

One Earth Solar Farm

Volume 6.0 Environmental Statement [EN010159]

Volume 3: Technical Appendices Supporting ES Volume 1 and 2

Appendix 2.4: Electromagnetic Fields Impact Report

February 2025

Document Reference: EN010159/APP/6.21

Revision 01

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009
– Reg 5 (2) (a)

Contents

Contents	1
A.2 Appendix 2.4: Electromagnetic Fields Impact Report	2
A.2.1 Introduction	2
A.2.2 Legislation, Policy and Guidance	3
A.2.3 Consultation	4
A.2.4 Assessment Methodology	4
Figure 1: EMF Areas	8

A.2 Appendix 2.4: Electromagnetic Fields Impact Report

A.2.1 Introduction

- A.2.1.1. This Report considers the potential effects of the Proposed Development on Electric and Electromagnetic Fields ('EMF'). This includes any significant effects which are likely and the potential for cumulative impacts based on underground cabling. This Report responds to the Scoping Opinion (see **ES Volume 3, Appendix 2.2: ES Response to PINs Scoping Opinion [EN01059/APP/6.21]**) and considers PINs guidance for Scoping Solar Development¹, which states:
- A.2.1.2. *"Where proposed cables are over 132kV, an EMF assessment should be provided in an appendix to the Environmental Statement. This should include the location, routing and voltages of any cables over 132kV and a risk assessment to any human and ecological sensitive receptors within the Zol."*
- A.2.1.3. Electric fields are the result of voltages applied to electrical conductors and equipment. Fences, shrubs and buildings easily block electric fields. EMF are produced by the flow of electric current; however, unlike electric fields, most materials do not readily block EMF. The intensity of both electric fields and EMF diminishes with increasing distance from the source.
- A.2.1.4. No overhead electricity cables will be used or constructed as part of the Proposed Development. Except for relatively short lengths of low voltage onsite electrical cabling connecting the solar panels and the Power Conversion Systems (PCS) (which is typically above ground level and fixed to the mounting structure, or to other parts of nearby components), all cables will be buried underground. The dimension of the trenches will vary depending on the number of cables or ducts they contain as are further described in **ES Volume 1, Chapter 5: Description of the Proposed Development [EN010159/APP/6.5]**. Underground cables eliminate the electric field altogether as it is screened out by the sheath around the cable, and therefore the assessment only considers EMF, in particular above 132kV.
- A.2.1.5. Onsite electrical cabling is required to connect the solar panels to PCS and from the PCS to the transformers. These low voltage cables are all less than 1.5kV. They are anticipated to have a typical maximum installation depth of up to 1.20m.

¹ Planning Inspectorate (2024), Nationally Significant Infrastructure Projects: Technical Advice Page for Scoping Solar Development. Available at: <https://www.gov.uk/guidance/nationally-significant-infrastructure-projects-technical-advice-page-for-scoping-solar-development>

- A.2.1.6. The medium voltage 33kV interconnecting cables are then required to transfer electricity between the transformers/switchgear at PCS and one of the substations. The typical installation depth is expected to be 1.2m. The routes of the interconnecting cables have been designed to avoid sensitive receptors as far as possible. The majority of interconnecting cables lie within the Solar PV Site and Grid Connection Corridor.
- A.2.1.7. From the interconnecting cables, the electricity is then exported from the substations to the proposed National Grid (NG) High Marnham 400kV substation by 400kV underground cables via the Grid Connection Corridor. The typical installation depth is expected to be up to 3.0m. The exact locations will be identified following further utility surveys.

A.2.2 Legislation, Policy and Guidance

- A.2.2.1. Legislation, planning policy, and guidance relating to Electric and EMF and pertinent to the Proposed Development comprise of the documents listed below.

Legislative Framework – Electric and EMF

- > The Control of Electromagnetic Fields at Work Regulations 2016²

National Planning Policy – Electric and EMF

- > National Policy Statement for Electricity Networks Infrastructure (EN-5) (2023)³.

Guidance – Electric and EMF.

- > DECC (2012). Power Lines: Demonstrating Compliance with EMF public exposure guidelines⁴.
- > National Grid (2015). Undergrounding high voltage electricity transmission lines⁵.
- > Energy Networks Association (2017). Electric and Magnetic Fields⁶.

