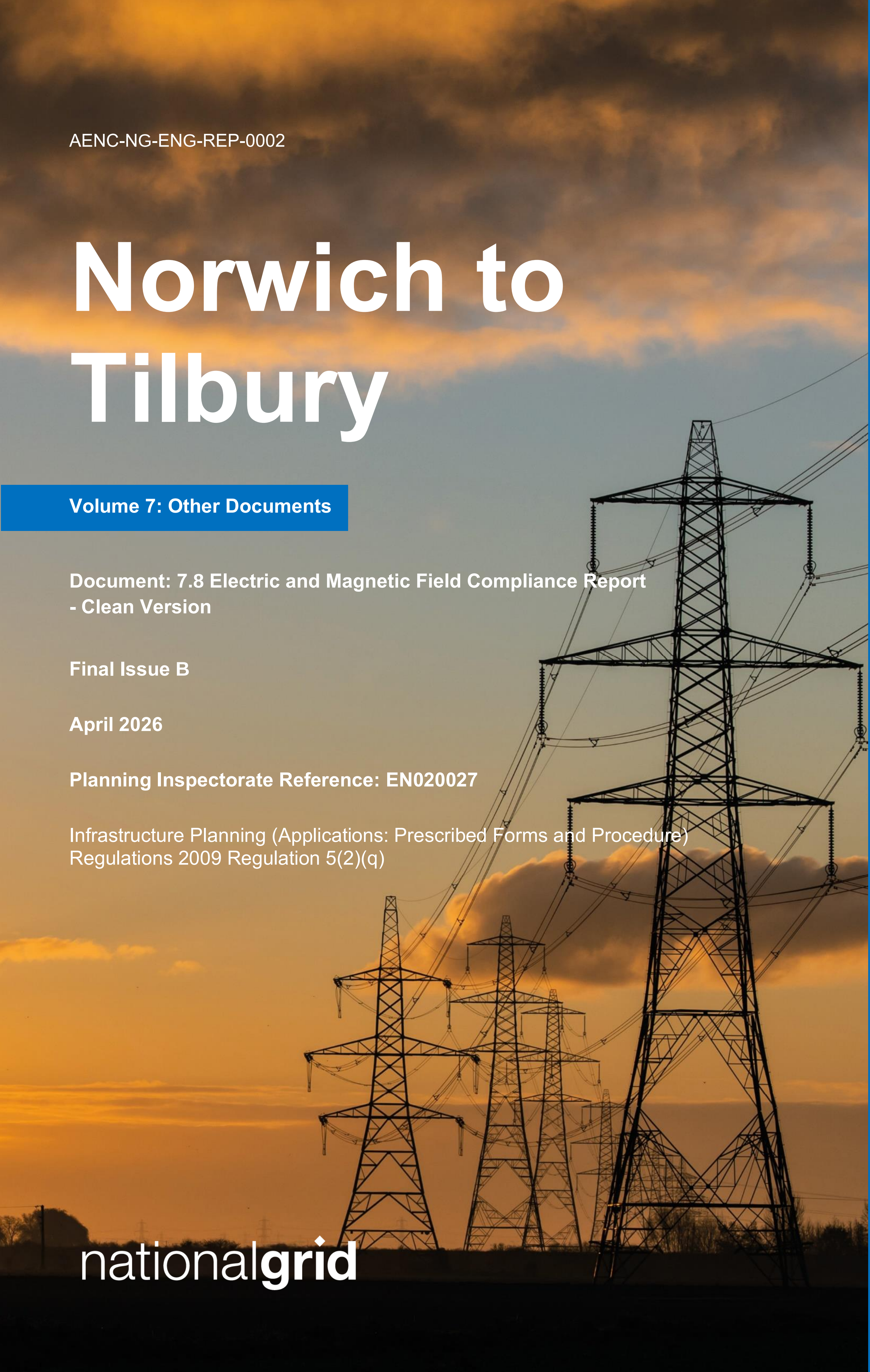


AENC-NG-ENG-REP-0002

Norwich to Tilbury

Volume 7: Other Documents

Document: 7.8 Electric and Magnetic Field Compliance Report - Clean Version

Final Issue B

April 2026

Planning Inspectorate Reference: EN020027

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 Regulation 5(2)(q)

nationalgrid

Revision History

Version	Date	Submitted at
A	29 August 2025	DCO Application
B	10 April 2026	Deadline 3

Contents

1. Introduction

1.1 The Applicant

1.1.1 National Grid Electricity Transmission ('National Grid') owns and maintains the national high voltage electricity transmission network throughout England and Wales.

1.1.2 The transmission network connects the power from where it is generated to the regional Distribution Network Operators (DNO) who then supply businesses and homes.

1.1.3 National Grid holds the Transmission Licence for England and Wales, and its statutory duty is to develop and maintain an efficient, coordinated and economical system of electricity transmission and to facilitate competition in the generation and supply of electricity, as set out in the Electricity Act 1989.

1.1.4 This document accompanies National Grid's application for an order granting development consent to build a new 400 kilovolt (kV) electricity transmission connection of approximately 180 km overall length from Norwich Main Substation to Tilbury Substation via Bramford Substation, a new East Anglia Connection Node (EACN) Substation and a new Tilbury North Substation, including:

- Approximately 159 km of new overhead line supported on approximately 509 pylons, either standard steel lattice pylons (approximately 50 m in height) or low height steel lattice pylons (approximately 40 m in height) and some of which would be gantries (typically up to 15 m in height) within proposed Cable Sealing End (CSE) compounds or existing or proposed substations
- Approximately 21 km of 400 kV underground cabling, some of which would be located through the Dedham Vale National Landscape (an Area of Outstanding Natural Beauty)
- Up to seven new CSE compounds (with permanent access) to connect the overhead lines to the underground cables
- Modification works to connect into the existing Norwich Main Substation and a substation extension at the existing Bramford Substation
- A new 400 kV substation on the Tendring Peninsula, referred to as the EACN Substation (with a new permanent access). This is proposed to be an Air Insulated Switchgear (AIS) substation
- A new 400 kV substation to the south of Orsett Golf Course in Essex, referred to as the Tilbury North Substation (with a new permanent access). This is proposed to be a Gas Insulated Switchgear (GIS) substation
- Modifications to the existing National Grid Electricity Transmission overhead lines to facilitate the connection of the existing network into the new Tilbury North Substation to provide connection to the Tilbury Substation
- Ancillary and/or temporary works associated with the construction of the Project.

1.1.5 The Project meets the threshold as a Nationally Significant Infrastructure Project, as defined under Part 3 of the Planning Act 2008, hence National Grid requires a Development Consent Order. Some aspects of the Project constitute 'associated development' under the Planning Act 2008. Where these developments produce electric and magnetic fields (EMFs), assessments have been conducted to ensure compliance with relevant electric and magnetic field exposure limits.

1.1.6 For a full description of the Project, reference should be made to Chapter 4: Project Description of the Environmental Statement (document reference 6.4).

1.2 Purpose of this Report

1.2.1 This report provides an assessment and conclusions of the compliance of EMFs produced by the Project with the requirements of National Policy Statement (NPS) EN-5 (Department for Energy Security & Net Zero (DESNZ), 2024a).

1.2.2 National Grid has a very clear policy on EMFs, as set out in its Public Position Statement[1] which states '*In all our operations, as a minimum, we comply with legal requirements, including relevant EMF regulations. We also aim to follow industry guidelines or best practice in the countries and different jurisdictions in which we operate*', and this policy would be applied to the Project. As is explained in more detail in Policy and Legislation, compliance with the relevant guidelines and practices in force in the UK ensures that there would be no significant health or environmental effects of EMFs. Therefore, it was proposed in the Norwich to Tilbury Scoping Report (document reference 6.19) that the assessment of EMF be scoped out of the Environmental Statement (ES). It was instead proposed that comprehensive information about EMFs be provided in a separate report to be submitted with the application for development consent.

1.2.3 The Scoping Opinion (The Planning Inspectorate, 2022), which was received December 2022, states:

- EMFs – construction: The Inspectorate agrees that an assessment of EMFs during construction can be scoped out on the basis that they are associated with power distribution.
- EMFs – operation: On the basis that the Proposed Development would be designed in accordance with cited Government guidance and precautionary policies (and that a compliance report will be submitted with the application for development consent), the Inspectorate agrees that an assessment of effects from EMFs during operation can be scoped out of the ES. However, the Inspectorate considers that the ES should contain a summary of the compliance report.

1.2.4 The Secretary of State and the Planning Inspectorate have previously accepted, for other Nationally Significant Infrastructure Projects submitted by National Grid, the required EMF information being provided in a separate report. Based on this and the response provided in the Scoping Opinion, National Grid has produced this separate document covering EMFs, submitted as part of the application for development consent.

[1] National Grid's Public Position Statement on Electric and Magnetic Fields see Appendix A

1.3 Introduction to Electric and Magnetic Fields (EMFs)

1.3.1 EMFs and the electromagnetic forces they represent are an essential part of the physical world. Their sources are the charged fundamental particles of matter (principally electrons and protons). EMFs occur naturally within the body in association with nerve and muscle activity, allowing these functions to take place. Humans also experience the natural static magnetic field of the Earth (to which a magnetic compass responds) and natural static electric fields in the atmosphere.

1.3.2 EMFs occur in the natural world, and people have been exposed to them for the whole of human evolution. The advent of modern technology and the wider use of electricity and electrical devices have inevitably introduced changes to the naturally occurring EMF patterns. Energised high voltage power-transmission equipment, along with all other uses of electricity, is a source of EMF. The UK power system mainly uses alternating current (AC) so the fields that are produced are likewise alternating. The EMFs have the same frequency as the voltages and currents that produce them, which is 50 hertz (Hz) in the UK. The fields are described as power-frequency or extremely-low-frequency (ELF) EMFs and exist in addition to the Earth's steady natural fields.

1.3.3 Electric fields depend on the operating voltage of the equipment producing them and are measured in volts per metre (symbol V/m). The operating voltage of most equipment is a relatively constant value. Electric fields are shielded by most common building materials, trees and fences, and diminish rapidly with distance from the source.

1.3.4 Magnetic fields are measured in microteslas (symbol μT) and depend on the electrical currents flowing, which vary according to the electrical power requirements at any given time. They are not significantly shielded by most common building materials or trees but do diminish rapidly with distance from the source.

1.3.5 The EMFs are assessed in detail in this report. It can be noted here that above-ground equipment produces both electric and magnetic fields, whereas underground cables produce only a magnetic field, as the electric field is confined within the cable by the metallic sheath of the cable.

1.3.6 EMF at 50 Hz can cause induced currents to occur in the body, which, if high enough, can interfere with nerves. There are Government-adopted exposure guidelines (discussed in Policy and Legislation), which are set to protect against these known or direct effects of EMF exposure. There are also ‘indirect’ effects that can occur as a result of exposure to EMFs, and which are not explicitly covered by the exposure guidelines. Examples of indirect effects are interference with active implantable medical devices (AIMDs), and microshocks (discussed in paragraphs 2.9.1 to 2.10.7). The potential impact of both direct and indirect effects has been assessed using the guidance provided in NPS EN-5 (DESNZ, 2024a) and the codes of practice (discussed in Policy and Legislation).

1.3.7 EMFs at much higher frequencies, typically hundreds of thousands of times higher than those generated by the electricity transmission system, can be generated by other devices, e.g. radio, television transmissions and microwaves. These higher frequencies interact with objects and people in a different way to power frequencies, for example by heating the body, so in scientific terms these are a different phenomenon, and it is important to make the distinction.

1.3.8 EMFs produced by electricity transmission systems at 50 Hz (ELF) are termed as non-ionising radiation. Non-ionising radiation is the term given to radiation in the part of the electromagnetic spectrum where there is insufficient energy to cause ionisation. It includes EMFs, radio waves, microwaves, infrared, ultraviolet and visible radiation.

1.3.9 Ionising radiation includes X-ray and gamma-ray radiation which present a high risk to human health.

2. Policy and Legislation

2.1 Overview of Policy

2.1.1 Whilst there are no statutory regulations in the UK that limit the exposure of the general public to power-frequency EMF, responsibility for implementing appropriate measures for the protection of the public lies with the UK Government which has a clear policy, incorporated in NPS EN-5 (DESNZ, 2024a) on the exposure limits; and other policies it expects to see applied. Practical details of how the policy is to be implemented are contained in Power Lines: Demonstrating compliance with EMF public exposure guidelines – a voluntary Code of Practice' (Department of Energy & Climate Change (DECC), 2012a) (hereon referred to as the Code of Practice on Compliance) agreed between industry and Government.

2.1.2 Government in turn acts on the scientific advice from the UK Health Security Agency (UKHSA), which has responsibility for advising on non-ionising radiation protection, including power-frequency EMF. The National Radiological Protection Board (NRPB) had this responsibility until becoming part of the Health Protection Agency (HPA) on 1 April 2005, which in turn was replaced by Public Health England (PHE) on 1 April 2013. PHE officially became the UKHSA in October 2021. This report refers to UKHSA, PHE, NRPB or HPA according to the name of the organisation at the time each statement was issued.

2.1.3 In 2004, following a recommendation by the then NRPB (NRPB, 2004a), the UK Government adopted exposure guidelines for the public published in 1998 by the International Commission on Non-Ionizing Radiation Protection (ICNIRP, 1998) in line with the terms of the 1999 European Union (EU) Recommendation (European Commission (EC), 1999) on public exposure to EMF. In a Written Ministerial Statement in October 2009 (Department of Health, 2009) (references to the Written Ministerial Statement encompass both the Statement itself and the detailed Response to the Statement) the Government restated this policy of compliance with exposure limits. In addition, acting on the recommendations of a stakeholder process, it added a single precautionary measure in relation to high voltage infrastructure, a policy of optimum phasing of some overhead lines. 'Optimum phasing' is an engineering measure that can be incorporated in the design of some overhead lines, which reduces the EMFs they produce with distance and is considered in detail in Section 6.2. The Government also made clear in the Written Ministerial Statement that no other precautionary measures are appropriate for high voltage infrastructure.

