Environmental Impact Assessment Report

NISA
North Irish Sea Array

Volume 11: Appendices (Wider Scheme)

Appendix 32.1
EMF Assessment

Tables

Figures

Appendix 32.1: EMF Assessment

1. Introduction

The North Irish Sea Array (NISA) Offshore Wind Farm, located off the coast of counties Dublin, Meath, and Louth, hereafter referred to as the proposed development is the subject of this Environmental Impact Assessment Report (EIAR). The proposed development is a combination of offshore infrastructure and onshore infrastructure and is detailed further in Section 1.3 of Volume 2, Chapter 1: Introduction. The proposed development boundary is shown in Figure 1.1 of Volume 7A of the EIAR. The proposed development is being developed by North Irish Sea Array Windfarm Limited (the Developer).

This appendix to the EIAR has been prepared by Compliance Engineering Ireland Ltd and provides an assessment of the electrical and magnetic field impacts associated with the onshore infrastructure of the proposed development as described in Volume 2, Chapter 7: Description of the Proposed Development Onshore, (hereafter referred to as the Onshore Description chapter).

For ease of reading and understanding, the following terms referred to throughout this technical appendix are described, including Electromagnetic Compatibility (EMC), Electromagnetic Interference (EMI) and Electromagnetic Fields (EMF). EMC relates to the ability of different EM (Electromagnetic) devices to function properly when they are situated in the same environment, i.e. it relates to the compatibility between different devices. EM devices can generate and propagate energy causing EMI. Devices can also receive and be interfered with by energy generated and propagated by other devices in the same environment. If an EM device is not compatible with other devices in the same environment, EMI can lead to the device or other devices not functioning properly. EMF relates to electromagnetic fields and human health and the health of livestock and plants. If sufficiently strong, electromagnetic fields can have a physiological impact and affect human health.

EMF is a phenomenon that takes the form of self-propagating waves in air or in water. It consists of electric and magnetic field components which oscillate in phase perpendicular to each other and perpendicular to the direction of energy propagation.

EMF is classified into several types according to the frequency of its wave; these include (in order of increasing frequency and decreasing wavelength) radio waves, microwaves, terahertz radiation, infra-red radiation, visible light, ultraviolet radiation, x-ray, and gamma rays. The electromagnetic fields from power lines/cables (including both overhead and underground) at 50 Hz are at the bottom end of the electromagnetic spectrum and have a long wavelength compared to other EM fields listed. A small and somewhat variable window of frequencies is sensed by the eyes of various organisms; this is what we call the visible spectrum or light. EMF carries energy and momentum that may be imparted into matter with which it interacts. The wavelength at 50 Hz is in a part of the electromagnetic spectrum that imparts the lowest amount of energy.

2. Overview

Extremely Low frequency (ELF) EMF including frequencies from 0 Hz to 100 kHz surround all things that:

- Generate (e.g. electricity generators)
- Transmit (e.g., Substations, power lines and wiring) or
- Use electricity (e.g., appliances, motors, and other devices)

Thus, exposure to EMF is common in modern life. These fields will be generated in the vicinity of the proposed development. This chapter addresses the nature of ELF-EMF and the levels associated with the proposed Bremore to Belcamp 220 kV onshore cable route, as well as the scientific consensus on potential relationships between ELF-EMF and health.

3. Methodology

The baseline environment is defined as the existing environment against which future changes can be measured. This section presents the methodology used in assessing the impact on the baseline environment. As well as considering the relevant guidance with respect to environmental impact, the scope and methodology for the impact assessment has been devised in consideration of the following guidelines:

- International Commission on Non-Ionising Radiation Protection (ICNIRP) (1998) Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz). Health Physics 74 (4): 494-552; 1998
- Department of Communications, Marine and Natural Resources (DCMNR) (2007) Health Effects of Electromagnetic Fields
- European Commission (EC) Council Recommendation on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) 1999/519/EC
- ICNIRP (2010) Guidelines for limiting exposure to time varying electric and magnetic fields (1 Hz–100 kHz) Health Physics 99(6):818-836; 2010
- EU Electromagnetic Compatibility Directive 2014/30/EU on the approximation of the laws of the Member States relating to electromagnetic compatibility