² Control of Electromagnetic Fields at Work Regulations (CEMFAW) (2016). Available at: <https://www.legislation.gov.uk/uksi/2016/588/contents>

³ Department for Energy Security and Net Zero (2024) National Policy Statement for electricity networks infrastructure (EN-5). Available at: <https://www.gov.uk/government/publications/national-policy-statement-for-electricity-networks-infrastructure-en-5>

⁴ Available at: <https://assets.publishing.service.gov.uk/media/5a796799ed915d07d35b5397/1256-code-practice-emf-public-exp-guidelines.pdf>

⁵ Available at: https://www.nationalgrid.com/electricity-transmission/sites/et/files/documents/45349-Undergrounding_high_voltage_electricity_transmission_lines_The_technical_issues_INT.pdf

⁶ Available at: <https://www.energynetworks.org/publications/electric-and-magnetic-fields-facts>

- > International Commission on Non-Ionizing Radiation Protection (ICNIRP) (1998). Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz)⁷.
- > Department of Transport (2002) The Town and Country Planning (Safeguarded Aerodromes, Technical Sites and Military Explosives Storage Areas) Direction (updated 2016)⁸.

A.2.3 Consultation

- A.2.3.1. The Scoping Report in **Appendix 2.1 in ES Volume 3, Technical Appendices Supporting ES Volumes 1 and 2 [EN010159/APP/6.21]** records the findings of the scoping exercise and details the technical guidance, standards and best practice and criteria to be applied in the assessment to identify and evaluate the likely significant effects of the Proposed Development on Electric and EMF.
- A.2.3.2. The Scoping Opinion response relating to EMF is included in **Appendix 2.2 ES Response to PINs Scoping Opinion in ES Volume 3, Appendix 2.2 [EN01059/APP/6.21]**.

A.2.4 Assessment Methodology

Assumptions, Limitations and Uncertainties

- A.2.4.1. Underground cables eliminate the electric field altogether as it is screened out by the sheath around the cable, but they still produce EMF. Therefore, effects of electric fields are not considered within the assessment, but effects of EMF have been considered further.
- A.2.4.2. The Control of Electromagnetic Fields at Work Regulations 2016 sets out the duties of employers in relation to controlling the risks of EMF to employees. This includes a requirement to assess employees' potential exposure to EMF with reference to action levels (ALs) and exposure limit values (ELVs). Therefore, as the effects of EMF on workers for the Proposed Development will be controlled and mitigated to acceptable levels through the legislative framework, impacts on workers are not considered within the assessment. The assessment therefore focusses on the potential impacts on the public.
- A.2.4.3. Similarly, as noted in NPS EN-5, electric and magnetic fields have the potential to have adverse impacts on aviation. NPS EN-5 states that the Secretary of State should take account of statutory technical aviation

⁷ Available at: <https://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf>

⁸ Available at: <https://www.gov.uk/government/publications/safeguarding-aerodromes-technical-sites-and-military-explosives-storage-areas/the-town-and-country-planning-safeguarded-aerodromes-technical-sites-and-military-explosives-storage-areas-direction-2002>

safeguarding zones when assessing Development Consent Order applications. These safeguarding zones are defined in Planning Circular 01/0318: Safeguarding Aerodromes, Technical Sites and Military Explosive Storage Areas (Ref. 16 80). The Site is not within the safeguarding zone of any safeguarded civil aerodrome as listed on Annex 3 of the planning circular: Officially safeguarded civil aerodromes. It is noted that the closest airfield to the Site is Retford (Gamston) Airport, approximately 12km away, but this is not included in Annex 3. Additionally, at the distances of separation between the underground cables, the on-site substations and potential aviation receptors, the levels of EMF experienced by potential aviation receptors are considered to be negligible and therefore aviation receptors are not included in the assessment.

- A.2.4.4. EN-5 (paragraph 2.9.8) recognises that there is little evidence that exposure of crops, farm animals and natural ecosystems to transmission line EMF has any agriculturally significant consequences. Consequently, consideration of the impacts to agriculture and natural ecosystems has not been included within the assessment.
- A.2.4.5. The DECC guidance document states that underground cables at voltages up to and including 132kV are considered not capable of exceeding the ICNIRP exposure guidelines for EMF and that compliance with exposure guidelines for such equipment can be assumed unless evidence is brought to the contrary in specific cases.
- A.2.4.6. The onsite electrical cabling is not considered in the assessment as it has a voltage of less than 1.5kV and therefore would not significantly contribute to any increase in EMF should it overlap with other infrastructure. Similarly, the intermediary voltage level Electrical Cabling (33kV) is not considered in the assessment. The planned grid connection for the Proposed Development is at the proposed NG High Marnham 400kV substation. As this is higher than 132kV it is necessary to perform an evaluation as to whether the exposure limitations stated in ICNIRP 1998 are likely to be exceeded.
- A.2.4.7. The ICNIRP 'reference levels' for the general public exposure are 100 microteslas (μT) and 5000 Volt per metre (Vm^{-1}) or EMF. The reference levels are not in themselves limits but provide guidance for assessing compliance with the basic restrictions and reducing the risk of indirect effects. The reference level is the level above which more investigation is needed if this level of exposure is likely to occur. The permitted levels of exposure (basic restriction) are somewhat higher, 360 μT and 9000 Vm^{-1} . They apply where the time of exposure is significant, for instance in a residence. As a worst-case the lower 'reference level' of 100 μT is used in the assessment as the threshold at which potentially significant effects could occur.
- A.2.4.8. The NG guidance document states that for a 400kV cable buried at 0.9m depth, the typical magnetic field is 24 μT when on the centre line of the cable, 3 μT at 5m from the cable centreline, and 0.9 μT at 10m the cable centreline,