2.1.4 These two policies (compliance with exposure limits and optimum phasing) are the only ones applying to high voltage infrastructure. The National Policy Statement for Energy (EN-1) (DESNZ, 2024b) does not contain any provisions specific to EMF. NPS EN-5 (DESNZ, 2024a) documents these policies, and they are explained below.

2.2 National Policy Statement EN-5

2.2.1 The Government has set out clear policies on control of EMF exposures in general. NPS EN-5 (DESNZ, 2024a) gives clear guidance on the EMF requirements of all electricity infrastructure projects stating: '*Before granting consent to an overhead line application, the Secretary of State should be satisfied that the proposal is in accordance with the guidelines, considering the evidence provided by the applicant and any other relevant evidence…'* (paragraph 2.11.10). *'Where the applicant cannot demonstrate that the line will be compliant … with the exposure guidelines as specified in the Code of Practice on compliance, and with the policy on phasing as specified in the Code of Practice on optimal phasing then the Secretary of State should not grant consent'* (paragraph 2.11.12).

2.2.2 The relevant paragraphs are summarised in Table 2.1, with a reference to where they are covered in this report, and a summary of how the Project complies with each policy requirement.

Table 2.1 Summary of NPS EN-5 requirements relevant to EMF

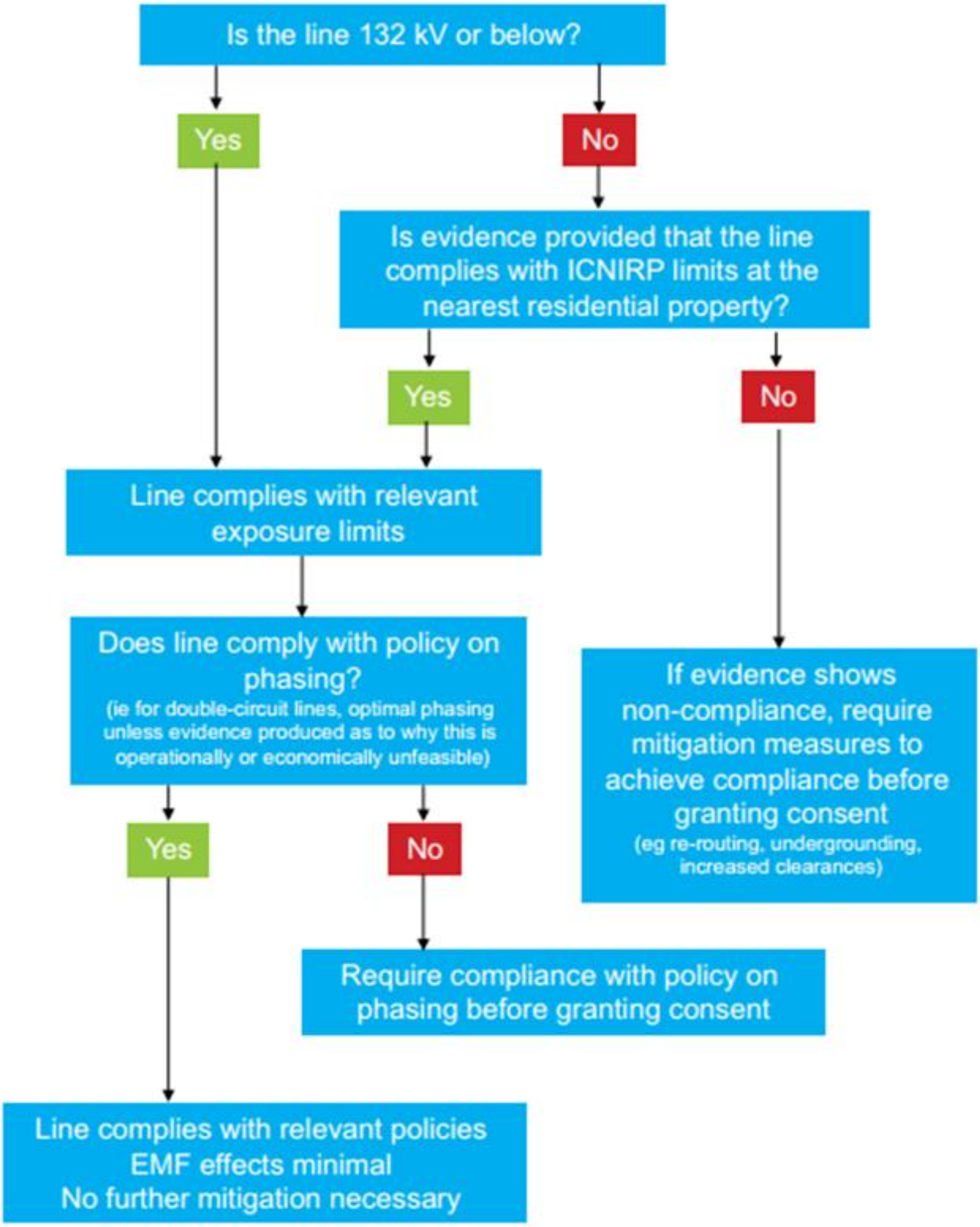
Paragraph	Requirement	Section of this report	Compliance assessment
2.10.12	'*Where it can be shown that the line will comply with the current public exposure guidelines and the policy on phasing, no further mitigation should be necessary*.'	6	This report shows that the Proposed Project would be compliant with the current public exposure guidelines (ICNIRP, 1998) and the policy on phasing using the principles in the Code of Practice on Compliance (DECC, 2012a) and 'Optimum Phasing of high voltage double-circuit Power Lines – A Voluntary Code of Practice' (DECC, 2012b) (hereon referred to as the Code of Practice on Optimum Phasing).
2.11.10	'*Before granting consent to an overhead line application, the Secretary of State should be satisfied that the proposal is in accordance with the guidelines, considering the evidence provided by the applicant and any other relevant evidence. It may also need to take expert advice from the Department of Health and Social Care*.'	6	All the EMFs produced by the proposed project would comply with the Government-adopted guidelines (ICNIRP, 1998), as demonstrated in this report.
2.11.11	'*Industry currently applies optimal phasing to 275kV and 400kV overhead lines voluntarily wherever operationally possible, which*	6.2	The overhead line has been designed in compliance with the policy on optimum phasing as specified in the Code of Practice on

Paragraph	Requirement	Section of this report	Compliance assessment
	helps to minimise the effects of EMF. The government has developed with industry a voluntary Code of Practice, 'Optimum Phasing of high voltage double-circuit Power Lines – A Voluntary Code of Practice', published in March 2012, that defines the circumstances where industry can and will optimally phase lines with a voltage of 132kV and above.'		Optimum Phasing (DECC, 2012b), as demonstrated in this report.
2.11.16	The diagram at the end of Section 2.11 shows a basic decision tree for dealing with EMF from overhead power lines to which the Secretary of State can refer.	2.2 in Figure 2.1	This decision tree has been replicated in Figure 2.1 and forms the basis for the assessment of EMFs from the Project.
2.10.11	'*The applicant should have considered the following factors:* *Height, position, insulation and protection (electrical or mechanical as appropriate) measures subject to ensuring compliance with the Electricity Safety, Quality and Continuity Regulations 2002.*'	2.12 and 6.2	The proposed overhead line has been designed to comply with the statutory requirements of the Electricity Safety, Quality and Continuity Regulations 2002 (The Electricity Safety, Quality and Continuity Regulations, 2002). EMF requirements can, for some designs of overhead line, result in conductor clearances to ground (one of the requirements of these regulations) being increased but never reduced compared to the requirements of the Electricity Safety, Quality and Continuity Regulations 2002. The minimum conductor clearance information provided in this report demonstrates this compliance.
	'*that optimal phasing of high voltage overhead power lines is introduced wherever possible and practicable in accordance with the Code of Practice to minimise EMFs*'...	6.2	The overhead line has been designed in line with the policy on optimum phasing as specified in the Code of Practice on Optimum Phasing (DECC, 2012b).

Paragraph	Requirement	Section of this report	Compliance assessment
	'*any new advice emerging from the Department of Health and Social Care relating to government policy for EMF exposure guidelines.*'	2.6	This has been considered in this chapter, and all current advice has been used for the assessment. The assessment has been carried out against the current Government-recommended EMF exposure guidelines and policies.
2.11.13	'*Undergrounding of a line would reduce the level of EMFs experienced, but high magnetic field levels may still occur immediately above the cable. It is the government's policy that power lines should not be undergrounded solely for the purpose of reducing exposure to EMFs.*'	2.7	This report shows that the Project would be compliant with the current public exposure guidelines so re-routing or undergrounding are not proportionate as mitigation for EMFs.

2.2.3 A simplified route map for dealing with EMFs is provided in NPS EN-5 (DESNZ, 2024a) and is reproduced in Figure 2.1.

Figure 2.1 Simplified route map for dealing with EMF. Reproduced from NPS EN-5 (page 34)



2.2.4 All relevant legislation, policies and guidance, including those contained within NPS EN-5 (DESNZ, 2024a), have been reviewed and applied to this EMF assessment of the Project. These policies, guidance and legislation are explained and documented below including, for openness and transparency, a commentary of the science on which these have been based.

2.3 Public Exposure Limits

2.3.1 In March 2004, the then NRPB provided new advice to Government (NRPB, 2004a), replacing previous advice from 1993, and recommending the adoption in the UK of guidelines published in 1998 (ICNIRP, 1998). The Government subsequently adopted this recommendation, saying that limits for public exposures should be applied in the terms of the 1999 EU Recommendation (EC, 1999). This Government policy was subsequently set out more formally in the Written Ministerial Statement and incorporated into NPS EN-5 (DESNZ, 2024a). Table 2.2 below summarises the relevant values for power frequencies.

Table 2.2 Exposure limits for power-frequency EMF

Public Exposure Limits	**Electric Fields**	**Magnetic Fields**
Basic restriction (induced current density in central nervous system)	2 mA/m^2	
Reference level (external unperturbed field)	5 kV/m	100 μT
Field corresponding to the basic restriction (external unperturbed field)	9 kV/m	360 μT

2.3.2 In recommending these levels, the NRPB considered the evidence for all suggested effects of EMF. It was concluded that the evidence for effects on the nervous system of currents induced by the fields was sufficient to justify setting exposure limits, and this is the basis of the quantitative recommendations (NRPB, 2004). It was concluded that the evidence for effects at lower fields, for example the evidence relating to childhood leukaemia, was not sufficient to justify setting exposure limits, but was sufficient to justify recommending that Government consider possible precautionary actions. Precautionary measures are considered in more detail below.

2.3.3 The EMF guidelines are documented in NPS EN-5 (DESNZ, 2024a) and practical details of their application are given in the Code of Practice on Compliance (DECC, 2012a). It is the electricity industry's policy to comply with Government guidelines on EMF, and this Code of Practice forms an integral part of this policy.

2.3.4 The ICNIRP guidelines (ICNIRP, 1998) are set to limit the currents induced in the body by external exposure to EMFs to below the threshold for those currents having any effects. These induced currents can be expressed as a current density, and this is the quantity on which the guidelines are based. Specifically, the ICNIRP guidelines recommend that the general public not be exposed to levels of EMFs able to cause a current density of more than 2 mA/m^2 within the human central nervous system, as shown in Table 2.2. This value of the induced current density is described as the 'basic restriction'. The 1999 EU Recommendation (EC, 1999) uses the same basic restriction value as ICNIRP.

2.3.5 However, the basic restriction cannot be assessed directly since *in vivo* measurements of current density are not practicable. Instead, the external fields that have to be applied to the body to produce this current density are calculated by numerical dosimetry. Those calculations are normally performed for uniform fields because this is the most onerous exposure condition; non-uniform fields produce lower induced currents.

2.3.6 Therefore, the ICNIRP guidelines also contain values of the external fields called ‘reference levels’. For the public, the reference level for electric fields is 5 kV/m, and the reference level for magnetic fields is 100 μT. The 1999 EU Recommendation uses the same reference level values as ICNIRP.

2.3.7 In the ICNIRP guidelines (ICNIRP, 1998) and the EU Recommendation (EC, 1999), the limit that compliance should be achieved against is the basic restriction. The reference levels are not limits but are guides to when detailed investigation of compliance with the actual limit, the basic restriction, is required. If the reference level is not exceeded, the basic restriction cannot be exceeded, and no further investigation is needed. If the reference level is exceeded, the basic restriction may or may not be exceeded.

2.3.8 The Code of Practice on Compliance (DECC, 2012a) endorses this approach and gives the values of field corresponding to the basic restriction, stating:

‘The 1998 ICNIRP exposure guidelines specify a basic restriction for the public which is that the induced current density in the central nervous system should not exceed 2mA m^{-2}. The Health Protection Agency specify that this induced current density equates to uniform unperturbed fields of 360μT for magnetic fields and 9.0kV m^{-1} for electric fields. Where the field is not uniform, more detailed investigation is needed. Accordingly, these are the field levels with which overhead power lines (which produce essentially uniform fields near ground level) shall comply where necessary. For other equipment, such as underground cables, which produce non-uniform fields, the equivalent figures will never be lower but may be higher and will need establishing on a case-by-case basis in accordance with the procedures specified by HPA. Further explanation of basic restrictions, reference levels etc is given by the Health Protection Agency.’

2.3.9 The Code of Practice on Compliance (DECC, 2012a) also specifies the land uses where exposure is deemed to be potentially for a significant period and consequently where the public guidelines apply. These land uses are, broadly, residential uses and schools.

2.3.10 Therefore, if the EMFs produced by an item of equipment are lower than 9 kV/m and 360 μT, the fields corresponding to the ICNIRP basic restriction, the equipment is compliant with the ICNIRP guidelines (ICNIRP, 1998) and with HPA recommendations (HPA, 2005) and Government policy (DECC, 2012a). If the fields are greater than these values, the equipment is still compliant with Government policy if the land use falls outside the residential and other uses specified in the Code of Practice, and it may also still be compliant if the fields are non-uniform.