4. Limit Values

In terms of public exposure, Irish Government policy is to comply with the 1998 ICNIRP Guidelines in the terms of the 1999 EU Recommendation.(European Commission (EC) Council (1999) Recommendation on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) 1999/519/EC)

A panel of independent scientists, convened by Ireland's Department of Communications, Marine and Natural Resources (DCMNR), published a brief question and answer document entitled "Health Effects of Electromagnetic Fields" (2007). The conclusions of this report were consistent with those of International Agency for Research on Cancer (IARC), the World Health Organisation (WHO) and other national and international agencies. In relation to ELF-EMF, the report stated, "No adverse health effects have been established below the limits suggested by international guidelines."

International guidelines for ELF-EMF were set in 1998 by the ICNIRP, a formal advisory agency to the WHO. The ICNIRP reviewed the research and concluded it was insufficient to establish exposure guidelines on the basis of long-term health effects; on the other hand, the agency found sufficient evidence for short-term, neurostimulatory effects at very high field levels and exposure guidelines were established to protect against this effect.

The ICNIRP 1998 Guidelines subsequently formed the basis of the EU EMF Recommendation in 1999. In 2010 ICNIRP issued updated guidelines, which reviewed the research since the 1998 Guidelines and replaced previous recommendations given by ICNIRP for this frequency range. The Irish electricity network and the proposed development (consisting of 220 kV underground cables and substations at the grid facility) will comply with the same guidelines.

According to international authoritative agencies (ICNIRP, WHO), the cumulative body of evidence indicates that ELF-EMF from power lines/cables does not have any adverse effects on health at the levels below ICNIRP guidelines. None of these scientific agencies considered it necessary or appropriate to limit the construction of electric facilities or recommend exposure standards below the ICNIRP limits.

The acceptable levels of electric and magnetic fields are published by ICNIRP. The 1998 guidelines and 2010 guidelines are reproduced below in Table 1. The EU EMF Recommendation 1999/519/EC for public exposure adopts the 1998 guidelines.

Table 1: Health Guidelines

Exposure Characteristics	Electric Field Strength kV/m	Magnetic Flux Density, µT
ICNIRP 1998 General Public Reference Level 2010 General Public Reference Level	 5 5	 100 200

The baseline EMF levels applicable to the proposed NISA onshore infrastructure have been defined through a desktop study and consultation with relevant stakeholders. The proposed development is then assessed to determine if there is an impact.

Magnetic flux densities for AC magnetic fields are reported using units of microtesla (µT) and AC electric fields are reported as kilovolts per metre (kV/m).

5. Assessment Methodology

The electromagnetic fields have been calculated by a proprietary computer modelling package SoCal Edison 3.5.0A produced by Southern Californian Edison which is based on the industry standard method using the BiotSavart Law.

6. Study Area and Proposed Development

A full description of the onshore infrastructure of the proposed development is presented in the Onshore Description Chapter of the EIAR. The onshore infrastructure is presented in Figures 7.1 to 7.3 of Volume 7A of the EIAR.

The onshore infrastructure of the proposed development will provide:

- Landfall site: this is where the 220 kV high voltage alternating current (HVAC) offshore export cables come onshore. Located close to the shoreline, the transition joint bays (TJBs) are the point at which the offshore export (subsea) cables transition to the onshore export cables which then connect on to the grid facility.

  The site identified for landfall is located north of Balbriggan and as shown on Figure 7.2 (of Volume 7A of the EIAR, which also shows the onshore export cables), it is located immediately south of Bremore Point in the townland of Bremore in North County Dublin.