with the maximum known by NG being 96 μ T on top of the cable, 13 μ T at 5m, and 3.6 μ T at 10m. The maximum recorded levels of EMF directly above an underground 400kV cable are therefore less than 30% of the permitted levels and 96% of the reference levels set by ICNIRP.

- A.2.4.9. For context, the Energy Networks Association publication 'Electric and Magnetic Fields' states that in 'the vast majority of homes in the UK, the magnetic field, averaged over 24 hours, is between 0.01 and 0.2 μ T, but goes on to note that exposure to EMF from a vacuum cleaner is 800 μ T, reducing to 2 μ T at 1m away, and for a TV, washing machine or microwave exposure is 50 μ T next to these appliances and 0.2 μ T at 1m distance.
- A.2.4.10. Using NG's maximum known levels of electro-magnetic field generation for 400kV cables, the assessment considers that as a worse case a residential receptor would need to be within 5m of the centreline of a 400kV grid connection cable, and for the cable to be overlapped by other electricity infrastructure, for the 100 μ T threshold to be approached and for potentially significant effects to occur.

Assessment of Likely Effects

- A.2.4.11. There are no residential properties within the Order Limits. The nearest properties are at least 5m from the Order Limits and it is unlikely cables will be installed that close to any property due to the need for construction vehicles to manoeuvre both sides of the trench within the working width. Cables would be installed at a minimum of 10m from the façade of any residential dwelling. Therefore, no significant effects to residential receptors are predicted to occur.
- A.2.4.12. Some Public Rights of Way (PRoW) do cross over the proposed interconnecting and grid connection cable corridors, and may also pass over the interconnecting and grid connection cables where they are routed within the Solar PV Site. PRoW are shown in **Volume 2, Plans/Drawings/Sections, Streets, rights of way and access plans [EN010159/APP2.4]**. The presence of the public either directly above or adjacent to underground cables associated with the Proposed Development would be transient, with the individuals using the PRoW exposed to EMF from the cables for only very short periods of time. It is considered that the level of exposure to users of PRoW would be similar to that associated with general household appliances (and noticeably less than associated with the exposure when using a vacuum cleaner). Therefore, no significant effects to users of PRoW are predicted to occur.
- A.2.4.13. Three locations where cumulative EMF exposure could occur have been identified in Figure 1. It is noted that there are no PRoWs or residential properties within 100m of these locations. Resultant magnetic field strength due to interactions between the underground export cabling and the existing NG overhead lines (OHLs) has not been modelled/calculated. However, it is noted that there are no PRoWs or residential properties within 100m of these

locations. At these distances, magnetic field strengths will be well below the ICNIRP reference level of 100µT.

- A.2.4.14. **ES Volume 3, Chapter 6: Biodiversity [EN010159/APP/6.6]** describes the following migratory fish being present in the River Trent European Eel; River and Sea Lamprey; Allis and Twaite Shad; European Smelt and Salmonids. Data provided on the 'EMFs.info' website (which is run by NG on behalf of the UK electricity industry) identifies salmon and trout as being sensitive to direct current (DC) EMF, noting that they are expected to be 'much less sensitive' to alternating current (AC) fields. The 400kV grid connection cables are AC.
- A.2.4.15. There is limited evidence regarding the impacts of EMF on fish and the major studies which have been undertaken are for subsea cabling rather than inland (fresh or brackish) waters. However, in its consideration of off-shore wind developments National Policy Statement EN-3: Renewable Energy Infrastructure states (at paragraph 2.6.76) that EMF from subsea cabling:
- A.2.4.16. *"may be mitigated by use of armoured cable for inter-array and export cables which should be buried at a sufficient depth. Some research has shown that where cables are buried at depths greater than 1.5 m below the seabed, impacts are likely to be negligible. However sufficient depth to mitigate impacts will depend on the geology of the sea bed".* Paragraph 2.6.75 states that where the mitigation set out in paragraph 2.6.76 is followed *"the residual effects of EMF on sensitive species from cable infrastructure during operation are not likely to be significant. Once installed, operational EMF impacts are unlikely to be of sufficient range or strength to create a barrier to fish movement"*.
- A.2.4.17. Therefore, considering the following factors:
- > Salmon and trout are less sensitive to AC than DC EMF;
 - > The AC grid connection cables are sheathed; and
 - > The installation depth of the cables will be at least 5 m below the watercourse bed of the River Trent (secured through the Construction Environmental Management Plan (CEMP)).
- A.2.4.18. It is considered that there would be no significant effects to the migratory fish species using the River Trent due to the generation of EMF by the grid connection cables.