2.4 Occupational Exposure Limits

2.4.1 Occupational exposures to EMFs in England, Wales and Scotland are controlled by the Control of Electromagnetic Fields at Work Regulations 2016 (CEMFAW Regulations), which implement a 2013 EU Directive (EU Directive 2013/35/EU, 2013). For power frequencies, these are based on a more recent ICNIRP publication; it is ICNIRP 2010 rather than the ICNIRP 1998 that is the basis for the public exposure limits.

2.4.2 The CEMFAW Regulations are based on limiting the same underlying physical quantity, the current induced in the body by external exposure to EMF, as for public exposure, but the quantity is expressed in a different way, i.e. as the induced field rather than the induced current density, and different values are given for the head and for the rest of the body. This makes direct comparison between the occupational and public limits difficult, but the occupational limits are always higher than the public limits, typically by factors of two or more. Therefore, where the fields are compliant with the public limits, any occupational activities would also be compliant with the relevant occupational limits.

2.4.3 Employers have a duty of care to their employees. Employers discharge that duty of care in relation to EMFs primarily by complying with the relevant exposure limits. As noted above, occupational exposure limits are higher than the public exposure limits which the Project would be compliant with in all areas accessible to the public and to employees of third parties. Therefore, all exposures from the Project would be compliant with the occupational exposure limits, and employers need take no additional action specific to the Project in order to comply. The CEMFAW Regulations impose certain general duties on all employers which would apply regardless of the Project.

2.4.4 In some areas of the Project, accessible only to National Grid staff and to contractors of National Grid but not to the public or to employees of third parties, e.g. inside substation perimeter fences, higher fields could be found that exceed the public exposure limits. National Grid has its own procedures for ensuring that staff do not exceed the occupational exposure limits in these areas.

2.5 Potential Future Changes to Exposure Limits

2.5.1 As discussed, current Government policy for public exposure is based on the limits from the ICNIRP Guidelines (ICNIRP, 1998), in the terms of the 1999 EU Recommendation. In 2010, ICNIRP published new exposure guidelines (ICNIRP, 2010) for the range of frequencies including power frequencies. These new guidelines do not apply in the UK for public exposure unless and until Government decides to adopt them. This is clear in the Code of Practice on Compliance (DECC, 2012a):

'Current Government policy on electric and magnetic fields (EMF) is that power lines should comply with the 1998 ICNIRP Guidelines on exposure to EMF in the terms of the 1999 EU Recommendation, and this Code of Practice implements this policy. As and when either ICNIRP issue new Guidelines or the EU revise the Recommendation, it will be for Government to consider those changes and to decide whether to adopt them or not. If Government policy changes, this Code of Practice will also be changed accordingly, but until that happens, the present policy as reflected in this Code of Practice remains in force.' (Page 2)

2.5.2 In fact, ICNIRP's intention in its new guidelines does not appear to be to make the guidelines either more or less onerous. It takes account of the most recent scientific developments but, having done so, the key scientific effects used as the basis for the guideline levels are unchanged and the safety margins applied are broadly unchanged. The detailed values derived as basic restrictions and reference levels have changed, but this is principally a consequence of a different method of derivation, without representing any change in scientific thinking about the appropriate level of protection. National Grid's assessment is that the Project would in fact be compliant with those guidelines were they ever to be introduced.

2.6 Scientific Evidence

2.6.1 As well as these established effects, over the past 30 years it has been suggested that exposure to power-frequency EMFs of the magnitude encountered in the environment could be linked with various health problems, ranging from headaches to Alzheimer's disease and cancer. The most persistent of these suggestions relates to childhood leukaemia. Several epidemiological studies have suggested a statistical association between the incidence of childhood leukaemia and the proximity of homes to power transmission and distribution equipment or the power-frequency magnetic-field strengths found in the homes. However, no causal link has been established between cancer (or any other disease) and magnetic or electric fields and indeed there is no established mechanism by which these fields could cause or promote the disease.

2.6.2 The question of possible health effects of environmental power-frequency fields has been thoroughly reviewed in recent years by several national and international bodies. The principal such bodies that currently have authoritative relevance in the UK are the UKHSA (formerly the PHE, the HPA, and the NRPB), the International Agency for Research on Cancer (IARC), the World Health Organisation (WHO), and the relevant official scientific advisory committee for the EU, Scientific Committee on Health, Environmental and Emerging Risks (SCHEER) (formerly the Scientific Committee on Emerging and Newly Identified Health Risks).

2.6.3 When assessing the scientific evidence on EMF, it is essential to consider all the evidence and to perform an overall assessment of the evidence, weighting each strand of evidence and each individual study as appropriate to its strengths and weaknesses. No single study can ever be conclusive (in either direction). Such reviews have been performed by the authoritative expert bodies, and it is those bodies that provide the most reliable conclusions, and on whose conclusions Government policy is based. The following are summaries of the conclusions of these relevant authoritative review bodies.

The National Radiological Protection Board/The Health Protection Agency/Public Health England/UK Health Security Agency

2.6.4 In 2004, the then NRPB published new ‘Advice on Limiting Exposure to Electromagnetic Fields (0-300 GHz)’ (NRPB, 2004a) and accompanied it with a ‘Review of the Scientific Evidence for Limiting Exposure to Electromagnetic Fields (0-300 GHz)’ (NRPB, 2004b). The former summarises epidemiological evidence as follows (page 15):

‘54 In the view of NRPB, the epidemiological evidence that time-weighted average exposure to power frequency magnetic fields above 0.4 µT is associated with a small absolute raised risk of leukaemia in children is, at present, an observation for which there is no sound scientific explanation. There is no clear evidence of a carcinogenic effect of ELF EMFs in adults and no plausible biological explanation of the association that can be obtained from experiments with animals or from cellular and molecular studies. Alternative explanations for this epidemiological association are possible: for example, potential bias in the selection of control children with whom leukaemia cases were in some studies and chance variations resulting from small numbers of individuals affected. Thus, any judgements developed on the assumption that the association is causal would be subject to a very high level of uncertainty.

55 Studies of occupational exposure to ELF EMFs do not provide strong evidence of associations with neurodegenerative diseases…'

56 Studies of suicide and depressive illness have given inconsistent results in relation to ELF EMF exposure, and evidence for a link with cardiovascular disease is weak.

57 The overall evidence from studies of maternal exposure to ELF EMFs in the workplace does not indicate an association with adverse pregnancy outcomes, while studies of maternal exposure in the home are difficult to interpret.

58 Results from studies of male fertility and of birth outcome and childhood cancer in relation to parental occupational exposure to ELF EMFs have been inconsistent and unconvincing.

59 All these conclusions are consistent with those of AGNIR (2001).[2]

60 NRPB concludes that the results of epidemiological studies, taken individually or as collectively reviewed by expert groups, cannot currently be used as a basis for restrictions on exposure to EMFs.'

International Agency for Research on Cancer (IARC)

2.6.5 The IARC is an agency of the WHO. Since 1972 the IARC's Unit of Carcinogen Identification and Evaluation has periodically published monographs that assess the evidence as to whether various agents are carcinogenic and classify the agents accordingly. In June 2001, a Working Group met to consider static and ELF EMFs (IARC, 2002). Power-frequency magnetic fields were classified as 'possibly carcinogenic', based on 'limited' evidence from humans concerning childhood leukaemia, 'inadequate' evidence from humans concerning all other cancer types, and 'inadequate' evidence from animals. Power-frequency electric fields were judged 'not classifiable' on the basis of 'inadequate' evidence from both humans and animals. These classifications are consistent with the conclusions reached by the NRPB (NRPB, 2004b).

World Health Organisation

2.6.6 The WHO published an Environmental Health Criteria Monograph in 2007 on ELF EMF, produced by a Task Group that met in 2005 (WHO, 2007). This concluded, in part:

'Chronic effects

Scientific evidence suggesting that every-day, chronic low-intensity (above 0.3-0.4μT) power-frequency magnetic field exposure poses a health risk is based on epidemiological studies demonstrating a consistent pattern of increased risk for childhood leukaemia. Uncertainties in the hazard assessment include the role that control selection bias and exposure misclassification might have on the observed relationship between magnetic fields and childhood leukaemia. In addition, virtually all of the laboratory evidence and the mechanistic evidence fail to support a relationship between low-level ELF magnetic fields and changes in biological function or disease status. Thus, on balance, the evidence is not strong enough to be considered causal, but sufficiently strong to remain a concern.

[2] A reference to the previous NRPB review of the science by its Advisory Group on Non-Ionising Radiation.

A number of other diseases have been investigated for possible association with ELF magnetic field exposure. These include cancers in both children and adults, depression, suicide, reproductive dysfunction, developmental disorders, immunological modifications and neurological disease.

The scientific evidence supporting a linkage between ELF magnetic fields and any of these diseases is much weaker than for childhood leukaemia and in some cases (for example, for cardiovascular disease or breast cancer) the evidence is sufficient to give confidence that magnetic fields do not cause the disease.'

Scientific Committee on Emerging and Newly Identified Health Risks

2.6.7 The Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) was, until 2016, the EU's designated source of expert scientific advice on EMFs (along with other issues). In March 2015 SCENIHR published its most recent report on EMF, 'Potential Health Effects of Exposure to EMF' (SCENIHR, 2016). The section of the abstract concerned with power-frequency fields states:

'Overall, existing studies do not provide convincing evidence for a causal relationship between ELF MF exposure and self-reported symptoms.

The new epidemiological studies are consistent with earlier findings of an increased risk of childhood leukaemia with estimated daily average exposures above 0.3 to 0.4 µT. As stated in the previous Opinions, no mechanisms have been identified and no support is existing from experimental studies that could explain these findings, which, together with shortcomings of the epidemiological studies prevent a causal interpretation.

Studies investigating possible effects of ELF exposure on the power spectra of the waking EEG are too heterogeneous with regard to applied fields, duration of exposure, and number of considered leads, and statistical methods to draw a sound conclusion. The same is true for behavioural outcomes and cortical excitability.

Epidemiological studies do not provide convincing evidence of an increased risk of neurodegenerative diseases, including dementia, related to power frequency MF exposure. Furthermore, they show no evidence for adverse pregnancy outcomes in relation to ELF MF. The studies concerning childhood health outcomes in relation to maternal residential ELF MF exposure during pregnancy involve some methodological issues that need to be addressed. They suggest implausible effects and need to be replicated independently before they can be used for risk assessment.

Recent results do not show an effect of the ELF fields on the reproductive function in humans.'

Conclusions from Reviews of Science

2.6.8 There is some scientific evidence suggesting that electric or, particularly, magnetic fields may have health effects at levels below the current UK exposure guidelines. The authoritative classification is that of the WHO, in 2001 and reiterated in 2007, that power frequency magnetic fields are 'possibly' a cause of cancer, specifically just of childhood leukaemia, with the evidence relating to any other health effect *'much weaker'*. The scientific evidence in these various reviews has been used to formulate the EMF precautionary policies that the Project has applied.

2.7 Precautionary Policies

2.7.1 The Government has addressed the uncertainty in the scientific evidence by adopting specified precautionary measures relating to various sources of EMF.

2.7.2 The only specific precautionary measure that relates to high-voltage power lines or any other high-voltage transmission equipment is the policy of ‘optimum phasing’. ‘Phasing’ is the order in which the conductors of the two circuits of double-circuit overhead lines are connected relative to each other, and certain phasing arrangements produce lower magnetic fields than others. This policy was introduced in the Written Ministerial Statement of 2009 (Department of Health, 2009) in response to a recommendation from the Stakeholder Advisory Group on ELF EMF (SAGE) in its First Interim Assessment (SAGE, 2007). The details are given in the Code of Practice on Optimum Phasing (DECC, 2012b).

2.7.3 ‘Optimum phasing’ is the phasing that produces the lowest magnetic fields to the sides of the line, taking account of the likely current flows in the line. Paragraph 2.11.11 of NPS EN-5 (DESNZ, 2024a) mentions the Code of Practice on Optimum Phasing which states that new overhead power lines should have optimum phasing where reasonable. It explains that it will normally be possible to achieve optimum phasing simply by choosing how to order the connections at the end of the overhead line, but that if achieving optimum phasing would either require an extra structure or would conflict with the requirements for power system stability, this would normally be ‘unreasonable’ and is not required. The Code of Practice states that where necessary, ‘unreasonable’ will be interpreted in terms of the cost-benefit analysis presented in the SAGE First Interim Assessment.

2.7.4 All the relevant scientific evidence on EMFs was considered fully in the process of establishing the exposure guidelines that apply in the UK. Those exposure guidelines together with the policy on optimum phasing (and other precautionary policies that relate only to low-voltage equipment) are considered by UKHSA and the Government to be the appropriate response to that evidence.

2.7.5 The Government has specifically rejected the introduction of ‘corridors’ around power lines on EMF grounds, stating of this option in the Written Ministerial Statement:

‘The Government therefore considers this additional option to be disproportionate in the light of the evidence base on the potential health risks arising from exposure to ELF/EMF and has no plans to take forward this action.’

2.7.6 Having established that it is not Government policy to have restrictions on homes and schools near power lines, the Statement goes on to say (paragraph 38):

‘It is central Government’s responsibility (rather than individual local authorities) to determine what national measures are necessary to protect public health.’

2.7.7 This makes it clear that the Government has not introduced any restrictions (beyond those that may be created by the EMF exposure limits and the safety clearance distances) on constructing new power lines close to existing properties on grounds of safety or health risks, and neither is it appropriate for individual local authorities to do so.

2.7.8 The Government has recommended against re-routeing a proposed line purely on the basis of EMF, NPS EN-5 (DESNZ, 2024a) states, in 2.10.13:

‘Where EMF exposure is within the relevant public exposure guidelines, re-routeing a proposed overhead line purely on the basis of EMF exposure or undergrounding a line solely to further reduce the level of EMF exposure are unlikely to be proportionate mitigation measures.’

2.7.9 In relation to undergrounding, the NPS EN-5 states, in paragraph 2.11.13:

‘Undergrounding of a line would reduce the level of EMFs experienced, but high magnetic field levels may still occur immediately above the cable. It is the government’s policy that power lines should not be undergrounded solely for the purpose of reducing exposure to EMFs.’