- Grid Facility: The onshore export cables terminate at the grid facility, which is located in Bremore, just north of Balbriggan, and is comprised of two distinct substations on the same site: the compensation substation and the Bremore substation. The compensation substation will be contained within a rectangular compound approximately 100m by 190m. The Bremore substation will be contained within a smaller adjacent compound approximately 50m by 115m with the nearest residential dwelling approximately 100m north-east of the grid facility. The proposed grid facility layout is shown on Figure 7.2 of the EIAR, with further detail provided on the grid facility planning drawings included in Appendix 7.1 of Volume 8 of the EIAR.

- Onshore cable route: Connection by two underground 220kV high voltage alternating current cables (in two cable circuits) over a distance of c.33-35km, from the grid facility to the existing 220kV ESB substation at Belcamp. Each cable circuit will comprise the electrical cables, earthing and communications cables. The majority of the route – approximately 29km out of the 33km – is contained within the footprint of existing roads including the R132, the R106 and other local roads. The full route is shown on Figure 7.3 of Volume 7A of the EIAR and is also presented in in greater detail on the planning drawings 281240-ARP-ONS-CR-DR-PL-1110 through 281240-ARP-ONS-CR-DR-PL-1164 (Appendix 7.1 of Volume 8 of the EIAR).

The study area consists of the underground cable routing from landfall 2km north of Balbriggan to ESB Belcamp 220 kV substation. The routing is shown in Figure 7.3 of Volume 7A of the EIAR.

The study area has been defined in order to ensure that all possible EMF effects are captured and is set out in Table 2.

Table 2: Study Area

Criteria	Distance either side of proposed development (redline) boundary
Identification of land uses where sensitive receptors and/or people and/or animals are located.	Within 100m

The onshore cables will be placed in buried underground ducts laid either in:

- a single trench of width 1400mm with six cables arranged in a double trefoil arrangement, or
- two narrower trenches of width 1100mm each with three cables in each arranged in a trefoil arrangement, or
- a single trench of width 2275mm with the six cables arranged in a flat formation

Typical trench details are shown on planning drawing 281240-ARP-ONS-XX-DR-PL-3000 *Typical cable trench details* in Appendix 7.1 of Volume 8 of the EIAR. For ease, this drawing has also been included in Appendix A of this report. For the majority of the route, the double trefoil arrangement will be used in order to minimise the width of trenching required. The options of two narrower trenches and the flat cable formations will be used only where necessary to navigate existing utilities or watercourses.

The potential cable arrangements are summarised in Table 3 below.

Table 3: A summary of the potential cable configurations

ID	Cable Type	Cable Material	Voltage (kV)	Power (MW)	Phase current (A)	No. of sets of 3-phase cables	Phase layout	Phase spacing (m)	Depth (m)	Notes
G1	2 x 1600mm2	Copper (No Enamel Coating)	220	700	918.5	2	Trefoil (Standard phase arrangement)	0.19	1.1	Total current = 1837 A
G2	2 x 1600mm2	Copper (No Enamel Coating)	220	700	918.5	2	Trefoil (Optimal phase arrangement)	0.19	1.1	Total current = 1837 A
H1	2 x 1600mm2	Copper (No Enamel Coating)	220	700	918.5	2	Flat (Standard phase arrangement)	0.3	0.6	Total current = 1837 A
H2	2 x 1600mm2	Copper (No Enamel Coating)	220	700	918.5	2	Flat (Optimal phase arrangement)	0.3	0.6	Total current = 1837 A

Note that the distance between the trefoil circuits was 0.6m. The distance between the flat circuits was the phase spacing (0.3m)

7. Baseline Environment

The proposed development is located through public roads, green field sites, road crossings, industrial parks, and residential areas.

As there are no significant EMF sources on the proposed route, it can be stated with confidence that the existing electromagnetic fields are below the guideline levels at all locations including at the location of the highest electromagnetic fields which will exist directly above the proposed cables.

