotes that Sand or CBS may be used as a cable/duct surround material.

Document Reference:-		NSP/002/006	Document Type:-		Code of Practice			
Version:-	2.0	Date of Issue:-	March 2024	Page	6	of	12	

3.3. Approval Process

3.3.1. Approval In Principle

Approval must be sought from the Company for every application of trench layout outside of standard depth. This will require reasoning and justification, particularly if the only available option is for a shallow installation.

The following must not normally be considered as reasonable justifications for ruling out a potential installation method; difficulty, effort, financial cost, time cost.

All approvals from the Company shall always be in writing.

3.3.2. Basic Process

As discussed in Section 2 **Error! Reference source not found.**, the relevant Company department must follow a suitable process for the identification, design, installation and quality assurance for a Difficulty installation.

The onus is on the Installer to identify and provide a solution to a Difficulty; however, any Company employee may also identify a Difficulty (such as a Delivery Engineer) and initiate the process.

The existing process shall include the following items (following the technical guidance of this document):

1. Installer to identify a Difficulty on their planned cable route, prior to installation.
2. Installer to provide the details of the difficulty to the Company and why it is unavoidable.
3. Installer to propose a suitable design solution to mitigate or negotiate the Difficulty, along with all reasonable justifications, by:
 - a. Identifying a suitable trench layout as per Section 3.1
 - b. Applying protection as per Appendix 1, Appendix 2, Appendix 3 and Appendix 4.
4. The Company representative shall review the Installers proposal and may:
 - a. Approve the proposal
 - b. Request additional information, investigations or options.
 - c. Propose alternatives
 - d. Reject the proposal
5. Site works shall be completed in line with all Company agreements and approvals.
6. Any Installation that deviates from the agreed proposal shall be retrospectively submitted for re-approval.

Document Reference:-	NSP/002/006	Document Type:-	Code of Practice			
Version:-	2.0	Date of Issue:-	March 2024	Page	7	of 12

4. References

4.1. External Documentation

Reference	Title
ENA TS 09-2	Specification for the supply, delivery & installation of power cables with operating voltages in the range 33kV to 400kV and associated auxiliary cables.
ENA TS 97-1	Special backfill material for cable installations
ESQCR	The Electricity Safety, Quality and Continuity Regulations 2002
HSG47	Avoiding danger from underground services

4.2. Internal Documentation

Reference	Title
NPS/001/011	Technical Specification for Notice Plates and Signs
NPS/002/003	Technical Specification for Protection Tile, Protection Tape, Cable Ducting and Route Markers
NSP/002	Policy for the Installation of Distribution Power Cables
NSP/002/001	Guidance Document for the Installation of Fibre Optic Underground Cables
NSP/002/005	Code of Practice for Cable Locations in Trench Layouts

4.3. Amendments from Previous Version

Reference	Description
Appendix 1 & 2	Limestone Dust removed

5. Definitions

Term	Definition
Company	Northern Powergrid
Difficulty	An engineering or environmental issue or obstacle that could result in deviation from normal Company policy.
Installer	An organisation that is physically installing the underground cable.

Document Reference:-	NSP/002/006	Document Type:-	Code of Practice			
Version:-	2.0	Date of Issue:-	March 2024	Page	8	of 12

6. Authority for Issue

6.1. CDS Assurance

I sign to confirm that I have completed and checked this document and I am satisfied with its content and submit it for approval and authorisation.

		Date
Liz Beat	Governance Administrator	06/03/2024

6.2. Author

I sign to confirm that I have completed and checked this document and I am satisfied with its content and submit it for approval and authorisation.

Review Period - This document should be reviewed within the following time period;

Standard CDS review of 3 years?	Non-Standard Review Period & Reason	
Yes	Period: n/a	Reason: n/a
Should this document be displayed on the Northern Powergrid external website?		Yes
		Date
David Johnson	Specification and Design Engineer	25/03/2024

6.3. Technical Assurance

I sign to confirm that I am satisfied with all aspects of the content and preparation of this document and submit it for approval and authorisation.

		Date
Paul Hanrahan	Policy and Standards Engineer	14/03/2024
Aaron Chung	Policy and Standards Engineer	12/03/2024

6.4. Authorisation

Authorisation is granted for publication of this document.

		Date
David Sillito	Head of Major Projects	21/03/2024

Document Reference:-		NSP/002/006	Document Type:-		Code of Practice			
Version:-	2.0	Date of Issue:-	March 2024	Page	9	of	12	

Appendix 1 – Application of Protection Table (LV)

Depth (D)	On Public land	On Private land	Within Bridges, Structures & Company Substations
450 ≤ D (trenchless)	Marker blocks/posts/plates Bentonite surround SDR-11 PE Ducts	Marker blocks/posts/plates Bentonite surround SDR-11 PE Ducts	N/A
450 ≤ D	Plastic Marker Tile Tape Soil/Sand Surround Standard Ducts	Marker posts/plates Plastic Marker Tile Tape Soil/Sand Surround Standard Ducts	Marker posts/plates Plastic Marker Tile Tape Sand/CBS Surround Standard Ducts
200 ≤ D < 450	Plastic Marker Tile Tape Steel Plates Sand/CBS Surround Standard Ducts	Marker posts/plates Plastic Marker Tile Tape Steel Plates Sand/CBS Surround Standard Ducts	Marker posts/plates Plastic Marker Tile Tape Steel Plates Sand/CBS Surround Standard Ducts
D < 200	Not Allowed	Not Allowed	Not Allowed

Depth (D) is between the finished ground level and the crown of uppermost duct, measured in mm.