2.7.10 Therefore, the UK has a carefully thought-out set of policies for managing EMF, which include both numerical exposure guidelines to protect against established, acute effects of EMFs, and precautionary policies to provide appropriate protection against the possibility of chronic effects of EMFs at lower levels, including, specifically, the possibility of a risk for childhood leukaemia. These policies are incorporated into the decision-making process for development consent in NPS EN-5 (DESNZ, 2024a) and no additional measures or precautions are necessary.

2.8 Pregnant Women and Other Potentially Sensitive Subgroups

2.8.1 The scientific basis as given by the NRPB (now UKHSA) in its recommendation to Government for setting the public exposure limits lower than the occupational limits is not that the public in general need greater protection; it is that the public contains certain potentially sensitive subgroups, which may be more affected by low-level EMFs than the population at large. One of those subgroups is pregnant women and the developing embryo (others include people with epilepsy or taking certain drugs).

2.8.2 Therefore, the potential extra sensitivity of pregnant women is already built into the public exposure limits. No additional protective measures are required.

2.9 Microshocks

2.9.1 Under high-voltage overhead lines, conducting objects may become electrically charged if they are isolated from earth. If this charged object is then touched by a person at a different electrical potential, charge is transferred between the person and the object. When the person is very close to the object but before touching it, the voltage difference between the person and the object can be sufficient to cause the air in the gap to break down, and a small spark discharge occurs. This can be perceived by the person and is known as a microshock.

2.9.2 The size of a microshock depends on the size of the electric field, the sizes of the objects concerned, how well grounded or insulated they are, meteorological conditions, and the sensitivity of the skin. All of these factors determine the severity of the sensation which can range from barely perceptible through to annoyance and in some rare circumstances even pain. Microshocks are similar to the static shocks that can occur, for example, by walking across a nylon carpet in dry weather. Microshocks have no known long-term health effects and any sensation is normally confined to the momentary spark discharge as contact is made or broken.

2.9.3 In a 2005 Information Sheet (HPA, 2005), HPA (now UKHSA) states:

'…on the basis of the available evidence, the direct effects of microshocks on the body are not considered capable of producing lasting harm. The response to some extent will depend on the sensitivity of the individual. Although the possibility of microshocks cannot be ruled out, in field strengths up to about 5kV m^{-1} they are unlikely to be painful to the majority of people.'

2.9.4 Microshocks are indirect effects and as such are not directly covered by the quantitative exposure limit values that protect against direct effects of electric fields. The ICNIRP guidelines (ICNIRP, 1998) do have a cautionary reference level of 5 kV/m but limiting exposure to 5 kV/m is not considered the most appropriate way of dealing with microshocks. Reducing electric fields by changes to the design is possible, but will usually result in taller pylons, increasing the visual impact of the overhead line. As there is no threshold of electric field for preventing microshocks, the benefit of reducing the field to 5 kV/m may be marginal. Rather than introducing an arbitrary limit the Code of Practice on Compliance (2012a) states:

'...there is a suite of measures that may be called upon in particular situations, including provision of information, earthing, and screening, alongside limiting the field which should be used to reduce the risk to the public of indirect effects. In some situations, there may be no reasonable way of eliminating indirect effects, for instance where erecting screening would obstruct the intended use of the land.'

2.9.5 A separate document, 'Power lines: Control of microshocks and other indirect effects of public exposure to electric fields. A voluntary Code of Practice' (DECC, 2013), hereon referred to as the Code of Practice on Microshocks, developed jointly by the electricity transmission industry and the then DECC, has been adopted. This follows the principles quoted above for managing microshocks but contains more details on the practical measures which can be taken.

2.9.6 The proposed overhead line has been designed to comply with the government exposure limit values for electric fields, ensuring 9 kV/m is not exceeded (demonstrated in Section 6.2), and in accordance with the Code of Practice on Microshocks. Some areas under the proposed overhead line would have electric fields which could potentially cause microshocks to occur if the required circumstances exist. Where this would present an issue, embedded measures have been applied to the design in line with the Code of Practice on Microshocks, such as raising conductor clearances, or avoiding specific land uses. National Grid will ensure that if microshocks are reported these will be investigated and managed in accordance with the provisions of the Code of Practice on Microshocks (DECC, 2013).

2.9.7 This is only applicable to overhead lines as underground cables produce no external electric fields.

2.10 Active Implantable Medical Devices

2.10.1 EMFs can affect Active Implantable Medical Devices (AIMDs), such as pacemakers, insulin pumps and Implanted Cardiac Defibrillators (ICDs) if the external field strength exceeds the immunity of the device. EMFs can induce voltages in the body which, if high enough, can potentially exceed the immunity of the device and temporarily affect its operation.

2.10.2 All modern AIMDs are expected to be immune from interference from EMFs up to the reference levels for public exposure of the 1999 EU Recommendation where the AIMD has been implanted and programmed in a standard manner. The reference levels at 50 Hz are 100 μT for magnetic fields and 5 kV/m for electric fields. However, many AIMDs will have considerably higher immunity to external EMFs than the minimum requirements.

2.10.3 Specifically, the Active Implantable Medical Devices Directive (90/385/EEC) (EC, 1990) includes the following provision:

'Devices must be designed and manufactured in such a way as to remove or minimize as far as possible: […] risks connected with reasonably foreseeable environmental conditions such as magnetic fields, external electrical influences'

2.10.4 Neither National Grid nor the Medicines and Healthcare Products Regulatory Agency (MHRA) are aware of any instance of a patient with a modern, correctly fitted AIMD experiencing any interference from the electricity transmission system.

2.10.5 The Project would be capable of producing EMFs which, while still compliant with the public exposure limits, are in excess of the reference levels for public exposure. Therefore, in theory, some interference of EMFs with AIMDs could possibly occur. However, some existing National Grid overhead lines and underground cables are likewise theoretically capable of producing fields that exceed the public reference levels, and as noted above neither the MHRA or National Grid is aware of any instance of electricity transmission infrastructure interfering with a correctly fitted modern AIMD such as a pacemaker or ICD. The risk of any interference occurring is not significant in practice for the following reasons:

1) While manufacturers have to ensure that AIMDs are immune up to the reference levels for public exposure, many modern AIMDs will be immune to EMFs considerably in excess of these levels.
2) The maximum EMFs from an overhead line or underground cable as calculated for assessing compliance with the exposure limits represent a worst-case scenario, chosen to demonstrate that exceeding the exposure guidelines is not possible. However, typically, the overhead line or underground cable would produce EMFs lower than these levels for two reasons: the circuits are unlikely to operate at the maximum rating routinely, and a typical current on a day-to-day basis would be lower than this; and for overhead lines, typically the conductors would be higher than the minimum design clearance used for assessing compliance, reducing the EMFs at ground level, with the minimum clearance found only in a limited area towards the middle of certain spans.

2.10.6 Thus, there is considerable confidence in saying that, based on the absence of reported incidents and on the typical EMF exposures that would occur daily, transmission assets do not appear to interfere with AIMDs in practice. The risk of any interference occurring is assessed as being negligible and does not constitute a significant effect.

2.10.7 This is supported in NPS EN-5 (DESNZ, 2024a), at paragraph 2.9.57, which states that:

'The Department of Health and Social Care's Medicines and Healthcare Products Regulatory Agency does not consider that transmission line EMFs constitute a significant hazard to the operation of pacemakers.'

2.11 Farming, Flora and Fauna

2.11.1 No effects of EMFs on farming, flora and fauna are expected.

2.11.2 Paragraph 2.9.58 of NPS EN-5 states:

'There is little evidence that exposure of crops, farm animals or natural ecosystems to transmission line EMFs has any agriculturally significant consequences.'

2.12 The Electricity Safety, Quality and Continuity Regulations 2002

2.12.1 NPS EN-5 (DESNZ, 2024a) (paragraph 2.10.11) refers to the Electricity Safety, Quality and Continuity Regulations 2002 which set out the minimum height, position, insulation and protection specifications at which conductors can be strung between pylons to ensure safe clearance of objects. Regulation 17(2) and Schedule 2 require the clearances set out in Table 2.3.

Table 2.3 The Electricity Safety, Quality and Continuity Regulations 2002 – Minimum Height Above Ground of Overhead Lines

Nominal Voltages	Over Roads (m)	Other Locations (m)
Exceeding 66 kV but not exceeding 132 kV	6.7	6.7
Exceeding 132 kV but not exceeding 275 kV	7	7
Exceeding 275 kV but not exceeding 400 kV	7.3	7.3

2.12.2 The minimum conductor clearance information for the Project is provided in Section 6.2 which demonstrates compliance with these requirements.

2.13 Summary of Policy and Legislation

2.13.1 The EMF policies applying to high-voltage electricity equipment comprise compliance with the exposure guidelines, as set out in the Code of Practice on Compliance (DECC, 2012a); the policy on optimum phasing, as set out in the Code of Practice on Optimum Phasing (DECC, 2012b); and the policy on indirect effects expressed in the Code of Practice on Microshocks (DECC, 2013); but no other policies.

2.13.2 NPS EN-5 (DESNZ, 2024a) explicitly applies these policies to applications for consent for new electricity connections such as the Project. If a proposed overhead line or, where relevant, underground cable, substation complies with these, there are no grounds in relation to EMFs not to grant consent.

3. Electromagnetic Compatibility

3.1 Electromagnetic Compatibility

3.1.1 Electromagnetic compatibility (EMC) is controlled by EU Directive 2014/30/EU (the EMC Directive) which replaced Directive 2004/108/EC on 20 April 2016. These Directives are enacted in UK law by Regulations. The current Regulations are the Electromagnetic Compatibility Regulations 2016, which are based on the 2014 Directive.

3.1.2 The requirements of the EMC Directive are that the electromagnetic disturbance that an apparatus generates should not exceed a level allowing radio and telecommunication equipment and other apparatus to operate as intended; and that the apparatus itself has an adequate level of intrinsic immunity to electromagnetic disturbance to enable it to operate as intended.

3.1.3 Permanent, fixed infrastructure of the type owned and operated by National Grid is covered by specific provisions in the EMC Directive relating to 'fixed installations'.

3.1.4 Article 6 of the 2014 Directive requires conformity with Annex 1, Part 2 of that Directive, which in turn requires that '*A fixed installation shall be installed applying good engineering practices*…' in order to avoid EMC problems.

3.1.5 The main potential source of interference from transmission systems such as the overhead line proposed as part of the Project arises from radio frequency (RF) emissions caused by corona discharge from overhead lines and substations (underground cables do not in general produce any significant RF emissions). Corona discharge results from the high voltages on the surface of conductors, particularly in wet conditions where water droplets can concentrate the electric field; it is recognisable by the characteristic crackling sound. RF emissions and corona levels are limited by designing to National Grid's technical specifications which include British Standard 5049-3 (British Standards Institution, 1994), along with other equipment-specific standards such as British Standard EN 60437 (British Standards Institution, 1998) for the insulators on the pylons. Thus, National Grid's Transmission System applies good engineering practices and meets the essential requirements detailed in Annex 1 of the EMC Directive.

3.1.6 This was initially documented and certified under the provisions of the EMC Directive then in force, the 1989 Directive 89/336/EEC, by creating a Technical Construction File (TCF) for the National Grid transmission system. The TCF is based on a combination of extensive on-site testing (overhead lines and substations) and examination of National Grid's technical specifications, policies and standards to ensure that RF noise and corona are adequately addressed. The on-site surveys showed that there were no significant emission problems to address; and equipment technical specifications and policies ensured equipment was designed in accordance with British Standards to limit RF noise and corona. Using the rationale of the TCF, it was determined that the National Grid system meets the essential requirements of the EMC Directive. A Certificate of Conformity was issued by Hursley EMC Services (the Competent Body) and is provided at Appendix B.

3.1.7 The subsequent EMC Directive, 2004/108/EC, and the current EMC Directive 2014/30/EU, no longer use the terminology of a TCF and Certification. However, the essential requirements of the Directives have not changed, and the content of the TCF remains a valid method of documenting compliance with the EMC Directive.

3.1.8 The Project would contain electrical equipment that is the same as or similar to that tested by on-site measurements documented in the TCF and would also be designed to the same technical specifications.

3.1.9 Occasionally, radio interference is reported from equipment on the National Grid system. The most likely cause of such interference is equipment that has been damaged or degraded while in operation. This sort of occurrence is normally addressed during routine maintenance. Interference reports are extremely rare, but where interference is reported it will be investigated and remedial action will be taken to mitigate interference where it is appropriate to do so.

3.1.10 Given that the provisions of the current EMC Directive are met through using good engineering practice and applying the relevant technical standards, and that the EMC performance of this system has been certificated as compliant by a Competent Body following appropriate on-site testing, the Project would present no issues with TV or radio interference under normal operating conditions.

3.2 Effects on Magnetic Compasses

3.2.1 Magnetic compasses, whether traditional magnetic needle designs or alternatives such as fluxgate magnetometers, operate from the earth’s magnetic field, and are susceptible to any perturbation to the Earth’s magnetic field by other sources.

3.2.2 This is a potential issue with direct current (DC) conductors or cables, which produce a static magnetic field that perturbs the geomagnetic field. However, there are no DC cables proposed for use in the Project and no DC fields could be produced.

3.2.3 The magnetic fields produced by the Project would be 50 Hz fields. These oscillate far too quickly for a magnetic compass needle to be affected. Fluxgate magnetometers are capable of responding to 50 Hz fields, but, when used as a compass, always have filtering to eliminate unwanted frequencies including 50 Hz. They can cease working correctly if saturated by a high-enough field, but the fields required are orders of magnitude higher than would be produced by the Project.

3.2.4 Therefore, the Project would have no significant effect on magnetic compasses.

4. Assessment Methodology

4.1 Methodology

4.1.1 The assessment considers the EMFs produced from the electricity assets associated with the Project. Each asset is assessed including the cumulative impacts on existing assets.

