White Hill Wind Farm Electricity Substation & Electricity Line

Environmental Impact Assessment Report

Annex 12.4: Gas Pipeline Electrical Interference Assessment

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ELECTRICAL INTERFERENCE TO ADJACENT PIPELINES UNDER NORMAL AND AC FAULT CONDITIONS WHITE HILL WIND FARM

Document History

3	23/02/25	Cable Route & Executive Summary Amendments	DS	KCL	KCL			
2	21/10/24	Drawing Amended	DS	KCL	KCL			
1	18/09/24	Drawings added	KCL	KCL	KCL			
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			Corroconsult			**Client**		

Contract & Report Details

CCL Project Reference:	6999	**CCL Variation Number:**	N/A

Category	Code	Description
Location Code:	WWF	White Hill Wind Farm
Document Type:	REP	Report
System Number:	GNI	Unknown pipeline
Life Cycle:	N/A	Life Document

Location	System	CCL Job No.	Doc. Type	Sequence	Revision	Total
WWF	GNI	6999	REP	1	3	11

Contents

Introduction

There is a risk of electrical interference to the GNI pipeline where the two 33 kV circuits cross the pipeline.

Executive Summary

- Based on the assumptions made the level of induced AC interference during normal operation is acceptable.
- Based on the assumptions made the Earth Potential Rise is neither harmful to the pipeline coating nor is it an electric shock risk
- Baseline datalogging and soil resistivity measurements should be undertaken.
- With the new cable route advised, as long as the cables are in HDPE ducts, laid in trefoil formation and cross at an angle between 90 degrees and 45 degrees, the original assessment is still valid.

Documents used in the Assessment

Table 1 Documents used in the Assessment

Ref.	Title	Description
230222/KB/WH/001 Rev. 00	White Hill Wind Farm Cable route and GNI pipeline	Cable and pipeline Route
230118/KS/GOR/001 Rev.001	Cable and existing GNI pipeline	Cable crossing
BGE/AL/06/74/RD/66	Cork-Dublin Gas Pipeline As-laid road crossing minor No.66	RDX details

Relevant Standards

BS EN ISO 21857:2021 Petroleum, petrochemical, and natural gas industries – Prevention of corrosion on pipeline systems influenced by stray currents.

BS EN ISO 8044:2015 Corrosion of metals and alloys – Basic terms and definitions.

BS EN ISO 15589-1:2015 Petroleum, petrochemical, and natural gas industries – cathodic protection of pipeline transportation systems – Part 1: On-land pipelines.

BS EN ISO 18086:2020 Corrosion of metals and alloys. Determination of AC corrosion. Protection criteria.

CEN 12954:2019 General principles of Cathodic protection of buried or immersed metallic structures.

BS EN 50443:2012 Effects of electromagnetic interference on pipelines caused by high voltage AC electric traction systems and/or high voltage AC power supply systems

IEEE Std 80:2013 Guide for Safety in AC Substation Grounding

ENA EREC S34 Issue 2 A guide for assessing the rise of earth potential at electrical installations

IEC/TS 60479-1:2005	Effects Of Current On Human Beings And Livestock Part 1; General Aspects
NACE SP0177:2019	Mitigation Of Alternating Current And Lightning Effects On Metallic Structures And Corrosion Control Systems

Scope

Assess the risk of electrical interference to the adjacent pipeline at the road crossing.

Background

The proposed cables will be in trefoil formation and within non-conductive ducts. There will be two 33 kV circuits, and they will be buried for the entire route.

Electrical Interference

There are two interference mechanisms from the buried cable; induction during normal operation and conductive during fault conditions.

Inductance, during normal operation, can result in induced AC voltage in the pipeline. Under some conditions these induced voltages can cause, or exacerbate, external corrosion.

Normal Operation

Inductive

Induced voltage calculations are in accordance with EN ISO 21857 and relate to situations where the interfering source is parallel to the pipeline. In this case the buried cable crosses the pipeline at approximately 45 degrees, the induced effect is small.

Furthermore, the cables are laid in trefoil formation, which substantially reduces the electromagnetic radiation.

The short crossing length, combined with the trefoil formation, means that the induced voltage will be within acceptable limits. Theoretically, the induced voltage is less than 1 V rms.

Conductive

Significant conductive interference occurs only under fault conditions. This interference does not directly lead to corrosion (due to the short duration).

