Cable Installation Depth

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SCOTLAND TO ENGLAND GREEN LINK 2) COMPULSORY PURCHASE ORDER 2023

STATEMENT OF EVIDENCE

Dave Rogerson
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1. QUALIFICATIONS AND EXPERIENCE

1.0 My name is Dave Rogerson and I am a Lead Transmission Engineer with National Grid Electricity Transmission Plc (NGET), specialising in Over Head Lines (OHL) and High Voltage (HV) Cable Technology. I have a Degree in Electrical Engineering combined with Power Engineering and Communications.

1.1 I have eighteen years design experience with twelve years in my role with NGET where I am authorised to National Grids Business Procedure 141 for both OHL and Cable design assurance which is an assessed industry recognised authorisation currently only 5 people in the country hold for cables.

1.2 In my role I am responsible for ensuring that:

1.2.0 NGET discharge its legal obligations concerning health, safety and environmental requirements;

1.2.1 design is undertaken in accordance with NGET technical policy specifications and applicable supporting documents;

1.2.2 ensuring that a holistic design is integrated through all technical disciplines and is effectively specified, managed and optimised;

1.2.3 those undertaking the design from the Principal Contractor organisation have the minimum skill sets in accordance with the National Grids standards;

1.2.4 that the design is undertaken with a demonstrable level of technical governance; and

1.2.5 that the design appropriately balances technical compliance, cost and operational risk.

1.3 At present I am working on approximately 100 transmission asset projects across the NGET portfolio, across both OHL and HV cable projects.

1.4 I have been working on the Scotland to England Green Link 2 (SEGL2) project (the **Project)** since 2019 as cable design assurance engineer.

2. INTRODUCTION AND SCOPE OF EVIDENCE

2.0 The purpose of my evidence is to explain the engineering design around the cable installation depth as part of Scotland to England Green Link 2.

2.1 My statement of evidence is structured as follows:

2.1.0 Section **Error! Reference source not found.** describes the cable installation depth.

2.1.1 Section **Error! Reference source not found.** comments on objections made to the Order.

2.1.2 Section 55 contains my conclusions.

3. CABLE INSTALLATION DEPTH

Industry Guidance and Specifications

3.0 The following section sets out the relevant guidance pertaining to cable installation depths. This is to provide context around the position of a minimum depth of 900mm recognised as the industry standard.

3.1 The Electricity Safety, Quality and Continuity Regulations 2002 (ESQCR) part 4, section 14.1 states *"Every underground cable shall be kept at such depth or be otherwise protected so as to avoid, so far as is reasonably practicable, any damage or danger by reason of such uses of the land which can be reasonably expected"*.

3.2 Energy Networks Association, Engineering Recommendation (ER) G57, Issue 2 2019, Cable Laying on Agricultural Land clause 4.2 states that all new cables, of any voltage shall be laid with a cover depth of not less than 910mm to the top of the cable when laid across good agricultural land. For reference this does not include the additional backfill required as well as the protection tiles as detailed within my evidence which increases this depth for the actual cable/duct.

3.3 For reference within ER G57, good agricultural land is defined as "arable land and pastureland agreed to be good agricultural land but not pastureland agreed to be permanent". This is intended to start the definition of the minimum installation depth criteria.

3.4 Further within ER G57 Clause 4.2, paragraph 2 it is stated that the depth requirement takes account of the wishes of the National Farmers' Union (NFU). ER G57 explains that this is a recommendation on the minimum requirement and that in specific cases, laying depths that differ from those recommended may need to be considered to satisfy reasonable requirements of the owner and/or occupier of the land, subject to the agreement of all parties.

3.5 To implement the requirements of the ESQCR and the recommendations of ER G57, NGET adopted the requirements into National Grid Technical Specification 3.5.7 issue 10, *Installation Requirements for HV Power Cables*. Paragraph 1.6, b, ii, identifies the minimum depth below the surface of the ground and the protection tiles across good agricultural land at 900mm.

3.6 It should be noted, that within previous revisions of NGTS 3.5.7, up to and including revision 8, stated that the minimum depth in open countryside to cover the areas not categorised as good agricultural land (as defined by clause 3.3 above) at 600mm to the protection tile. When updating to revision 9, this was aligned with the good agricultural land depth 900mm to the protection tile for consistency and to avoid multiple changes in depth during installation.

3.7 To add context to the wider industry, Scottish and Southern Electricity Networks (SSEN), SP-NET-CAB-500, Underground Cable Specification for Transmission Rated AC voltages, issue 2, clause 7.2.1 refers out to NGTS 3.5.7 for the minimum installation depths.

3.8 Scottish Power Energy Networks Installation specification Cab-15-004 issue 2, Technical guidance note, Handling and installation requirements for 132KV power cables, Appendix 1 covers installation depth to a minimum of 900mm across good agricultural land.

3.9 The above paragraphs 3.2-3.8 cover the minimum installation depth from relevant UK transmission assets, in instances where it is demonstrated that the depth needs to increase as per the guidance, then this will be incorporated into the detail design.