8. Potential Impacts of the Proposed Development

8.1 Electromagnetic Compatibility (EMC)

Disruption of normal household appliances may occur when magnetic flux densities of 3.8 µT (microtesla) or more are present as defined by standards listed under the EU EMC Directive 2014/30/EU. For the proposed development, the required dwelling clearances to maintain a magnetic flux density of less than 3.8 µT are shown in Table 4 below. Where the as-built onshore cable route comes within 8m of residential properties, exceedances will be prevented by a combination of cable arrangement and/or shielding of the cables.

Table 4: Required clearance distances to comply with CENELEC EMC guidelines.

ID	Required Clearance to dwelling (m)
G1	5.5
G2	3.5
H1	8.0
H2	6.0

8.2 Electromagnetic Fields (EMF)

The magnetic fields at maximum loading of the underground circuits – that is, the trenched cabling making up the onshore export cables and the onshore cable route - are shown in Figure 1. The levels have been calculated for a height of 1m above ground in accordance with IEC 62110:2009 Electric and magnetic field levels generated by AC power systems – Measurement procedures with regard to public exposure.

The levels have been calculated using the maximum power capability of the circuits which is significantly greater than the levels that would typically be present. The magnetic field emissions are directly proportional to the load on the cable.

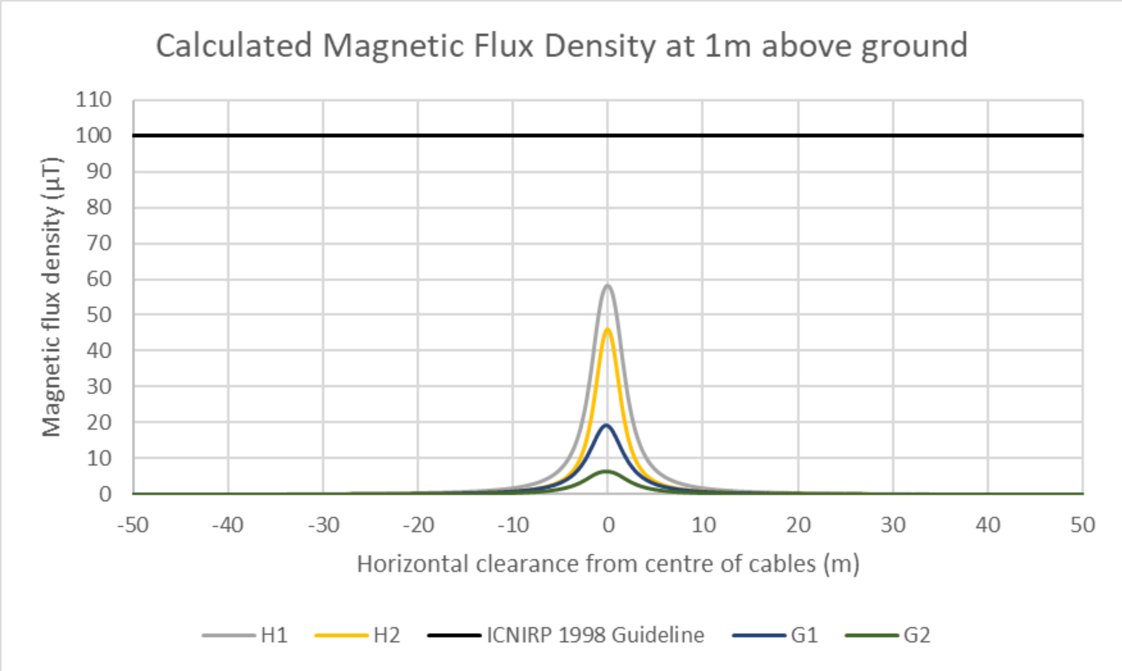


Figure 1: Magnetic Fields from Underground Cables

The flat arrangements generate higher levels of magnetic fields compared to the trefoil arrangements. At all locations, the magnetic field levels are below the EMF Recommendation/ICNIRP 1998 public limit, including directly above the cables.