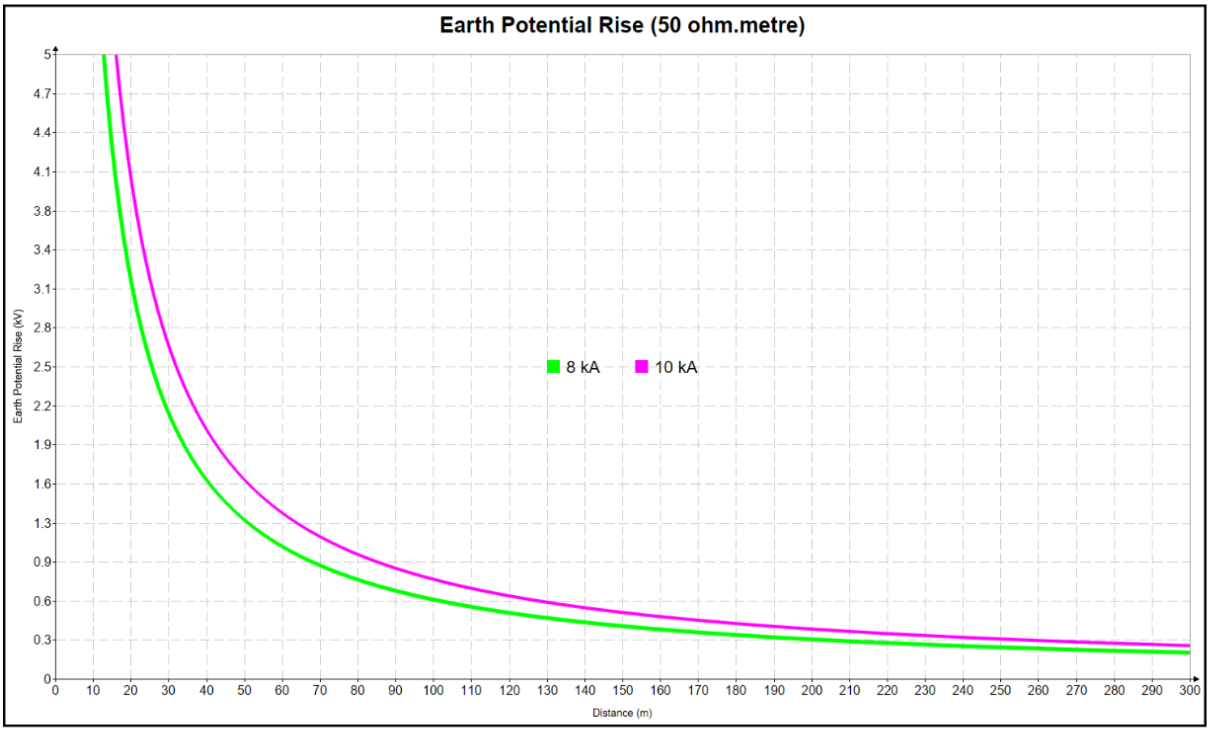
Fault Conditions

Conductive

If the earth potential rise at the pipeline exceeds the dielectric strength of the coating it can change the coating performance characteristics, which could encourage future corrosion. Further investigation is required if the earth potential rise at the pipeline is greater than 5 kV for two or three layer polyethylene coatings (i.e. GNI pipelines).

Calculations show that under fault conditions at the substation the Earth Potential Rise (EPR) is less than 0.5 kV, which is below the threshold of 3 kV – 5 kV, and this means that it is an acceptable level. These values will change with different soil resistivities.

Figure 1 EPR Plot for 8 kA and 10 kA



Personnel Safety

The risk to personnel arises only when they make physical contact with the pipe. Since the pipe is buried the only possibility to touch the pipe is at the existing test posts, where the pipe connection is connected to a stud on the outside of the test post. The EPR of less than 0.5 kV and the duration (0.3 s) means that no special precautions are required at the test posts or above ground appurtenances.

Mitigation Measures

Inductive Interference

Existing electrical interference on the pipeline is unknown. This will be verified when the baseline measurements are performed.

Based on the theoretical AC interference from the buried cable under normal operating conditions there will not be a requirement for mitigation.

Acceptable levels of interference are specified in EN ISO 18086. Assessing the interference levels for AC corrosion is risks is not straightforward, but the first step is to reduce the voltage level to less than 15 V rms.