4.2 Study Area

4.2.1 The EMFs produced by the electrical assets of the Project would have a given magnitude at a given distance from the asset. Therefore, the study area of the assessment includes all areas around the assets where the EMFs could potentially be significant, such that the assessment is asset-specific rather than location-specific. Any changes in alignment that could occur within the Order Limits or Limits of Deviation proposed for the Project would not alter the assessments presented here. This ensures that the equipment would be compliant with exposure guidelines irrespective of the Project's exact location within the Order Limits or Limits of Deviation.

4.3 Predicted Field Levels

4.3.1 The magnetic field produced by a current in an individual conductor falls with distance from the conductor. Where there is more than one current forming part of one or more electrical circuits, there is also partial cancellation between the magnetic fields produced by the individual currents, and that cancellation generally becomes more complete as the distance increases. Overall, the magnetic field is highest at the point of closest approach to the conductors and falls quite rapidly with distance. Similarly, there is partial cancellation between the electric fields produced by the voltages on individual conductors, and the electric field is usually highest at the point of closest approach to the conductors and falls quite rapidly with distance.

4.3.2 For sources of field with a simple, defined geometry, such as overhead lines or underground cables, calculations are the best way of assessing fields and are acceptably accurate. The calculations of fields for the Project presented in Demonstrating Compliance with EMF Requirements of NPS EN-5 follow the provisions specified in the Code of Practice on Compliance (DECC, 2012a) and were performed using specialised computer software that has been validated against direct measurement of EMFs from overhead lines and cables (Swanson, 1995).

4.3.3 By contrast, due to the complex physical arrangement of electrical equipment, the EMFs produced by an electrical substation or sealing-end compound are not readily calculable. However, the highest field levels at and outside the perimeter of a substation are usually those produced by the overhead lines entering the substation. The fields produced by equipment within the substation are generally smaller and decrease with distance more quickly than fields generated by overhead lines.

4.3.4 Since field strengths are constantly varying, they are usually described by reference to an averaging calculation known as the 'root mean square' or RMS. Future mention of power-frequency field strengths in this chapter refers to the RMS amplitude of the power frequency modulation of the total field, which is the conventional scientific way of expressing these quantities.

4.3.5 To assess compliance with exposure limits, the Code of Practice on Compliance (DECC, 2012a) specifies that the maximum fields the overhead line is capable of producing should be calculated using the following conditions:

- electric fields: for nominal voltage and design minimum clearance;
- magnetic fields: for the highest rating that can be applied continuously in an intact system (i.e., including ratings which apply only in cold weather, but not including short-term ratings or ratings which apply only for the duration of a fault elsewhere in the electricity system) and design minimum clearance; and
- EMFs: for 1 m above ground level, of the unperturbed field, taking account of the correct wire type and bundle size, and of the basic pylon geometry for the design of overhead line in question, but ignoring variations in conductor spacing at angle pylons, of the 50 Hz component ignoring harmonics, ignoring zero-sequence currents and voltages, and currents induced in the ground or earth wire, and using the infinite-straight-line approximation.

4.3.6 The same provisions apply, where relevant, to assessing the fields from underground cables.

4.3.7 Therefore, the calculations for the Project were performed using worst-case conditions including minimum conductor clearances for overhead lines. The circuits are unlikely to operate at this maximum rating routinely, resulting in lower typical magnetic fields on a day-to-day basis.

4.3.8 Electric fields (but not magnetic fields) are readily perturbed by conducting objects, including, for example, buildings, fences and trees. The fields calculated here are unperturbed fields, as specified by the Code of Practice on Compliance (DECC, 2012a). These give a valid indication of the size of any electric-field-related phenomena over the area concerned, but the local value, close to a source of perturbation, would vary. In practice, perturbations within or to the sides of buildings and other fixed objects usually act so as to reduce, not increase, the electric field. Fields inside any buildings are generally much reduced. However, the Code of Practice specifies that it is acceptable to demonstrate compliance by reference to the unperturbed fields.

4.3.9 As an alternative to calculations, the Code of Practice on Compliance specifies that there are certain classes of equipment which inherently produce fields below the guideline levels and can be assumed to comply without producing case-by-case specific assessments of the field. Substations are one such type of equipment:

'The Energy Networks Association will maintain a publicly-available list on its website of types of equipment where the design is such that it is not capable of exceeding the ICNIRP exposure guidelines, with evidence as to why this is the case. Such types of equipment are likely to include:

- *overhead power lines at voltages up to and including 132 kV;*
- *underground cables at voltages up to and including 132 kV; and*
- *substations at and beyond the publicly accessible perimeter.*

Compliance with exposure guidelines for such equipment will be assumed unless evidence is brought to the contrary in specific cases.' (Page 4) (DECC, 2012a)

4.3.10 The Energy Networks Association's publicly available list can be found on the National Grid EMF website[3]. This confirms that substations (that do not contain a static var compensator) and CSE compounds, such as those proposed or that would be extended by the Project, are within the class of equipment which are regarded as inherently compliant without the need for case-by-case specific assessments.

4.4 Combining Fields from Different Sources

4.4.1 When more than one source of EMFs is present, such as two different overhead lines or an overhead line and an underground cable, the field from each source is calculated separately, and it is then necessary to combine the two individual fields to obtain the resulting field.

4.4.2 Because of the physical properties of EMF, specifically that they are what is known as 'vectors' not 'scalars', (i.e., direction as well as magnitude is relevant), the magnitudes of the EMFs from two different sources do not simply add together. The addition of EMFs from different sources is complex, but has the general effect that, when the field from one source is larger than the other, the larger field dominates, with the smaller field making only a small difference to the resulting field.

4.5 Significance Evaluation

4.5.1 The Project is assessed as having a significant effect if non-compliance with the EMF exposure limits was demonstrated, using the principles set out in the Code of Practice on Compliance (DECC, 2012a). Conversely, as specified in NPS EN-5, if the Project complies with the exposure limits and with the policies on phasing and microshocks, EMF effects would be assessed as not significant, and no mitigation would be necessary. Compliance with these policies is documented in Demonstrating Compliance with EMF Requirements of NPS EN-5.

[3] http://www.emfs.info/exposure-limits-and-policy/compliance-with-public-limits

5. Baseline Environment

5.1.1 The Project would be located within a mixture of primarily rural and semi-rural areas, which accommodate existing electrical assets. All equipment that generates, distributes or uses electricity produces EMF. The UK power frequency is 50 Hz, which is the principal frequency of the EMFs produced.

5.1.2 Electric and magnetic fields both occur naturally. The Earth's magnetic field, which is caused mainly by currents circulating in the outer layer of the Earth's core, is roughly 50 μT in the UK. This field may be distorted locally by ferrous minerals or by steelwork such as in buildings. At the Earth's surface, there is also a natural electric field, created by electric charges high up in the ionosphere, of about 100 V/m in fine weather.

5.1.3 As detailed earlier in this report, the Earth's natural fields are static, and the power system produces alternating fields. In homes in the UK that are not close to high-voltage overhead lines or underground cables, the average 'background' power-frequency magnetic field (the field existing over the whole volume of the house) ranges typically from 0.01–0.2 μT with an average of approximately 0.05 μT, normally arising from currents in the low-voltage distribution circuits that supply electricity to homes. The highest magnetic fields to which most people are exposed arise close to domestic appliances that incorporate motors and transformers. For example, close to the surface, fields can be 2,000 μT for electric razors and hair dryers, 800 μT for vacuum cleaners, and 50 μT for washing machines. The electric field in most homes is in the range 1–20 V/m, rising to a few hundred V/m close to appliances.

5.1.4 Along the majority of the proposed Project, there are no overhead lines close enough to have an impact on the EMFs' baseline environment. For the circumstances where overhead lines are close to the Project, baseline environmental graphs are shown in Figure 5.1 and Figure 5.2 with typical EMFs.

5.1.5 Typical EMFs for electricity transmission overhead lines (275 kV and 400 kV) and overhead lines operated by the Distribution Network Operator at 132 kV and lower voltages are shown in Figure 5.1 and Figure 5.2. These EMFs have been produced using typical loads and conductor clearances that overhead lines such as these produce. Note that these are different to the compliance calculations provided in Demonstrating Compliance with EMF Requirements of NPS EN-5, which are at 100% load, representing the maximum magnetic fields the overhead line can produce.

Figure 5.1 Typical Electric Fields from Overhead Lines

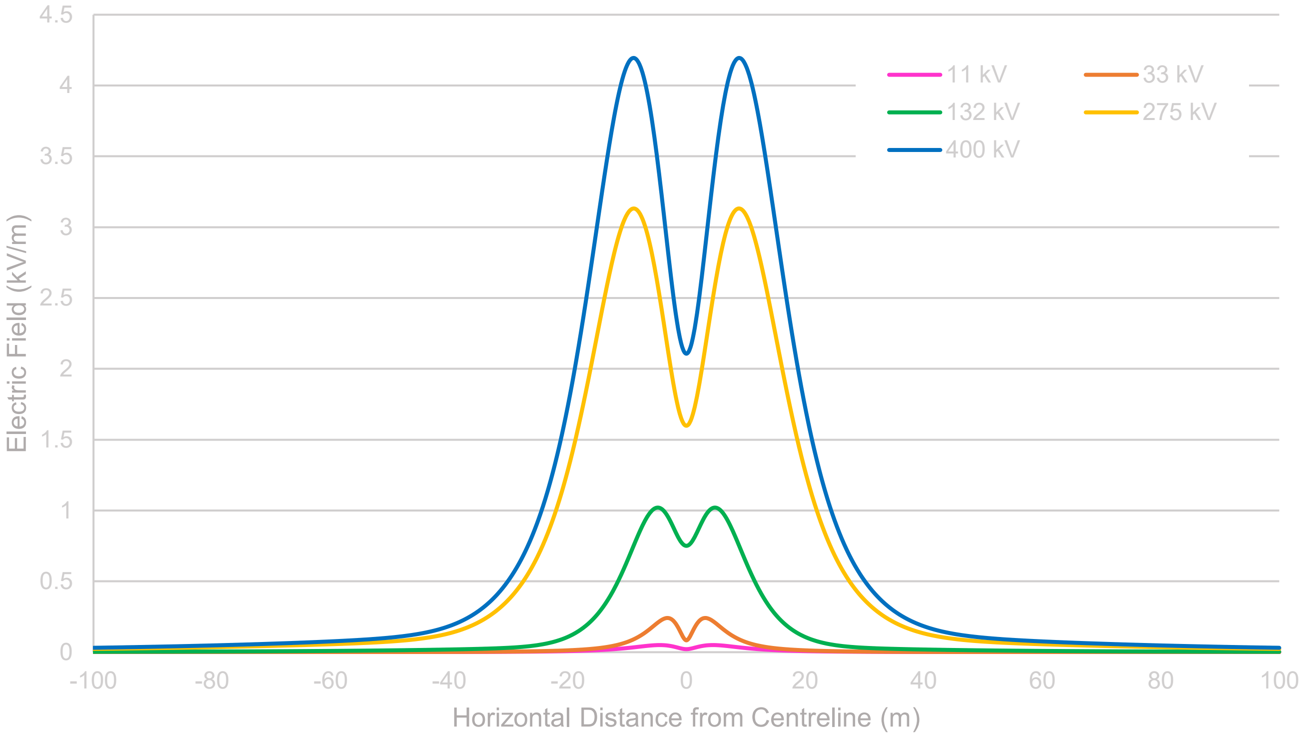
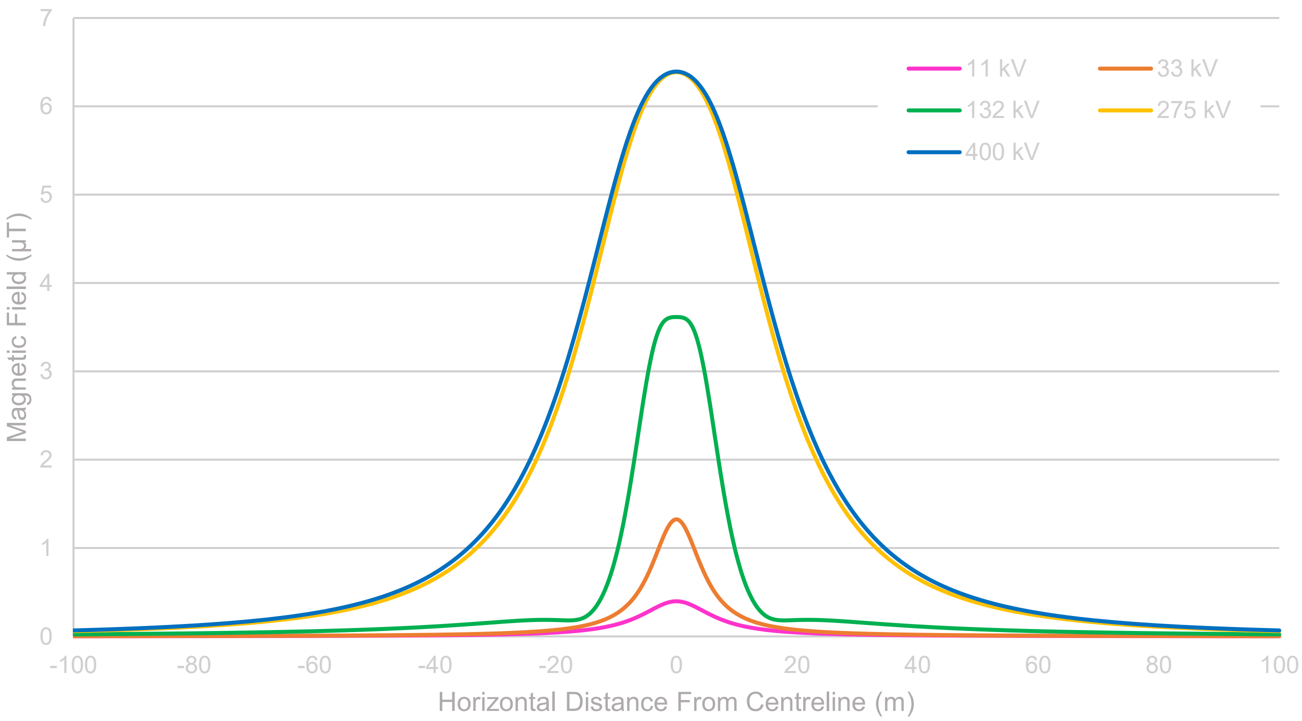


Figure 5.2 Typical Magnetic Fields from Overhead Lines



6. Demonstrating Compliance with EMF Requirements of NPS EN-5

6.1 Construction Effects

6.1.1 During construction and prior to energisation, transmission equipment would not produce any significant EMFs as no voltage is applied or current flowing in the equipment. Therefore, construction effects are not considered further.