It is also not expected that the resultant field strengths at the connection at the Belcamp substation or the substations at the grid facility will exceed the 100 µT threshold.

9. Mitigation and Enhancement Measures

As the impact on the EMF environment for all configurations is acceptable as defined by the EU and ICNIRP guideline limits, no mitigation measures are proposed.

10. Interrelationship with Other Impacts

Interrelationship with a proposed MetroLink rail line was assessed and it is not expected that there will be any issue with interference on the rail signalling system assuming a separation distance of 30m and parallel path of < 500m. Smaller separation distances than 30m would be achievable through optimisation of the cable design and/or further mitigation such as shielding.

Engagement with Irish rail has been carried out in order to establish that would be no adverse effects to the Dublin Belfast railway and associated signalling systems at the area within the landfall site where the two systems are withing a close proximity – including a perpendicular crossing.

There is no other interrelationship between EMF and other environmental aspects.

11. Monitoring

No monitoring is proposed relating to EMF. The levels of EMF are substantially below the recognised guidelines and the need for monitoring is not foreseen.

12. Cumulative Effects

There is the potential that the 110Kv cables of the proposed Metrolink project and the 220Kv onshore cables of the proposed development will be in the R139 road in Belcamp. As these cables may share the same stretch of road, the cumulative field strength from the proposed cables and adjacent Metrolink 110 kV system was modelled with a separation distance of 2m between the Metrolink and proposed development cables.

It was found that the resultant magnetic flux densities were not significantly different to modelling results for the NISA Bremore to Belcamp 220 kV onshore cable system in isolation. Thus, for EMC purposes, the previously stated clearances from the onshore cables will be sufficient. The results also showed that the ICNIRP threshold of 100 µT will not be exceeded.

13. Conclusion

If the suggested clearances are adhered to, there will be no significant impact from the proposed development from an EMF point of view on humans or animals as the development complies with the ICNIRP Guidelines (1998) and the EU EMF Recommendation 1999/519/EC. In addition, there will be no significant impact from the proposed development from an EMC point of view as the predicted levels are lower than equipment interference guidelines.

14. References

Department of Communications, Marine and Natural Resources (DCMNR) (2007) Health Effects of Electromagnetic Fields. https://www.three.ie/pdf/Expert%20Group%20on%20Health%20Effects%20of%20Electromagnetic%20Fields.pdf [Accessed January 2024]

Directive of the European Parliament and of the Council on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields) 2013/35/EU

EirGrid Evidence Based Environmental Studies Study 1: EMF https://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid-Evidence-Based-Environmental-Study-1-EMF.pdf

European Commission (EC) Council (1999) Recommendation on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) 1999/519/EC. Available from: <http://ec.europa.eu/enterprise/sectors/electrical/files/lv/rec519_en.pdf > [Accessed January 2024]

EU Electromagnetic Compatibility Directive 2014/30/EU on the approximation of the laws of the Member States relating to electromagnetic compatibility.

International Commission on Non-Ionising Radiation Protection (ICNIRP) (1998) Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz). Health Physics 74 (4): 494-552; 1998. Available from: <www.icnirp.de> [Accessed January 2024]

ICNIRP (2010) Guidelines for limiting exposure to time varying electric and magnetic fields (1 Hz–100 kHz) Health Physics 99(6):818-836; 2010. Available from: <www.icnirp.de> [Accessed January 2024]