Summary

- A.2.4.19. A review of the cabling routes, the type of cabling and the location of sensitive receptors have been undertaken. As above, the assessment shows there would be **no significant effects** from EMF associated with the Proposed Development on sensitive users, including on fish within the River Trent.

Figure 1: EMF Areas

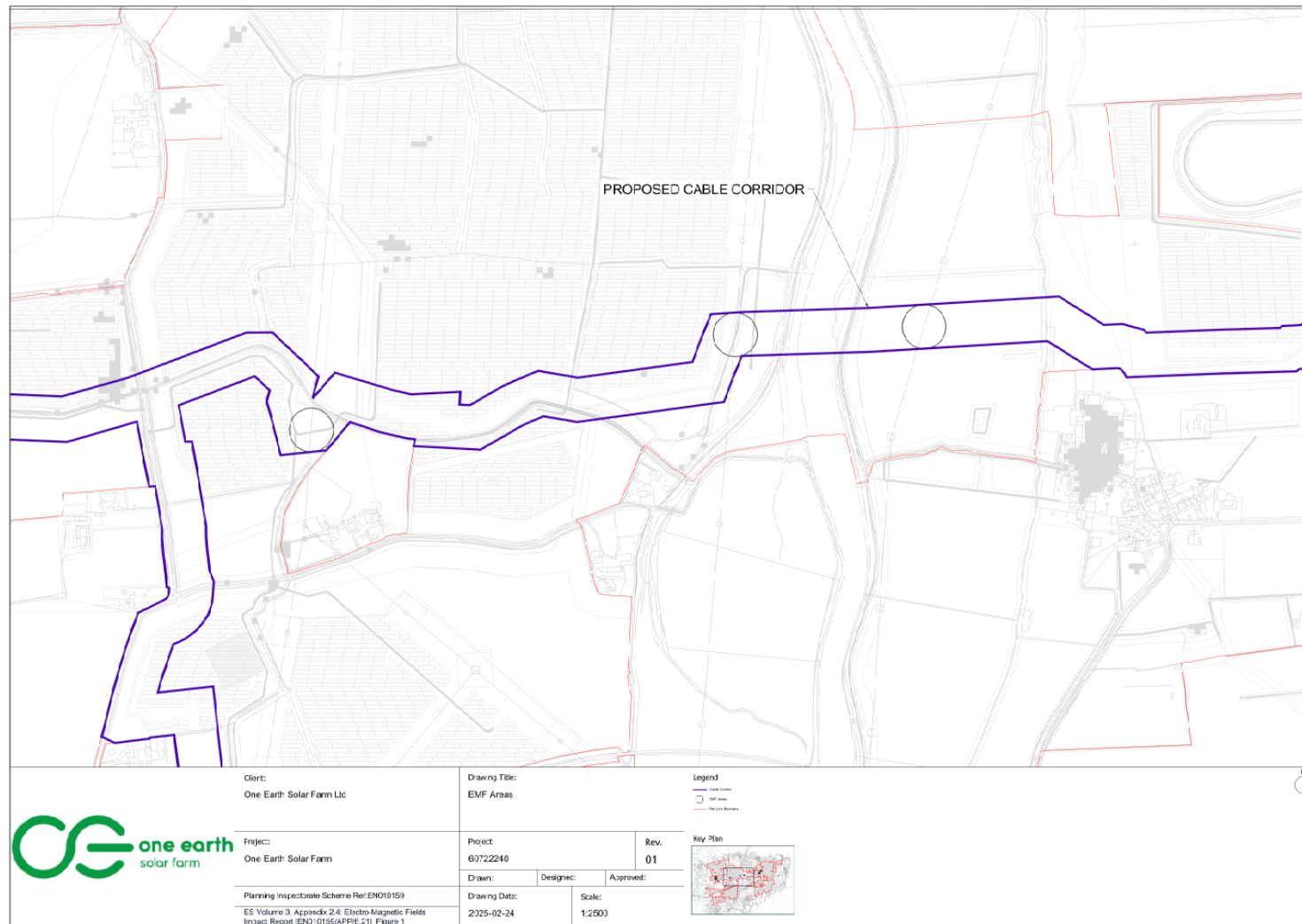


Figure 1 – Cumulative EMF areas



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