3.10 The current industry wide documentation confirms alignment with National Grid's minimum installation depth requirements and demonstrates consistency across the regulated industry. There is no intention to implement a new minimum installation depth greater than the 900mm, although consideration continues to be given to such an approach on a case-by-case basis.

Impact of Cable Depth

3.11 To achieve the most efficient cable solution that maximises the available ratings on the circuit, management of the heat generated from the cables is paramount. When cables transmit power, they generate heat in the conductor which is dissipated though the insulation of the cable into the surrounding material and ground. The deeper the cable is installed the time taken to dissipate the heat away from the cable increases, like adding more layers of insulation to a water pipe or a building.. The cable's ability to transmit power is directly related to how hot the cable can operate, and as a result of this higher temperature around the cable, this starts to impact on the amount of power than can be transmitted prior to reaching the temperature limits set out by the cable manufacturer. To offset this, the spacing between the two poles, in the case of a HVDC circuit, needs to increase to reduce the thermal interaction as a result of the cables being installed deeper to ensure the heat generated in each pole does not significantly affect the adjacent cable.

3.12 The cables have a limit to operating temperature, and without offsetting the additional heat generated with the additional separation, the cables would reach this limit which would either mean reducing the capacity of the cables and the power they can transmit, or running the risk of cable failure as a result of operating above the maximum temperature.

3.13 Although still subject to detail design, assessment of ground parameters such as thermal resistivity (the rate at which the in-situ material around the cable to dissipate this heat generated heat), an increase from a minimum installation depth from 900mm to the cable protection tile to a to a minimum installation depth of 1200mm to the protection tile will result in an approximate increase of pole spacing from 500mm to 800mm. This takes the typical overall trench width from around 900mm to 1200mm. These numbers may appear relatively small, but when considered against the overall length of the land route this has a significant overall impact. The additional depth and separation would also introduce additional time to excavate the trench and introduce additional storage requirements for the sub soil which needs to be removed, stored and processed. At this stage until the ground strata is known, it is difficult to estimate the additional time required as a result of the increased depth and width of excavation.

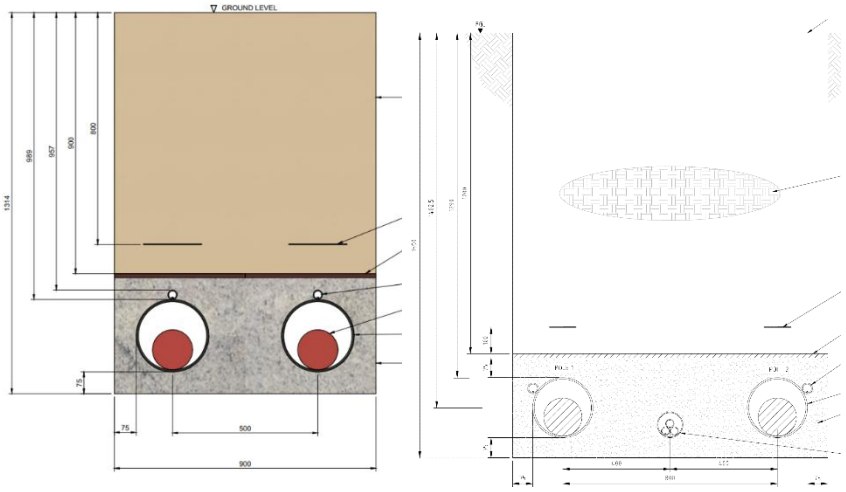
3.14 To add context, if this was applied as a blanket depth across the full SEGL2 route and all installed in such a manner, the additional stabilised backfill (Cement Bound Sand (CBS)) which is the surround installed around the cable for mechanical and thermal reasons would indicatively increase in the region of 6210m3. This would have a significant carbon impact on the project not only in the cement content of the back fill, but also the \vehicle movements required to transport this material. If this additional material were delivered in standard 20-ton vehicles, this would equate to an additional 440 vehicle movements.

3.15 Depending on the ground strata, an increase of 300mm in depth could also change the temporary works proposals, with the introduction of a stepped trench or timber supports to avoid a wider excavation. It could also change the plant and machinery required to excavate the trench depending on the ground conditions at that depth such as rock or chalk.

3.16 It follows from the above that any decision to deviate from the standard depths should be fully justified.

3.17 Notwithstanding the above note, the protection of the asset, the safety of landowners and occupiers of the land, be that agricultural, highways or under other third party assets is of critical importance to both NGET and myself as per my role set out in clause 1.3.1 of my evidence, thus any proposal would be considered as part of the detail design process.

3.18 The image below, is for reference and shows the difference between the two minimum installation depths.



4. OBJECTIONS RELATING TO CABLE DEPTH

4.0 Several objectors have raised the proposed cable depth provided in the Heads of Terms (**HoTs**), and the lack of confirmation on final burial depth, as grounds for objection to the scheme.

4.1 As discussed in section 3 of my evidence, and in section 7 of the Statement of Case (**CD D.6**), the HoTs identify a minimum cable burial depth (rather than an actual burial depth):

"The cables will generally be laid so as to avoid continued interference with normal agricultural operations as far as reasonably practicable. The cables shall be laid to contour with a depth of cover not less than 900mm from the original surface to the top of the protection tile above the cables."