6.2 Operational Effects – Overhead Lines

EMF Compliance of the New 400 kV Overhead Line

6.2.1 The new double circuit 400 kV overhead line would be erected on steel lattice pylons, using standard and low height variants which would carry triple Araucaria conductor bundles. All spans would have a minimum conductor design clearance to ground of 8.3 m for standard and low height pylons, although in many cases this would be higher.

6.2.2 Calculations were performed at the pre-fault continuous rating which is 2,525 megavolt ampere (MVA) per circuit and nominal voltage (400 kV) at 1 m above ground for standard and low height pylons. The results of these calculations are illustrated in Figure 6.1 (for electric fields) and Figure 6.2 (for magnetic fields). The highest calculated electric and magnetic fields produced by the overhead line using the worst-case conditions are 8.96 kV/m and 73.0 μT for standard height pylons and 8.06 kV/m and 79.1 μT for low height pylons. Calculations were performed in accordance with the conditions set out in the codes of practice (DECC, 2012a, 2012b, 2013).

Figure 6.1 Maximum Electric Fields from the New 400 kV Overhead Line Designs

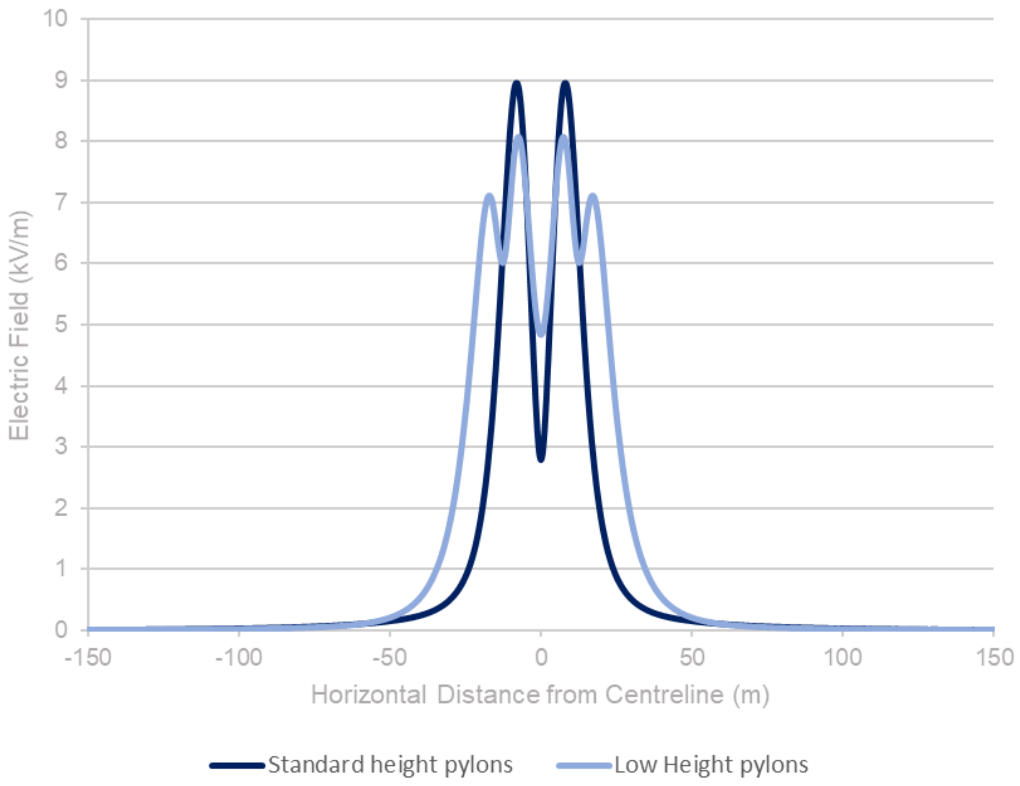
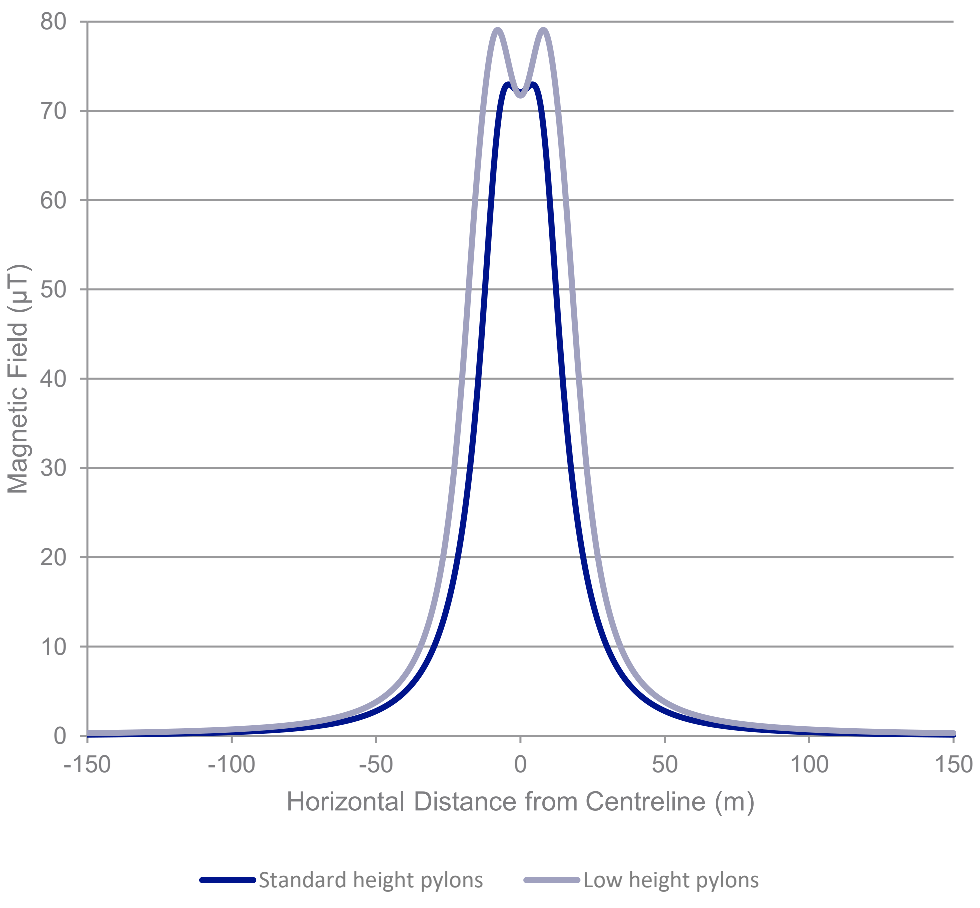


Figure 6.2 Maximum Magnetic Fields from the New 400 kV Overhead Line designs



Combined Effects with Existing 400 kV Overhead Line

6.2.3 The proposed new 400 kV overhead line would be parallel to existing National Grid overhead line 4YM, a 400 kV overhead line out of Norwich, for one span. Overhead line paralleling also occurs near the proposed Tilbury North substation with existing National Grid overhead lines, YYJ (400 kV) and ZB (275 kV), which are to be modified for the Project. Therefore, the combined effects have been considered from the two overhead lines where they are in close proximity for both of these individual sections.

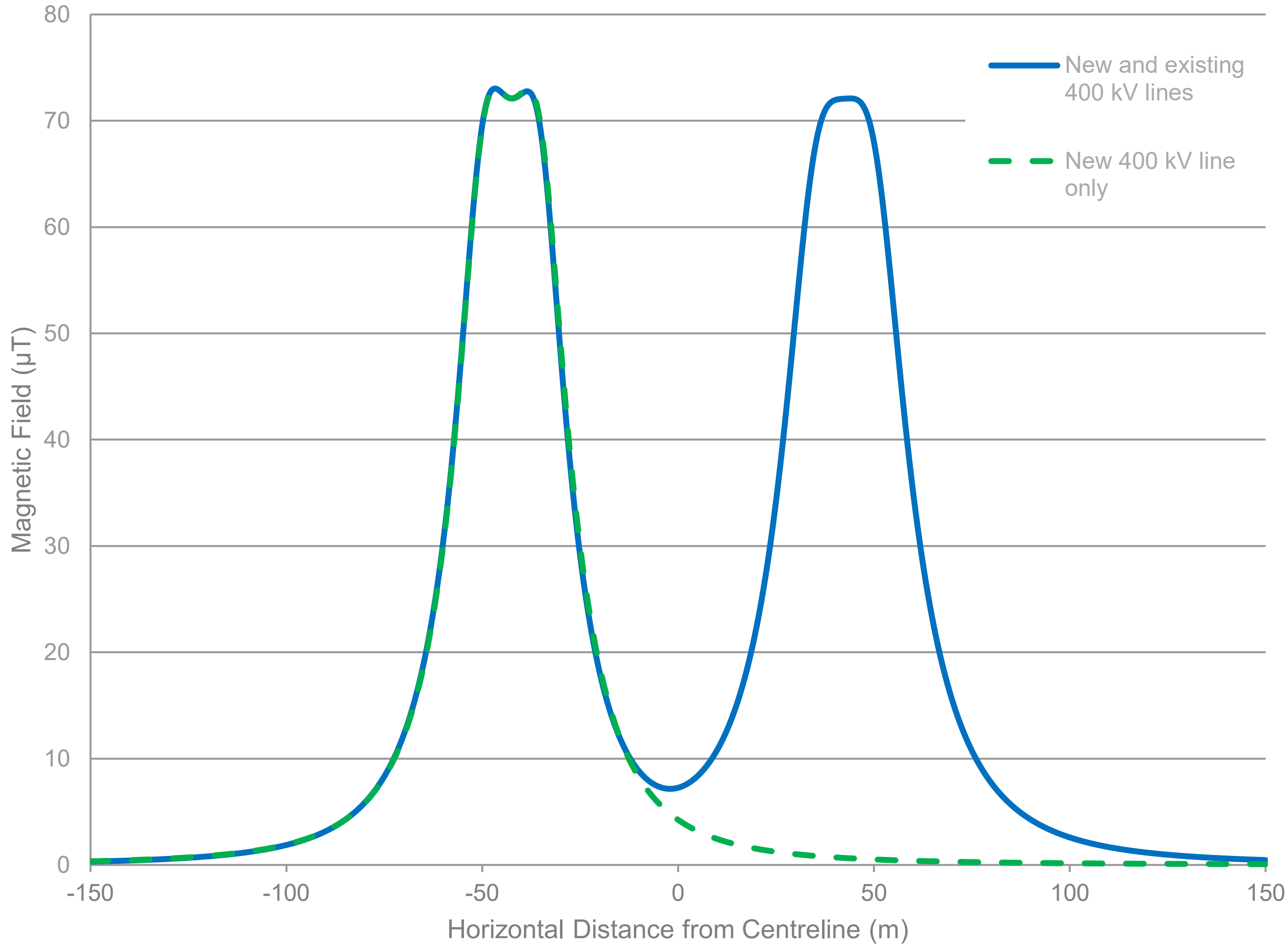
6.2.4 As explained in Section 4.4, because of the physical properties of EMF, specifically that they are ‘vectors’ not ‘scalars’, EMFs from two different sources do not simply add together. The addition of EMFs from different sources is complex, but has the general effect that when the field from one source is larger than the other, the larger field dominates, with the smaller field making only a small difference to the resultant field.

6.2.5 The maximum combined magnetic field from the new overhead line and existing overhead line out of Norwich (4YM) at 85 m apart is 73.0 µT. This is shown in Figure 6.3 which also illustrates the magnetic field from the new and existing overhead lines out of Norwich compared with the new overhead line only.

6.2.6 The maximum combined magnetic field from the existing overhead lines to be modified near the proposed Tilbury North Substation (YYJ and ZB), 34.3 m apart is 57.0 µT. Additionally, the maximum combined electric field from YYJ and ZB has been assessed to determine the current field levels and the expected levels following the proposed modifications. The maximum combined electric field will be 6.2 kV/m, representing an increase of 1.1% from the current level.

6.2.7 A combined field only has a very small effect on the maximum fields and the fields to the sides of the lines. Similar principles apply to electric fields and to fields calculated for typical conditions rather than for maximum conditions.

Figure 6.3 Combining Magnetic Fields from Parallel Overhead Lines



6.2.8 The exact difference that the field from the existing overhead line makes to the maximum field underneath the proposed new line (or vice versa) depends on specifics of relative phasing and loads (Figure 6.3 has been calculated for maximum continuous loading conditions but is representative of other possible conditions). The cumulative impacts have been assessed and in worst-case conditions, both the new and existing line comply.

Compliance with Policy on Phasing

6.2.9 The new 400 kV overhead line has been designed with transposed phasing meaning that it is optimally phased as set out in the Code of Practice on Optimum Phasing (DECC, 2012b). The two circuits are arranged to produce the greatest degree of cancellation between the magnetic fields produced by the two circuits and hence the lowest resultant magnetic field to the sides of the line.

Overhead Lines – Assessment

6.2.10 The maximum calculated magnetic field from the new 400 kV overhead line, calculated according to the Code of Practice on Compliance (DECC, 2012a), is 79.1 µT. The maximum calculated electric field is 8.96 kV/m. The respective exposure limits for the general public are 360 µT and 9 kV/m. Therefore, the maximum EMFs produced by the proposed overhead line would be less than the relevant public exposure limits (allowing for the effect with other overhead lines).