Conductive Interference

Under fault conditions the Earth Potential Rise has been estimated from the assumptions of the fault current, soil resistivity, and separation distance.

Table 2 Earth Potential Rise Parameters

Parameter	Value	Unit	Source
Fault Current	8	kA	Energia
Distance from centre to edge of earth grid	25	m	Assumed
Distance from edge of grid to pipeline	290	m	Scaled from map
Substation earth resistance	0.5	Ohms	Assumed
Soil resistivity	50	Ohm.m	Assumed
Rise of earth potential	220	V	Calculated

Regardless of the theoretical induced voltages and earth potential rise it is possible that GNI will require for any existing coating defects on the pipeline in the vicinity of the substation to be exposed and repaired.

Recommended Course of Action

This analysis is based on assumptions and experience, and can only serve as a guide to what the interference is likely to be.

There are four steps that need to be completed after the planning approval has been received.

Step 1

Carry out datalogging on the GNI test posts close to the substation. Logging shall be with satellite synchronized dataloggers on a two second sample for a period of at least 5 days, and including a weekend day. AC and DC pipe-to-soil potentials will be measured. This data will provide a baseline against which future interference will be assessed. At the same mobilisation, soil resistivity values will be measured.

Step 2

Another set of calculations should be completed when the detailed electrical design has been approved and the assumptions eliminated from the calculations in this assessment. If the new values are not within acceptable limits, then mitigation methods will need to be designed. Mitigation designs will require GNI approval. It is also possible that GNI will require permanent remote monitoring close to the substation.

Step 3

Repeat the baseline measurements during the commissioning of the system to verify that the interference is at acceptable levels.

Step 4

Continuous AC and DC pipe-to-soil potentials should be remotely monitored at two existing test posts closest to the crossings to ensure that there are no operational changes or system deterioration that adversely affects the integrity of the pipeline. The system should be compatible with the existing GNI remote monitoring system.

Appendix A – Background Information

Figure 1 shows the concepts of touch potentials.

Table 5 is an extract from EN 50443, which shows the recommended separation distance for electromagnetic interference.

The fault current values associated with insulating and resonant earth systems are low and do not result in danger or in significant risk of damage or disturbance, and calculations or measurements are only required when interference occurs.

Table 3 shows a typical situation when work is carried out by trained and experienced personnel. The safe limits are based on the fault clearance time (IEC/TS 60479-1).

Table 3 Safe Limits

Fault Duration (s)	Interference voltage (V rms)
$t \le 0.1$	2000
$0.1<t\le0.2$	1500
$0.2<t\le0.35$	1000
$0.35<t\le0.5$	650
$0.5<t\le1.0$	430
$1.0<t\le3.0$	150
$t > 3$	60

Corrosion Risk

Due to the short duration of fault currents, they are not a direct corrosion risk. Indirectly, however, excessive voltages can cause coating stress which will alter the corrosion protection performance of the coating.

To prevent damages to the pipeline or to the connected equipment, and in the absence of site specific calculations, the following conditions apply:

Conducting coupling from AC power supply systems shall be considered in case or proximity lower than:

- 5m from then closest visible part of the tower of an HV power line rated at 50 kV or less
- 20m from the closest visible part of the tower of an HV power line provided with earth wires with nominal voltage greater than 50 kV
- 100m from the closest visible part of the tower of a HV power line not provided with earth wires with nominal voltage greater than 50 kV
- 20m from earthing systems of HV power cables with nominal voltage greater than 50 kV
- 150m from the earthing grid of a power substation.

Table 4 NACE SP 0177 Recommended coating stress voltage limits

Coating	Coating Stress Voltage Limit (kV)
Bitumen	1 – 2
Coal tar and asphalt	3
FBE and polyethylene	3 – 5