Document Reference:-		NSP/002/006	Document Type:-		Code of Practice			
Version:-	2.0	Date of Issue:-	March 2024	Page	10	of	12	

Appendix 2 – Application of Protection Table (11 & 20kV)

Depth (D)	On Public land	On Private land	Within Bridges, Structures & Company Substations
$600 \leq D$ (trenchless)	Marker blocks/posts/plates Bentonite surround SDR-11 PE Ducts	Marker blocks/posts/plates Bentonite surround SDR-11 PE Ducts	N/A
$600 \leq D$	Plastic Marker Tile Tape Sand/CBS Surround Standard Ducts	Marker posts/plates Plastic Marker Tile Tape Sand/CBS Surround Standard Ducts	Marker posts/plates Plastic Marker Tile Tape Sand/CBS Surround Standard Ducts
$450 \leq D < 600$	Plastic Marker Tile Tape Steel Plates Sand/CBS Surround Standard Ducts	Marker posts/plates Plastic Marker Tile Tape Steel Plates Sand/CBS Surround Standard Ducts	Marker posts/plates Plastic Marker Tile Tape Steel Plates Sand/CBS Surround Standard Ducts
$200 \leq D < 450$	Not Allowed	Not Allowed	Marker posts/plates Plastic Marker Tile Tape Steel Plates CBS/Concrete Surround Standard/SDR-11 PE Ducts
$D < 200$	Not Allowed	Not Allowed	Not Allowed

Depth (D) is between the finished ground level and the crown of uppermost duct, measured in mm.

Document Reference:-		NSP/002/006	Document Type:-		Code of Practice			
Version:-	2.0	Date of Issue:-	March 2024	Page	11	of	12	

Appendix 3 – Application of Protection Table (33 & 66kV)

Depth (D)	On Public land	On Private land	Within Bridges, Structures & Company Substations
$750 \leq D$ (trenchless)	Marker blocks/posts/plates Bentonite surround SDR-11 PE Ducts	Marker blocks/posts/plates Bentonite surround SDR-11 PE Ducts	N/A
$750 \leq D$	Plastic Marker Tile Boards Sand/CBS Surround Standard Ducts	Marker posts/plates Plastic Marker Tile Boards Sand/CBS Surround Standard Ducts	Marker posts/plates Plastic Marker Tile Boards Sand/CBS Surround Standard Ducts
$600 \leq D < 750$	Plastic Marker Tile Boards (crossed) Plastic Marker Tile Boards Sand/CBS Surround Standard Ducts	Marker posts/plates Plastic Marker Tile Boards (crossed) Plastic Marker Tile Boards Sand/CBS Surround Standard Ducts	Marker posts/plates Plastic Marker Tile Boards (crossed) Plastic Marker Tile Boards Sand/CBS Surround Standard Ducts
$450 \leq D < 600$	Plastic Marker Tile Boards Steel Plates Sand/CBS Surround Standard Ducts	Marker posts/plates Plastic Marker Tile Boards Steel Plates Sand/CBS Surround Standard Ducts	Marker posts/plates Plastic Marker Tile Boards Steel Plates Sand/CBS Surround Standard Ducts
$200 \leq D < 450$	Not Allowed	Not Allowed	Marker posts/plates Plastic Marker Tile Boards Steel Plates CBS/Concrete Surround Standard/SDR-11 PE Ducts
$D < 200$	Not Allowed	Not Allowed	Not Allowed

Depth (D) is between the finished ground level and the crown of uppermost duct, measured in mm.

Document Reference:-		NSP/002/006	Document Type:-		Code of Practice			
Version:-	2.0	Date of Issue:-	March 2024	Page	12	of	12	

Appendix 4 – Application of Protection Table (132kV)

Depth (D)	On Public land	On Private land	Within Bridges, Structures & Company Substations
$900 \leq D$ (trenchless)	Marker blocks/posts/plates Bentonite surround SDR-11 PE Ducts	Marker blocks/posts/plates Bentonite surround SDR-11 PE Ducts	N/A
$900 \leq D$	Plastic Marker Tile Boards Sand/CBS Surround Standard Ducts	Marker posts/plates Plastic Marker Tile Boards Sand/CBS Surround Standard Ducts	Marker posts/plates Plastic Marker Tile Boards Sand/CBS Surround Standard Ducts
$750 \leq D < 900$	Plastic Marker Tile Boards (crossed) Plastic Marker Tile Boards Sand/CBS Surround Standard Ducts	Marker posts/plates Plastic Marker Tile Boards (crossed) Plastic Marker Tile Boards Sand/CBS Surround Standard Ducts	Marker posts/plates Plastic Marker Tile Boards (crossed) Plastic Marker Tile Boards Sand/CBS Surround Standard Ducts
$450 \leq D < 750$	Plastic Marker Tile Boards Steel Plates Sand/CBS Surround Standard Ducts	Marker posts/plates Plastic Marker Tile Boards Steel Plates Sand/CBS Surround Standard Ducts	Marker posts/plates Plastic Marker Tile Boards Steel Plates Sand/CBS Surround Standard Ducts
$200 \leq D < 450$	Not Allowed	Not Allowed	Marker posts/plates Plastic Marker Tile Boards Steel Plates CBS/Concrete Surround Standard/SDR-11 PE Ducts
$D < 200$	Not Allowed	Not Allowed	Not Allowed

Depth (D) is between the finished ground level and the crown of uppermost duct, measured in mm.