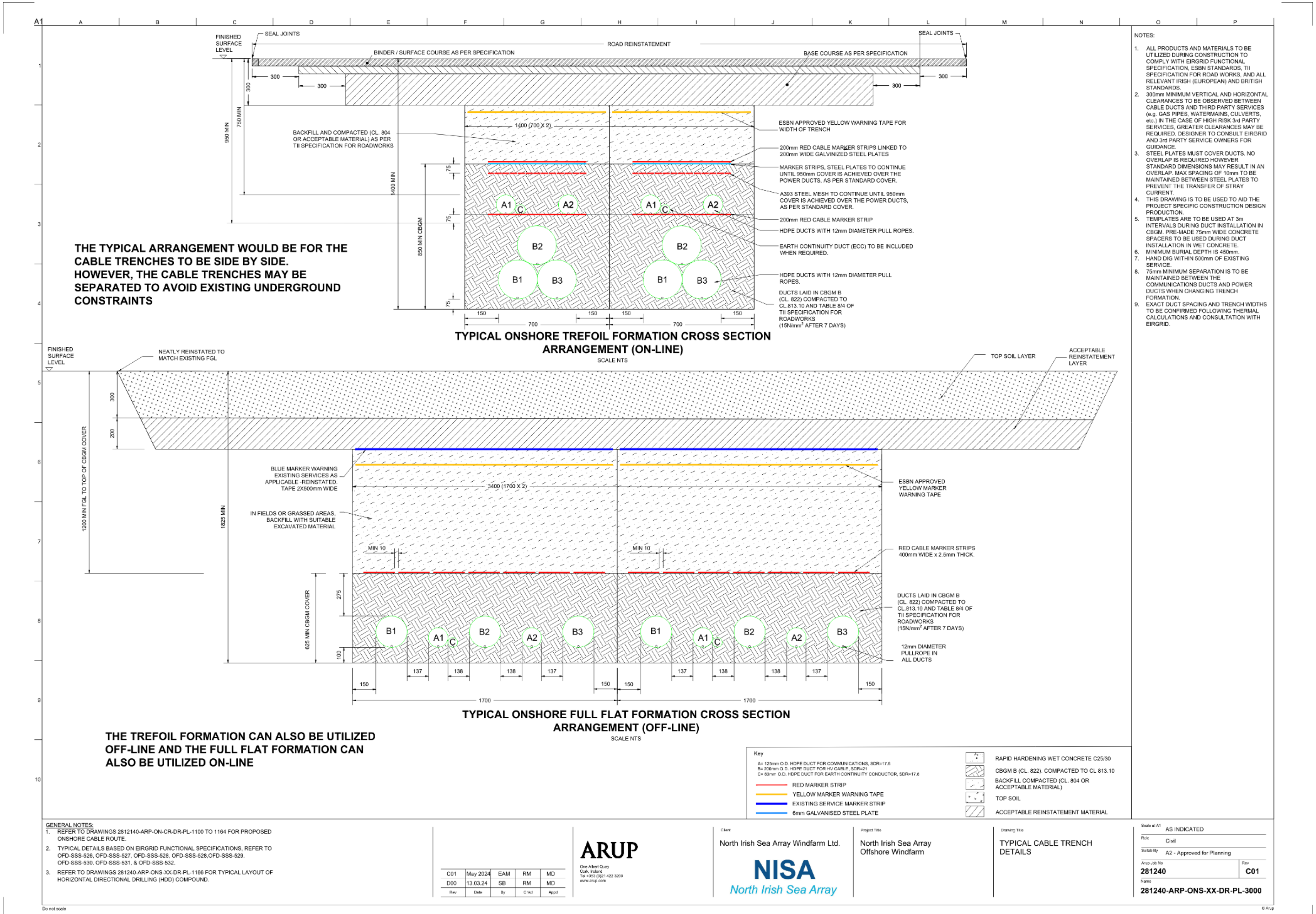
15. Glossary

ELF	Extremely low frequency
EM	Electromagnetic
EMC	Electromagnetic compatibility
EMF	Electromagnetic fields
EMI	Electromagnetic Interference
ICNIRP	International Commission on Non-Ionising Radiation Protection
DC	Direct Current
AC	Alternating current
RFI	Radiofrequency
IARC	International Agency for Research on Cancer
WHO	World Health Organisation

Appendix A

Typical Cable Trench Details (Drawing No 281240-ARP-ONS-XX-DR-PL-3000)

Typical trench details are shown in the image below and on planning drawing 281240-ARP-ONS-XX-DR-PL-3000 *Typical cable trench details* in Appendix 7.1 of Volume 8 of the EIAR.