4.2 Each set of HoTs that has been issued by NGET was accompanied by NGET's Construction best practice for underground cable installation version 1 (**CD F.5)**. NGET's HoTs include confirmation that all project works will be carried out in adherence to NGET's Best Practice Guide. None of the objections comment on NGET's Best Practice Guide or identify why NGET's Best Practice Guide is insufficient to regulate the construction of the English Onshore Scheme.

OBJ6

4.3 Objection 6, item 3, makes reference to the cable installation depth, stating that the installation needs to be at a depth of 1.2m to not interfere with future farming operations, the Objection introduces the requirement for sub soiling and mole drainage at 650mm. Although land

drainage is covered by Miles Flather in his evidence, any service installation at 650mm depth is more at risk from sub-soiling than the SEGL2 asset, thus gives no rise to an increase in installation depth as the farming operations would already be restricted as a result of their own drainage. If the objection also relates to the installation of future mole drainage, as the cable overall trench with is limited to approx. 1m, and full detailed as built drawings will be available with GPS coordinates, installation of new mole drainage can be undertaken in line with standard installation practices as recommended by Health and safety guidance 150 for avoiding underground services. No details within the objection relate to what the future farming operations include within the objection, which if stated could be discussed and agreed as per clause 3.4 of my evidence above.

OBJ7

4.4 Objection 7, key issue 3 makes reference to installation depth to mitigate the impact on drainage. Existing drainage will be treated and managed as an existing service and will either be avoided or mitigated with remedial drainage to be agreed with the landowner/occupier in detail design.

4.5 With respect to the cable installation depth changing over time. Prior to installation the surrounding ground is assessed for suitability and if required remediation techniques are used to ensure the ground directly below the cable is stable prior to installation. The cable weight and the stabilised backfill will also prevent this movement. It should be noted that the HVDC cables will be installed with a monitoring system along the full length of the land route which will be able to detect and alert any significant movement, from either vibration or elongation of the cable or from a change in temperature in real time (cables will show as cold spots if getting shallower). Any alerts would be investigated prior to them becoming an operational and or a health and safety risk to the land owner.

OBJ9

4.6 Objection 9, item 2.4 makes reference to a new minimum installation depth, greater than that stipulated within the industry documents. Reference is made to field drainage and mole drainage (identified by objector 6 at 650mm) which will be treated like any other services and crossed with the required depth at the specific locations. Reference is made to other schemes at which 1.2m has been agreed, these to date have been non regulated connections not subject to the same scrutiny on capital investment. As outlined in section 3, NGET are following the published industry recommendations and will consider any increase with substantiating evidence.

OBJ18

4.7 Objection 18, item 3, makes reference to the cable installation depth, stating that the installation needs to be at a depth of 1.2m to not interfere with future farming operations, the Objection introduces the requirement for sub soiling and mole drainage at 650mm. Although land drainage is covered by Miles Flather in his evidence, any service installation at 650mm depth is more at risk from sub-soiling than the asset, thus gives no rise to an increase in installation depth as per the details set out in section 3.

4.8 Concern within the objections is raised around drainage, my evidence does not cover the full impact of drainage, which is covered by Miles Flather in his evidence, however drainage from an installation design is considered as a service, as such would be managed or mitigated. This

would be in the form of crossing under the drains or mitigating the impact by diverting the drains. Any mitigation, would be incorporated into the overall drainage for the land as part of the pre-construction and validated in the post construction drainage design.

4.9 In general prior to any detailed design work being undertaken a detailed topographical survey will be undertaken to identify and confirm the existing ground level. This will be used to identify ground features and risks and also be used to ensure that following installation the depth is relevant to the existing ground features. This information will then be used as part of the design process in combined with all other data sources to confirm the installation requirements.

4.10 At present there is no industry guidelines available to substantiate a minimum installation depth of 1200mm and why this depth is considered safe and to support future farming options. It is understood this depth was proposed as part of an offshore connection as referenced in objection 9 There is no intention to update NGET specifications to revise this minimum depth, however NGET will still follow the recommendations stated in the industry standard documents.

5. SUMMARY AND CONCLUSION

5.0 In my statement of evidence, I have described the background to the UK and industry standards on the cable installation depth. What NGET proposed to complete as part of the installation detail design and how the installation risk will be assessed and managed to ensure both the safety of the asset and the land owner / occupier.

5.1 NGET are following industry requirements, consistent with other transmission owners when detailing the minimum installation depth.

5.2 NGET consider this as a minimum installation depth and if required, as per the industry requirements and recommendations will increase this to protect both the occupier and the asset, during the detail design.

5.3 NGET will consider drainage as any other service to be crossed or diverted as per agreed plans. I consider that the installation design and construction methodology of the above elements of the Project is appropriate, feasible, and compliant with the relevant standards, codes, and guidance.

6. DECLARATION

6.0 I confirm that the opinions expressed in this proof of evidence are my true and professional opinions.

Dave Rogerson

16th February 2024