Figure 2 Extract from IEEE80

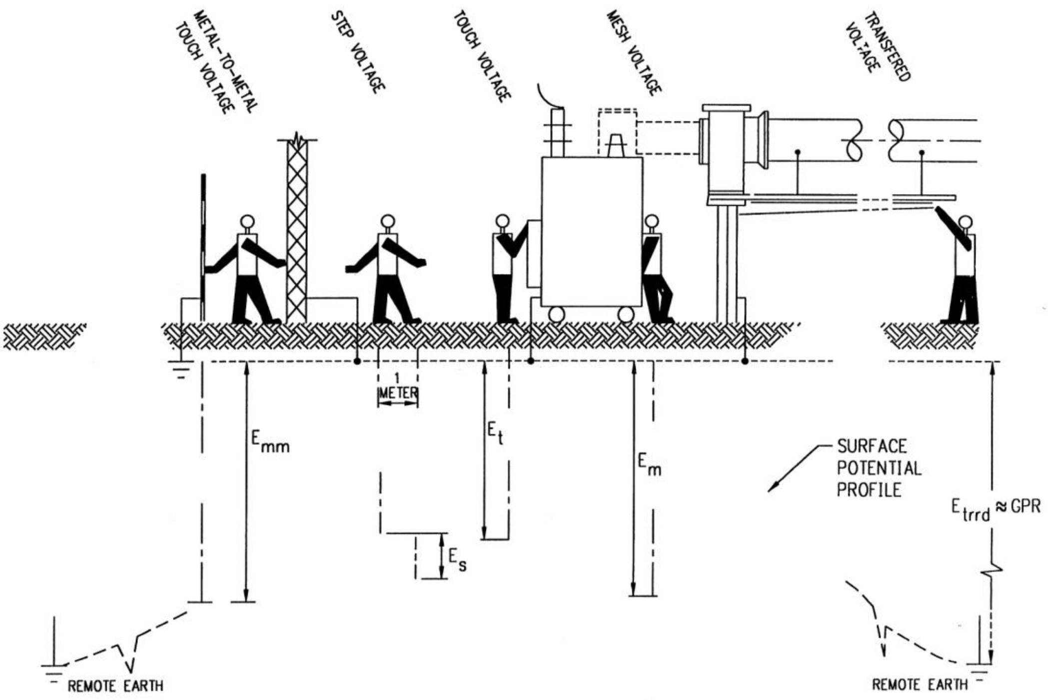
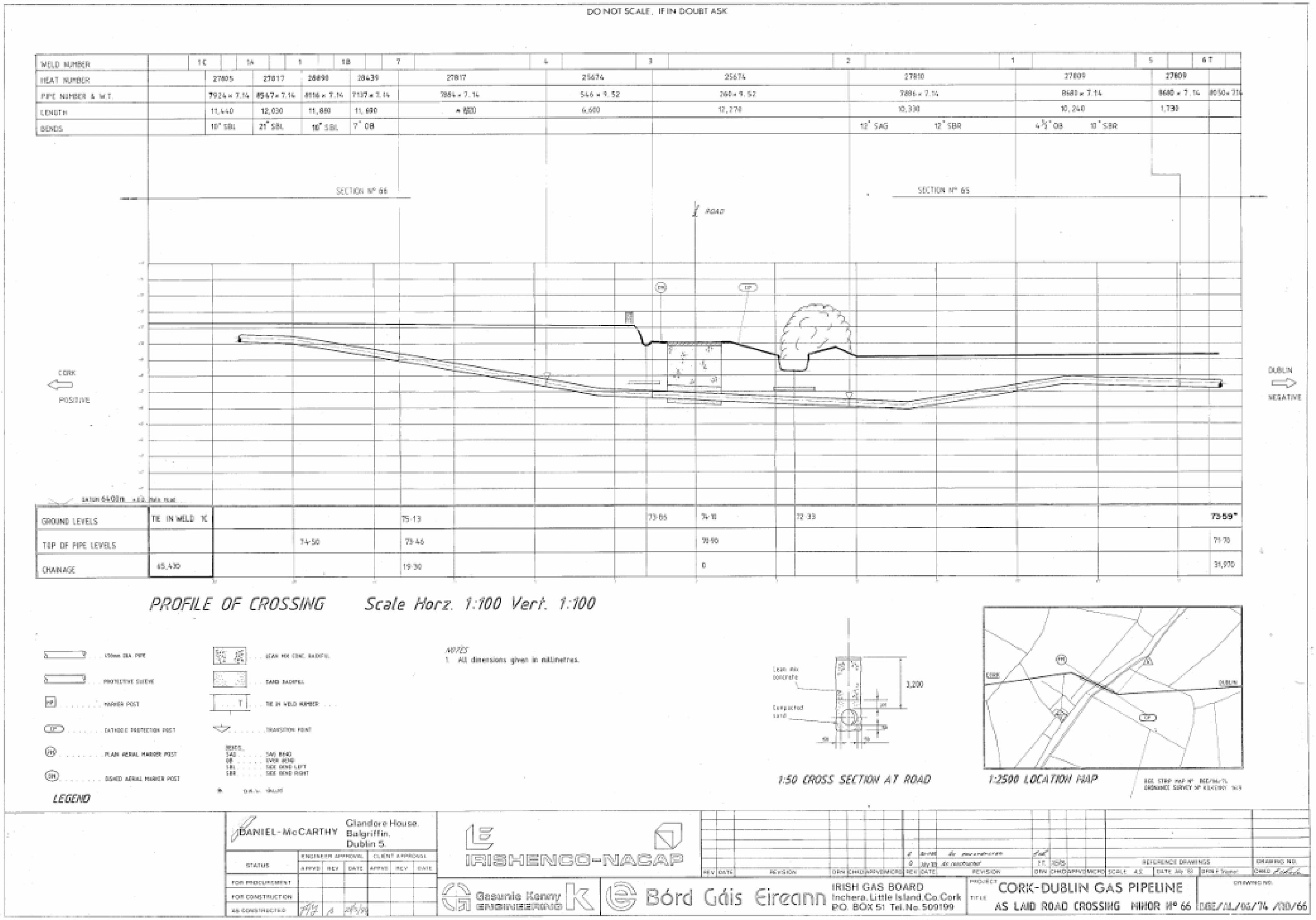