FINISHED SURFACE LEVEL
SEAL JOINTS
ROAD REINSTATEMENT
BINDER / SURFACE COURSE AS PER SPECIFICATION
BASE COURSE AS PER SPECIFICATION
BACKFILL AND COMPACTED (CL. 804 OR ACCEPTABLE MATERIAL) AS PER TII SPECIFICATION FOR ROADWORKS
ESBN APPROVED YELLOW WARNING TAPE FOR WIDTH OF TRENCH
200mm RED CABLE MARKER STRIPS LINKED TO 200mm WIDE GALVINIZED STEEL PLATES
MARKER STRIPS, STEEL PLATES TO CONTINUE UNTIL 950mm COVER IS ACHIEVED OVER THE POWER DUCTS, AS PER STANDARD COVER.
A393 STEEL MESH TO CONTINUE UNTIL 950mm COVER IS ACHIEVED OVER THE POWER DUCTS, AS PER STANDARD COVER.
200mm RED CABLE MARKER STRIP
HDPE DUCTS WITH 12mm DIAMETER PULL ROPES.
EARTH CONTINUITY DUCT (ECC) TO BE INCLUDED WHEN REQUIRED.
HDPE DUCTS WITH 12mm DIAMETER PULL ROPES.
DUCTS LAID IN CBGM B (CL. 822) COMPACTED TO CL.813.10 AND TABLE 8/4 OF TII SPECIFICATION FOR ROADWORKS (15N/mm² AFTER 7 DAYS)
THE TYPICAL ARRANGEMENT WOULD BE FOR THE CABLE TRENCHES TO BE SIDE BY SIDE. HOWEVER, THE CABLE TRENCHES MAY BE SEPARATED TO AVOID EXISTING UNDERGROUND CONSTRAINTS
TYPICAL ONSHORE TREFOIL FORMATION CROSS SECTION ARRANGEMENT (ON-LINE)
SCALE NTS
NEATLY REINSTATED TO MATCH EXISTING FGL
TOP SOIL LAYER
ACCEPTABLE REINSTATEMENT LAYER
BLUE MARKER WARNING EXISTING SERVICES AS APPLICABLE -REINSTATED. TAPE 2X500mm WIDE
IN FIELDS OR GRASSED AREAS, BACKFILL WITH SUITABLE EXCAVATED MATERIAL
ESBN APPROVED YELLOW MARKER WARNING TAPE
RED CABLE MARKER STRIPS 400mm WIDE x 2.5mm THICK.
DUCTS LAID IN CBGM B (CL. 822) COMPACTED TO CL.813.10 AND TABLE 8/4 OF TII SPECIFICATION FOR ROADWORKS (15N/mm² AFTER 7 DAYS)
12mm DIAMETER PULLROPE IN ALL DUCTS
1200 MIN FGL TO TOP OF CBGM COVER
1825 MIN
625 MIN CBGM COVER
TYPICAL ONSHORE FULL FLAT FORMATION CROSS SECTION ARRANGEMENT (OFF-LINE)
SCALE NTS
THE TREFOIL FORMATION CAN ALSO BE UTILIZED OFF-LINE AND THE FULL FLAT FORMATION CAN ALSO BE UTILIZED ON-LINE
NOTES:
1. ALL PRODUCTS AND MATERIALS TO BE UTILIZED DURING CONSTRUCTION TO COMPLY WITH EIRGRID FUNCTIONAL SPECIFICATION, ESBN STANDARDS, TII SPECIFICATION FOR ROAD WORKS, AND ALL RELEVANT IRISH (EUROPEAN) AND BRITISH STANDARDS.