Thus, the proposed overhead lines would meet the relevant exposure limits, the ICNIRP general public guidelines (ICNIRP, 1998) in the terms of the EU Recommendation (EC, 1999). They would also comply with the Government policy on phasing, and there are no other restrictions on grounds of EMFs applying to power lines.

6.2.11 The assessment presented above shows that the maximum value of the fields produced by the proposed 400 kV overhead lines would be compliant with the relevant exposure limits in Table 2.2, even directly under one of the overhead lines. There is no minimum lateral distance from the overhead line required in order to achieve compliance. Therefore, assessment of compliance is not dependent on:

- the exact routing of the overhead line;
- the exact location of the nearest existing residential property to the overhead line;
- the nearest proposed property already granted planning permission;
- or the nearest property that might in future be granted planning permission,

because the field from the overhead line is compliant everywhere, not just compliant outside a specified distance.

6.2.12 Although not required for assessing compliance, the graphs presented above can be used to estimate the maximum fields at any given distance from the line.

6.2.13 The calculated EMFs are presented for compliance purposes using worst-case conditions. Typically, the overhead line would produce EMFs lower than these levels for two reasons. Firstly, the circuits are unlikely to operate at the maximum rating routinely, and a typical current on a day-to-day basis would be lower than this. Secondly, for overhead lines, typically the conductors would be higher than the minimum design clearance used for assessing compliance, reducing the EMFs at ground level, with the minimum clearance found only in a limited area towards the middle of certain spans.

6.3 Operational Effects – Underground Cables

Electric Fields

6.3.1 Underground cables produce no external electric field because of the metallic sheath which surrounds the cable.

Magnetic Fields

6.3.2 Four sections of underground cable system will be installed as part of the Project. These sections are Dedham Vale National Landscape, Great Horkesley, Fairstead and North Tilbury. Transitions between overhead lines and underground cables are via CSE compounds and substations.

6.3.3 The underground cable system would consist of 18 transmission cables, three cables per phase. If circumstances allow, the configuration could be altered to two cables per phase and consist of 12 transmission cables. The cables will be installed using varying techniques depending on terrain and engineering difficulties. The installation design and burial depth of the cables can impact the magnetic fields produced. Compliance of each installation technique with the EMF exposure limits is demonstrated below.

Standard Installation – Magnetic Fields

6.3.4 The standard installation technique for three cables per phase involves installing 18 transmission cables in six trenches, three trenches per circuit and each trench containing three transmission cables. If circumstances allow and two cables per phase is used, the standard installation technique involves installing 12 transmission cables in four trenches, two trenches per circuit and each trench containing three transmission cables. The number of cables per phase impacts the magnetic field because the current in each circuit is split between the phases. Where there are more cables per phase, less current is carried in each phase cable, typically resulting in lower magnetic fields. Cables for both two and three cables per phase will be installed in ducts within a trench which is a minimum of 1.4 m to the base and 0.9 m from the finished ground level to the top of the protective slab. Calculations were performed using the maximum pre-fault continuous rating for each circuit which is 2,525 MVA and at minimal burial depth.

6.3.5 The maximum calculated magnetic field for standard trench installation is 77.4 μT for three cables per phase and 110.7 μT for two cables per phase, using worst-case conditions. Figure 6.4 and Figure 6.5 show the calculated magnetic field from the cables for both standard and trenchless installation. The graphs demonstrate how quickly the magnetic field reduces with distance. Calculations were performed in accordance with the conditions set out in the Codes of Practice on Compliance and on Optimum Phasing (DECC, 2012a, 2012b).

Trenchless Crossing – Magnetic Fields

6.3.6 Trenchless crossings are proposed in five locations on the Project: Higham Road; River Stour (north part); River Stour (south part); A12 highway crossing and railway crossing (east of Ardleigh). This method usually installs the cables deeper than a trenched installation, typically under the sensitive feature. To achieve the same electrical ratings despite being installed deeper, the cables are also installed further apart than in a trench installation. When cables are further apart it can impact the magnetic fields they produce, so trenchless crossings have been assessed separately.

6.3.7 A typical trenchless crossing was assessed using the following assumptions to calculate the maximum magnetic field. For three cables per phase, a total of 18 cables will be installed. These will have a maximum separation distance of 10 m and a minimum burial depth of 5 m. Alternatively, for two cables per phase a total of 12 cables will be installed, with a maximum separation distance of 15 m and a minimum burial depth of 5 m. Calculations were performed using the maximum pre-fault continuous rating for each circuit which is 2,525 MVA.

6.3.8 The maximum calculated magnetic field for a typical trenchless crossing installation is 50.2 μT for three cables per phase and 71.4 μT for two cables per phase using worst-case conditions. Figure 6.4 and Figure 6.5 show the calculated magnetic field from the cables for both standard and trenchless installation. The graphs demonstrate how quickly the magnetic field reduces with distance. Calculations were performed in accordance with the conditions set out in the Codes of Practice on Compliance and on Optimum Phasing (DECC, 2012a, 2012b).

Figure 6.4 Calculated Maximum Magnetic Field for the 400 kV Underground Cables using Two Installation Techniques: Standard/Trench (Blue Line) and Trenchless Crossing (Green Line) for Three Cables Per Phase

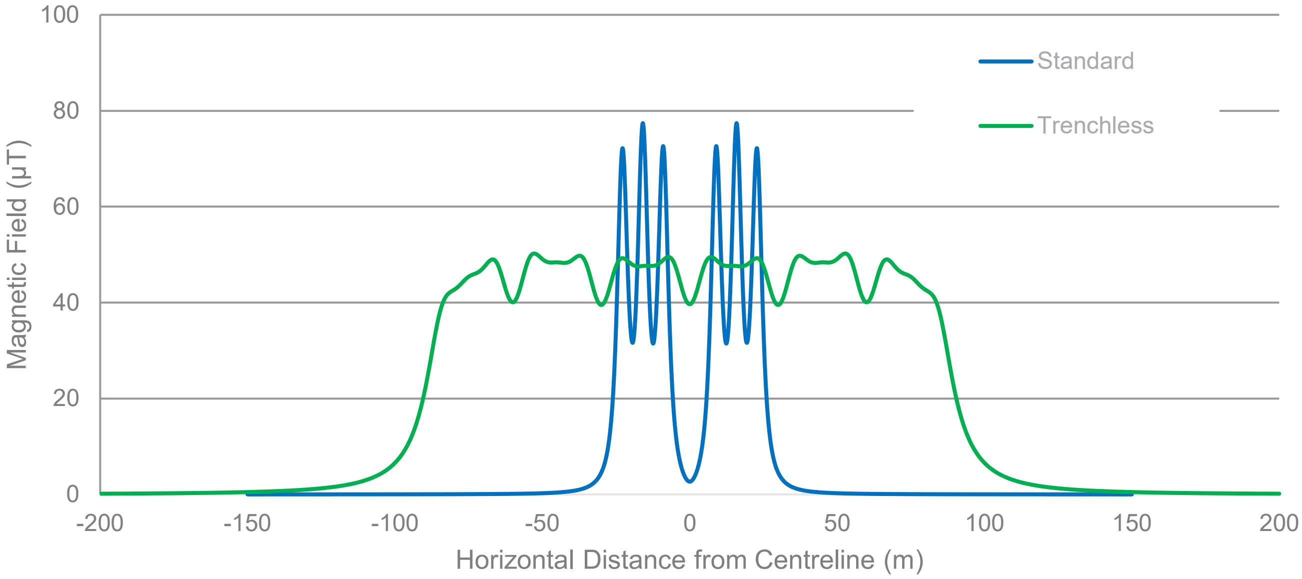
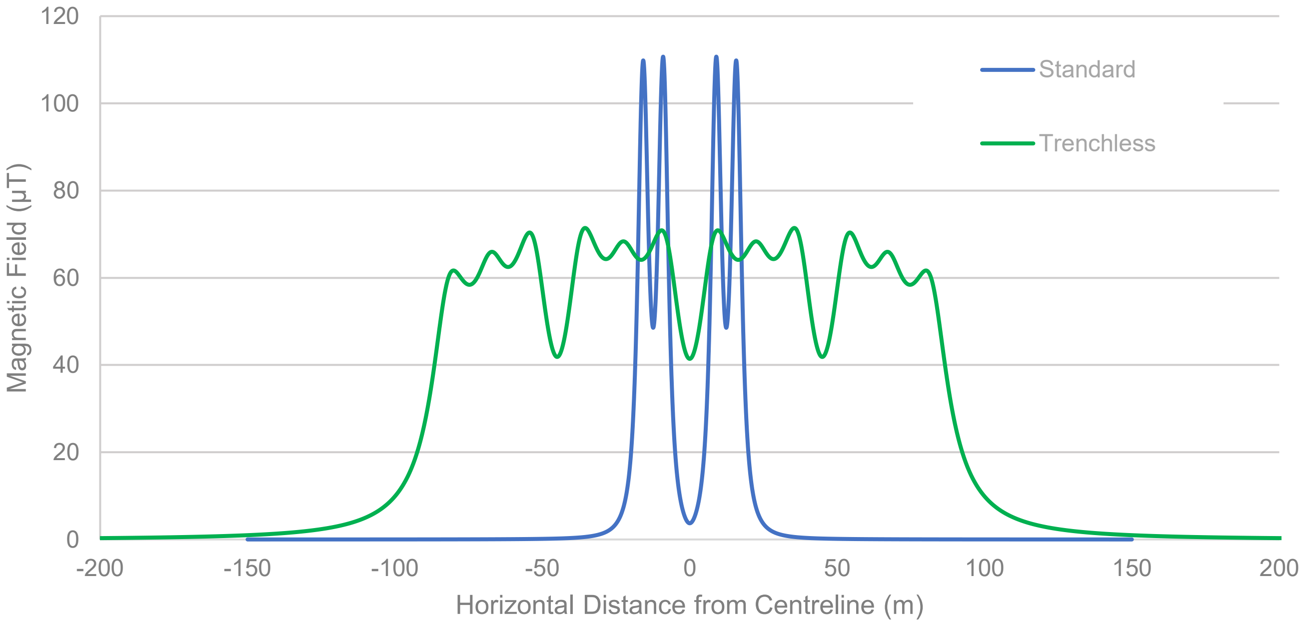


Figure 6.5 Calculated Maximum Magnetic Field for the 400 kV Underground Cables using Two Installation Techniques: Standard/Trench (Blue Line) and Trenchless Crossing (Green Line) for Two Cables Per Phase



Combined Effects with New 400 kV Overhead Line

6.3.9 For part of the route, the proposed new 400 kV underground cables would be in close proximity to the new overhead line. Therefore, the combined effects have been considered from the underground cable and overhead line.

6.3.10 Figure 6.6 and Figure 6.7 show the calculated maximum magnetic field from the new underground cable (for both two and three cable per phase scenarios) and the new 400 kV overhead line in close proximity to each other.

6.3.11 Figure 6.6 shows the maximum cumulative magnetic field for the proposed underground cable with three cables per phase and the new overhead line, is 120.3 μT. Figure 6.7 shows the maximum cumulative magnetic field for the proposed underground cable with two cables per phase and the new overhead line, is 148.3 μT. These effects will be localised to the crossing point only.

6.3.12 Underground cables produce no electric fields as detailed in Section 1.3.5; the combined effect is therefore the same as the effect of the overhead line without the underground cable (demonstrated in Figure 6.1).

Figure 6.6 Combining Magnetic Fields from Underground Cables in Close Proximity to New Overhead Lines for Three Cables Per Phase