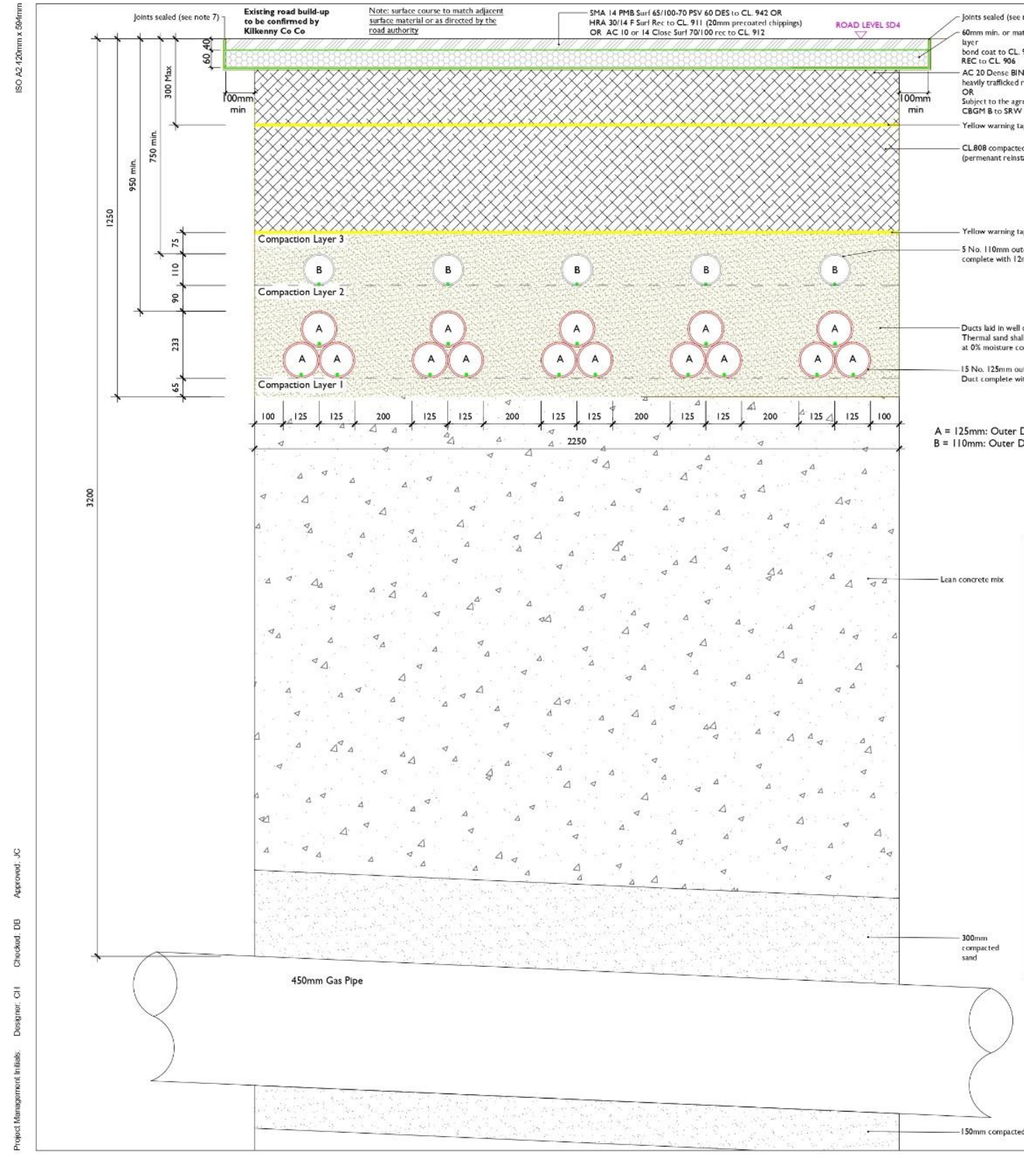
Figure 12—Basic shock situations

Table 5 Extract from BS 50443

Type of AC Power System	Areas	Resistivity (Ω·m)	Interference Distance (m)	
			Normal Operation	Fault Condition
Overhead	Rural	> 3000	Resistivity/3	Resistivity
		≤ 3000	1000	3000
Overhead	Urban	> 3000	≥ 300	Resistivity/10
		≤ 3000		≥ 300
Buried	All	All	50	50

Appendix B – Drawings





ALL REINSTATEMENT WORKS ARE TO BE IN ACCORDANCE WITH LOCAL AREA ENGINEERS REQUIREMENTS AND GUIDELINES FOR MANAGING OPENINGS IN PUBLIC ROADS

Note:

1. Refer to Guidelines for managing Openings in Public Roads (Purple Book - April 2017), Chapter 6 'Specifications' for guidance on Duct type / colour and Marker Tape type / colour.
2. All bound edges shall be saw cut to expose the full vertical thickness of each layer prior to excavation. All edges shall be essentially straight, smooth and vertical.
3. Where a temporary surface has been used, material shall be planed out to the depth specified in this drawing. The new permanent surface shall be machined laid and mechanically compacted with a vibrating roller.
4. Where the trimmed edge of excavation is within 400mm* of a joint / edge, ironwork or other reinstatement, this trimmed edge shall be extended to include same and the area of reinstatement shall be extended accordingly (* increase to 800mm where this is pre-existing practice).
5. Any damaged area adjacent to the opening and resulting from the excavation operation shall be included within the area to be reinstated.