2. 300mm MINIMUM VERTICAL AND HORIZONTAL CLEARANCES TO BE OBSERVED BETWEEN CABLE DUCTS AND THIRD PARTY SERVICES (e.g. GAS PIPES, WATERMAINS, CULVERTS, etc.) IN THE CASE OF HIGH RISK 3rd PARTY SERVICES, GREATER CLEARANCES MAY BE REQUIRED. DESIGNER TO CONSULT EIRGRID AND 3rd PARTY SERVICE OWNERS FOR GUIDANCE.
3. STEEL PLATES MUST COVER DUCTS. NO OVERLAP IS REQUIRED HOWEVER STANDARD DIMENSIONS MAY RESULT IN AN OVERLAP. MAX SPACING OF 10mm TO BE MAINTAINED BETWEEN STEEL PLATES TO PREVENT THE TRANSFER OF STRAY CURRENT.
4. THIS DRAWING IS TO BE USED TO AID THE PROJECT SPECIFIC CONSTRUCTION DESIGN PRODUCTION.
5. TEMPLATES ARE TO BE USED AT 3m INTERVALS DURING DUCT INSTALLATION IN CBGM. PRE-MADE 75mm WIDE CONCRETE SPACERS TO BE USED DURING DUCT INSTALLATION IN WET CONCRETE.
6. MINIMUM BURIAL DEPTH IS 450mm.
7. HAND DIG WITHIN 500mm OF EXISTING SERVICE.
8. 75mm MINIMUM SEPARATION IS TO BE MAINTAINED BETWEEN THE COMMUNICATIONS DUCTS AND POWER DUCTS WHEN CHANGING TRENCH FORMATION.
9. EXACT DUCT SPACING AND TRENCH WIDTHS TO BE CONFIRMED FOLLOWING THERMAL CALCULATIONS AND CONSULTATION WITH EIRGRID.
Key
A= 125mm O.D. HDPE DUCT FOR COMMUNICATIONS, SDR=17.6
B= 200mm O.D. HDPE DUCT FOR HV CABLE, SDR=21
C= 63mm O.D. HDPE DUCT FOR EARTH CONTINUITY CONDUCTOR, SDR=17.6
RED MARKER STRIP
YELLOW MARKER WARNING TAPE
EXISTING SERVICE MARKER STRIP
6mm GALVANISED STEEL PLATE
RAPID HARDENING WET CONCRETE C25/30
CBGM B (CL. 822). COMPACTED TO CL 813.10
BACKFILL COMPACTED (CL. 804 OR ACCEPTABLE MATERIAL)
TOP SOIL
ACCEPTABLE REINSTATEMENT MATERIAL
GENERAL NOTES:
1. REFER TO DRAWINGS 2812140-ARP-ON-CR-DR-PL-1100 TO 1164 FOR PROPOSED ONSHORE CABLE ROUTE.
2. TYPICAL DETAILS BASED ON EIRGRID FUNCTIONAL SPECIFICATIONS, REFER TO OFD-SSS-526, OFD-SSS-527, OFD-SSS-528, OFD-SSS-528,OFD-SSS-529, OFD-SSS-530, OFD-SSS-531, & OFD-SSS-532.
3. REFER TO DRAWINGS 281240-ARP-ONS-XX-DR-PL-1166 FOR TYPICAL LAYOUT OF HORIZONTAL DIRECTIONAL DRILLING (HDD) COMPOUND.
C01 May 2024 EAM RM MD
D00 13.03.24 SB RM MD
Rev Date By Chkd Appd
ARUP
Client
North Irish Sea Array Windfarm Ltd.
NISA
North Irish Sea Array
Project Title
North Irish Sea Array Offshore Windfarm
Drawing Title
TYPICAL CABLE TRENCH DETAILS
AS INDICATED
Civil
A2 - Approved for Planning
281240
C01
281240-ARP-ONS-XX-DR-PL-3000
Do not scale