6. Clause 808 or Cement Bound Granular Material surface to be sprayed per clause 920 prior to application of Asphalt Concrete Layer.
7. Joint sealer shall be a hot 50 pen bitumen binder or cold thixtropic bitumen 50 -70 pen to be applied to all vertical cuts in accordance with B.S.594987 prior to application of bituminous materials.
8. For roads without asphalt concrete surface (e.g. may be Cl.804 with double surface dressing), the road authority may as its discretion permit the temporary reinstatement surface of asphalt concrete to be regulated in lieu of excavation and reinstatement; and subsequendy surface dressed.
9. On highly trafficked roads services must have a minimum cover of 750mm.
10. Where required by the Road authority the trench may be reinstated with a Cement Bound Granular Material.
11. Full carriage way reinstatement will be carried out where the cable is in the local public road

Section Through Permanent Reinstatement of Longitudinal Opening In Roadway
SCALE 1:10

tli GROUP

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PROJECT
White Hill Wind Farm Grid Connection

CLIENT
White Hill Wind Limited

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NOTES: -
- This drawing is to be read in conjunction with relevant drawings, specifications and reports
- Dimensions are in millimeters, unless noted otherwise
- Drawings are not to be scaled use figured dimensions only
- Hand excavation only above pipeline crossing sections

LEGEND: -

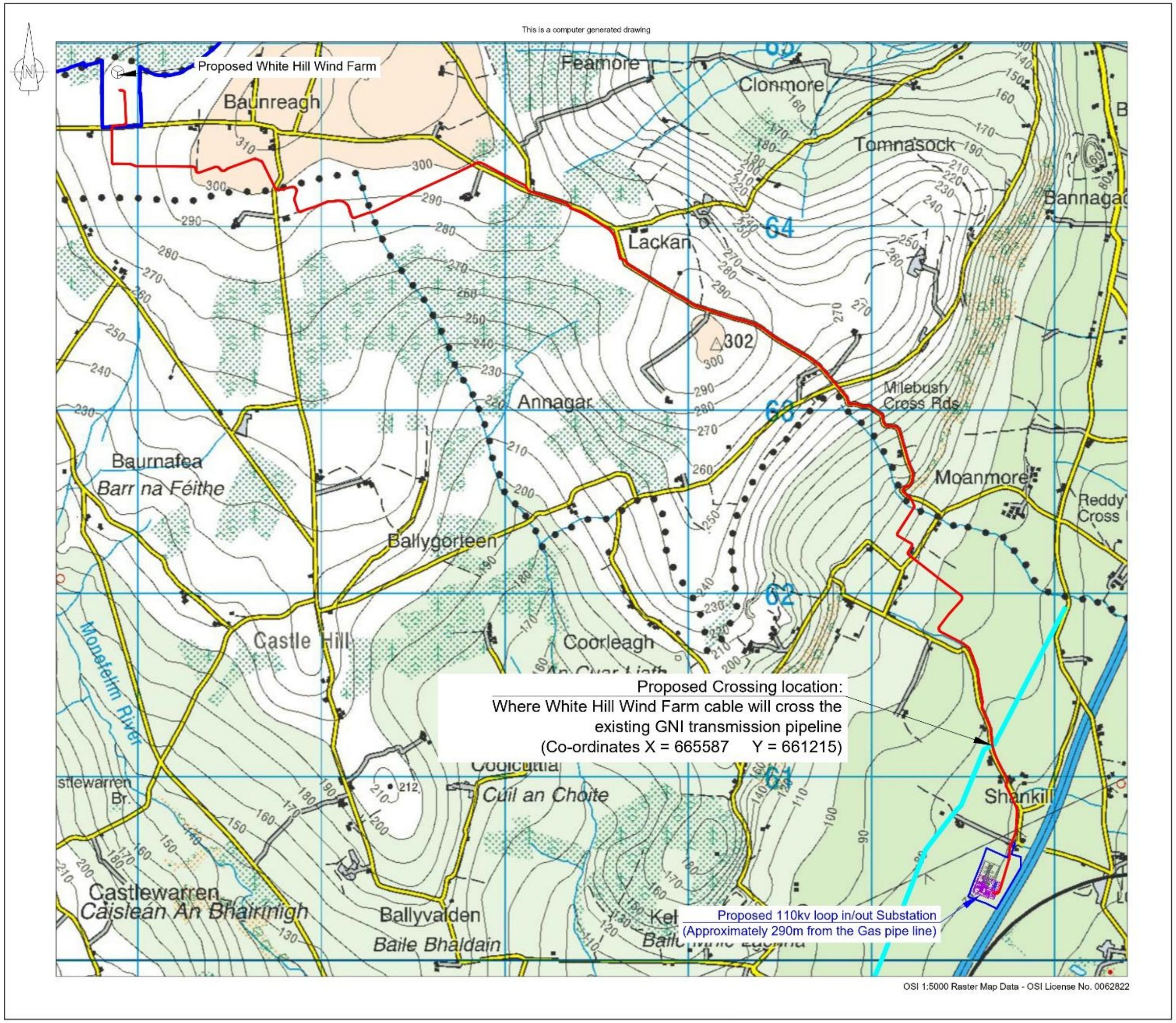
ISSUE/REVISION

P2	02.10.24	Issued for Planning
P1	23.09.24	Issued for Planning
I/R	DATE	DESCRIPTION

PROJECT NUMBER
300-101087

SHEET TITLE
Section through Roadway showing Gas Crossing

SHEET NUMBER
300101087-DR-121



Legend:

- Proposed White Hill Wind Farm Cable
- Existing GNI transmission pipeline

Notes:

- This is a draft desktop based design and may not be representative of final layout design

Date:	Rev:	Description:	Drawn By:
19.02.25	001	Cable Route Revised	KB

Prepared by:

Galetech Energy Developments Ltd,
Clondargan, Stradone,
Co. Cavan

Client: White Hill Wind Ltd

Job Title: White Hill Wind Farm

Drawing Title: Cable Route and GNI Pipeline

Drawing No.: 230222/KB/WH/001	Revision No.: 001	
Scale: 1:10,000 (A1)	Date: 29/04/2024	
Drawn By: K.B	Checked By: C.M.P	Confirmed By: M.M