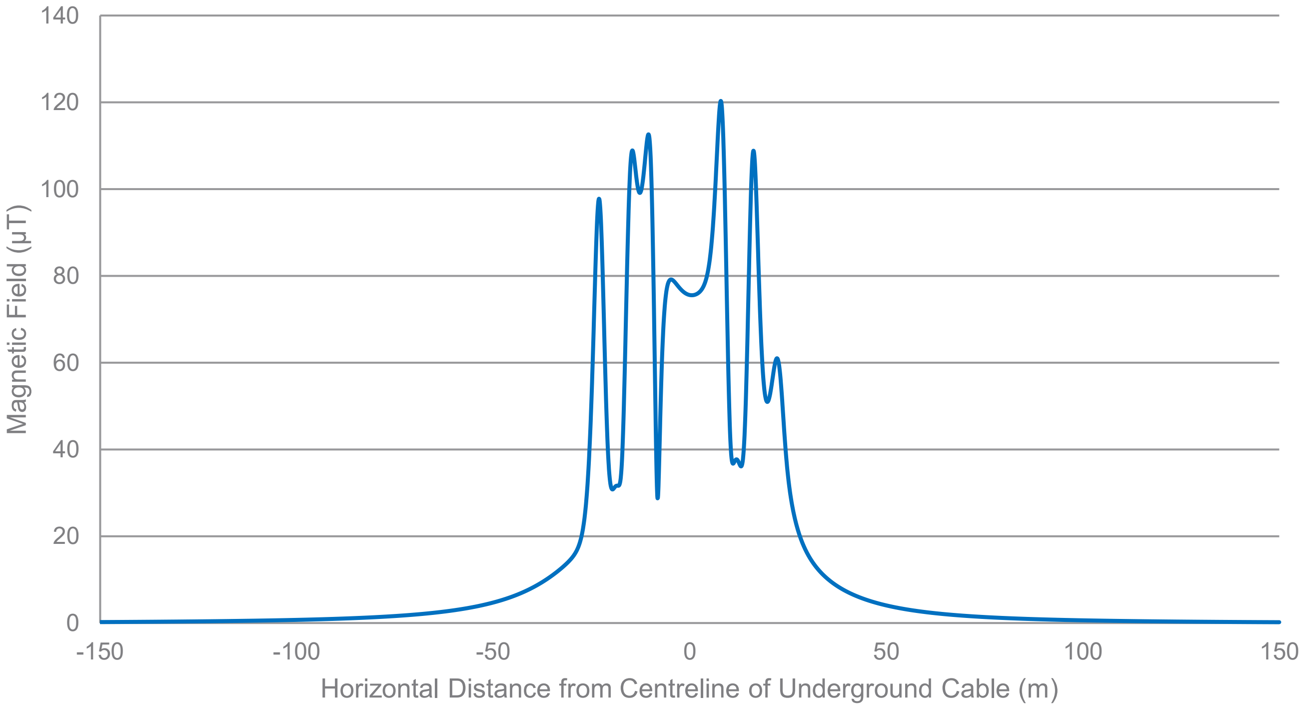
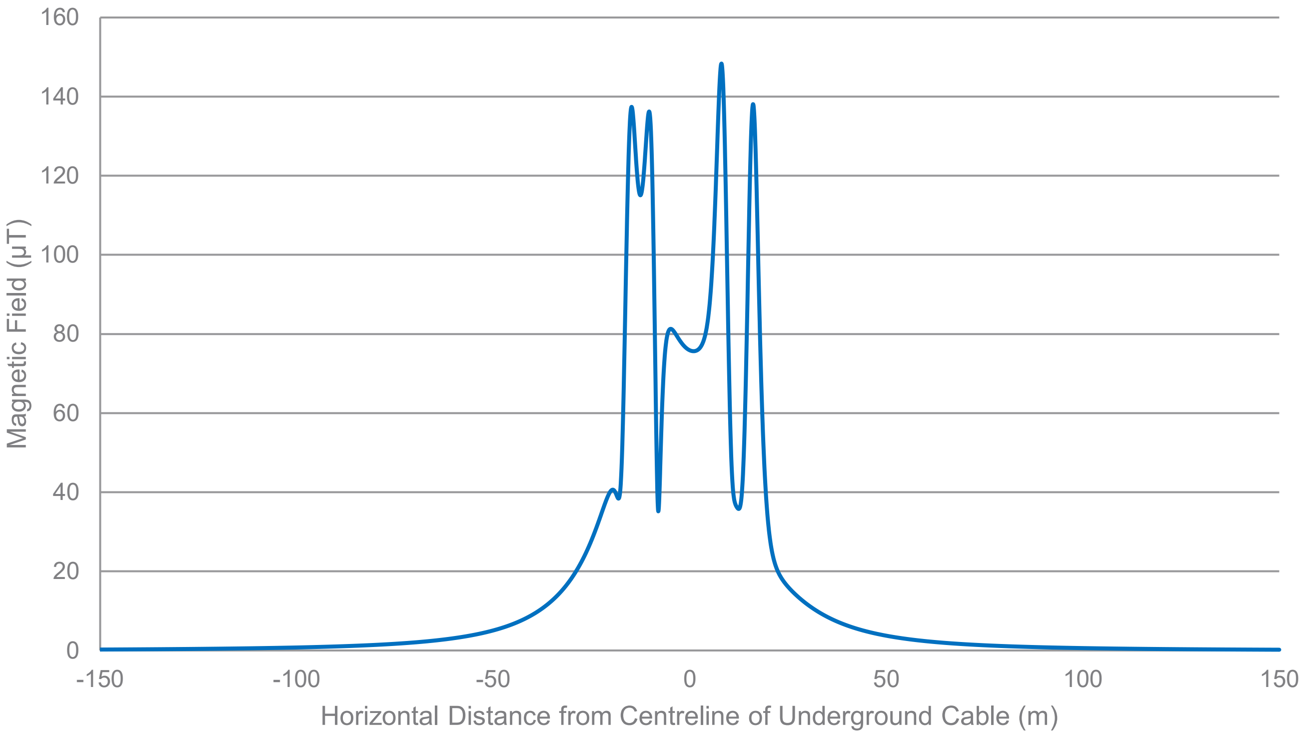


Figure 6.7 Combining Magnetic Fields from Underground Cables in Close Proximity to New Overhead Lines for Two Cables Per Phase



Combined Effects with Existing 400 kV Overhead Line

6.3.13 For part of the route, the proposed new 400 kV underground cables would be in close proximity to existing overhead line. Therefore, the combined effects have been considered from the underground cable and overhead line. The calculations below have been performed using the existing 400 kV overhead line, which runs between Braintree and Rayleigh Main, to model the maximum magnetic fields for the combined effect.

6.3.14 Figure 6.8 and Figure 6.9 show the calculated maximum magnetic field from the new underground cable (for both two and three cable per phase scenarios) and existing 400 kV overhead line in close proximity to each other.

6.3.15 Figure 6.8 shows the maximum cumulative magnetic field for the proposed underground cable with three cables per phase and the existing overhead line, is 145.2 µT. Figure 6.9 shows the maximum cumulative magnetic field for the proposed underground cable with two cables per phase and the existing overhead line, is 179.5 µT. These effects will be localised to the crossing point only.

6.3.16 The cumulative impacts have been assessed and using worst-case conditions as detailed in the Code of Practice on Compliance (DECC, 2012a), all EMFs comply with the requirements of NPS EN-5 (DESNZ, 2024a) and corresponding UK guidelines.

6.3.17 Underground cables produce no electric fields as detailed in Section 1.3.5; the combined effect is the same as the effect of the overhead line without the underground cable.

Figure 6.8 Combining Magnetic Fields from Underground Cables in Close Proximity to Existing Overhead Lines for Three Cables Per Phase

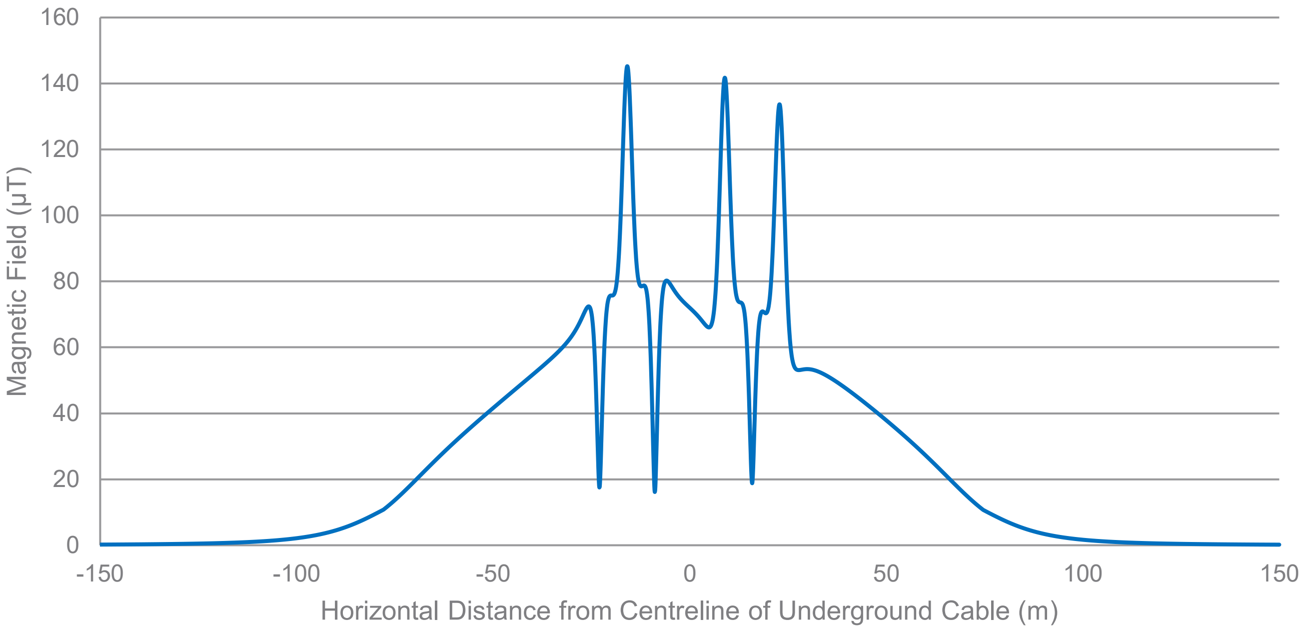
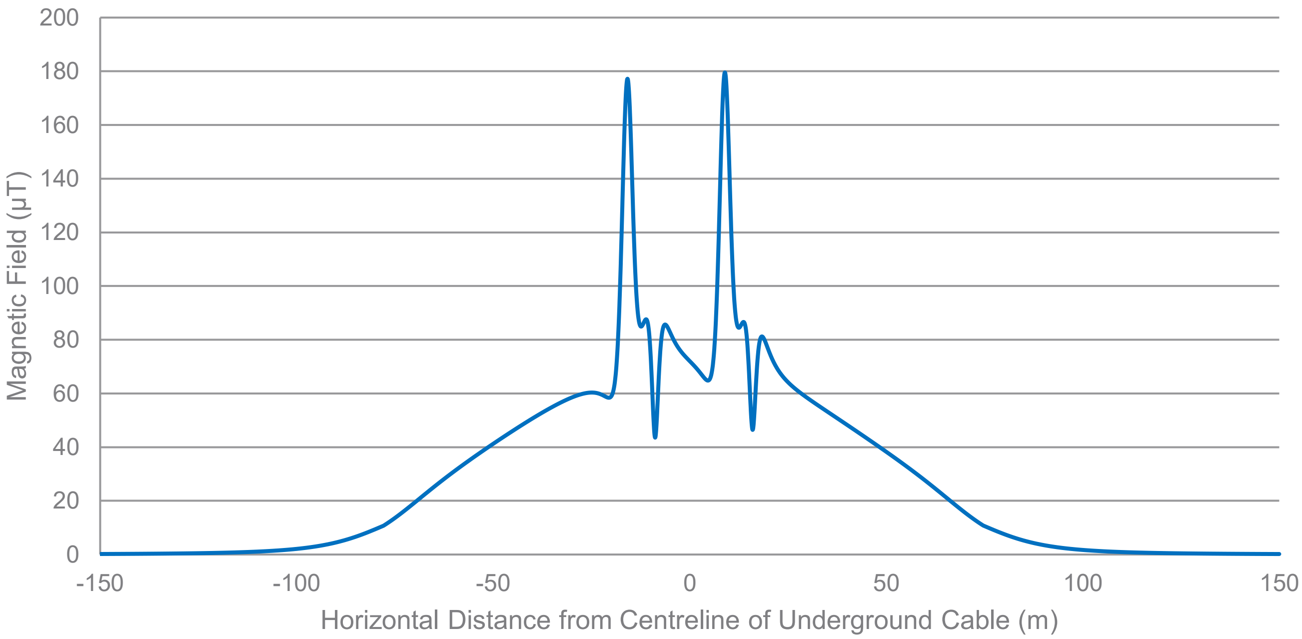


Figure 6.9 Combining Magnetic Fields from Underground Cables in Close Proximity to Existing Overhead Lines for Two Cables Per Phase



Compliance of Underground Cables with Exposure Limits

6.3.18 The maximum field the underground cables can produce is 145.2 μT for three cables per phase and 179.5 μT for two cables per phase (allowing for the effect with overhead lines), therefore the cables are below the relevant exposure limit and are compliant with the EMF requirements in NPS EN-5 (DESNZ, 2024a).

6.4 Operational Phase Effects: EACN Substation, Tilbury North Substation, Substation Extensions and CSE Compounds

6.4.1 As explained in paragraph 4.3.9, substations without air-cored reactive equipment and CSE compounds are treated, according to the Code of Practice on Compliance (DECC, 2012a), as inherently compliant with the exposure limits. This equipment is deemed compliant with the guidelines and does not require a detailed demonstration of compliance.

6.4.2 The new 400 kV EACN Substation is proposed to be an AIS design with air-cored reactive equipment installed and it will be designed in accordance with National Grid technical specifications to ensure that maximum magnetic field levels at the public boundary remain within the established public exposure limits. Associated works at EACN Substation are to be confirmed. These could include removal of UK Power Networks' existing 132 kV overhead line route, and replacement with underground cable. Underground cables at voltages up to and including 132 kV are treated, according to the Code of Practice on Compliance, as inherently compliant with the exposure limits. This equipment is deemed compliant with the guidelines and does not require a detailed demonstration of compliance.

6.4.3 The new 400 kV Tilbury North Substation is proposed to be a GIS substation with no air-cored reactive equipment installed, and therefore is inherently compliant. Sections of the existing YYJ and ZB National Grid overhead lines require modification to facilitate the connection of the existing transmission network into the new Tilbury North Substation. Calculations for the modifications of these existing overhead lines have been performed in Section 6.2 to demonstrate compliance.

6.4.4 The connection works into the existing Norwich Main Substation and the extension at the existing Bramford Substation will be designed with no air-cored reactive equipment installed and both are therefore inherently compliant. There would also be associated works at Bramford Substation, including replacement of existing 132 kV overhead lines with underground cables. As referenced in paragraph 6.4.2, underground cables at voltages up to and including 132 kV are inherently compliant.

6.4.5 The detailed design at each substation is yet to be finalised, however, if air-cored reactive equipment is utilised, it will be designed in accordance with National Grid technical specifications to ensure that maximum magnetic field levels at the public boundary remain within the established public exposure limits.

6.4.6 The highest fields around substations and CSE compounds are usually from any overhead lines or underground cables entering them and not from equipment within the substation or CSE compound itself. This compliance includes any lengths of underground cable making connections within the overall boundary of the substation or CSE compounds.

7. Conclusion

7.1.1 UK Government, acting on the advice of authoritative scientific bodies, has put in place appropriate measures to protect the public from EMF. These measures comprise compliance with the relevant exposure limits, and one additional precautionary measure, optimum phasing, applying to high voltage power lines. This policy is incorporated in NPS EN-5 (DESNZ, 2024a).

7.1.2 Components associated with the Project would be fully compliant with the UK Government policies on EMFs. Specifically, all the EMFs produced would be below the relevant exposure limits, and the proposed overhead lines would comply with the policy on optimum phasing. If these requirements are met, NPS EN-5's Simplified Route Map for dealing with EMFs states that '*EMF effects are minimal'* and therefore, there would be no significant EMF effects resulting from the Project. This report demonstrates compliance with these requirements.

7.1.3 As referenced in the Scoping Opinion (The Planning Inspectorate, 2022), assessment of EMFs can be scoped out for construction. The Proposed Development would be designed in accordance with Government guidance and precautionary policies, as evidenced in this compliance report, therefore assessment of EMFs can also be scoped out for operation.

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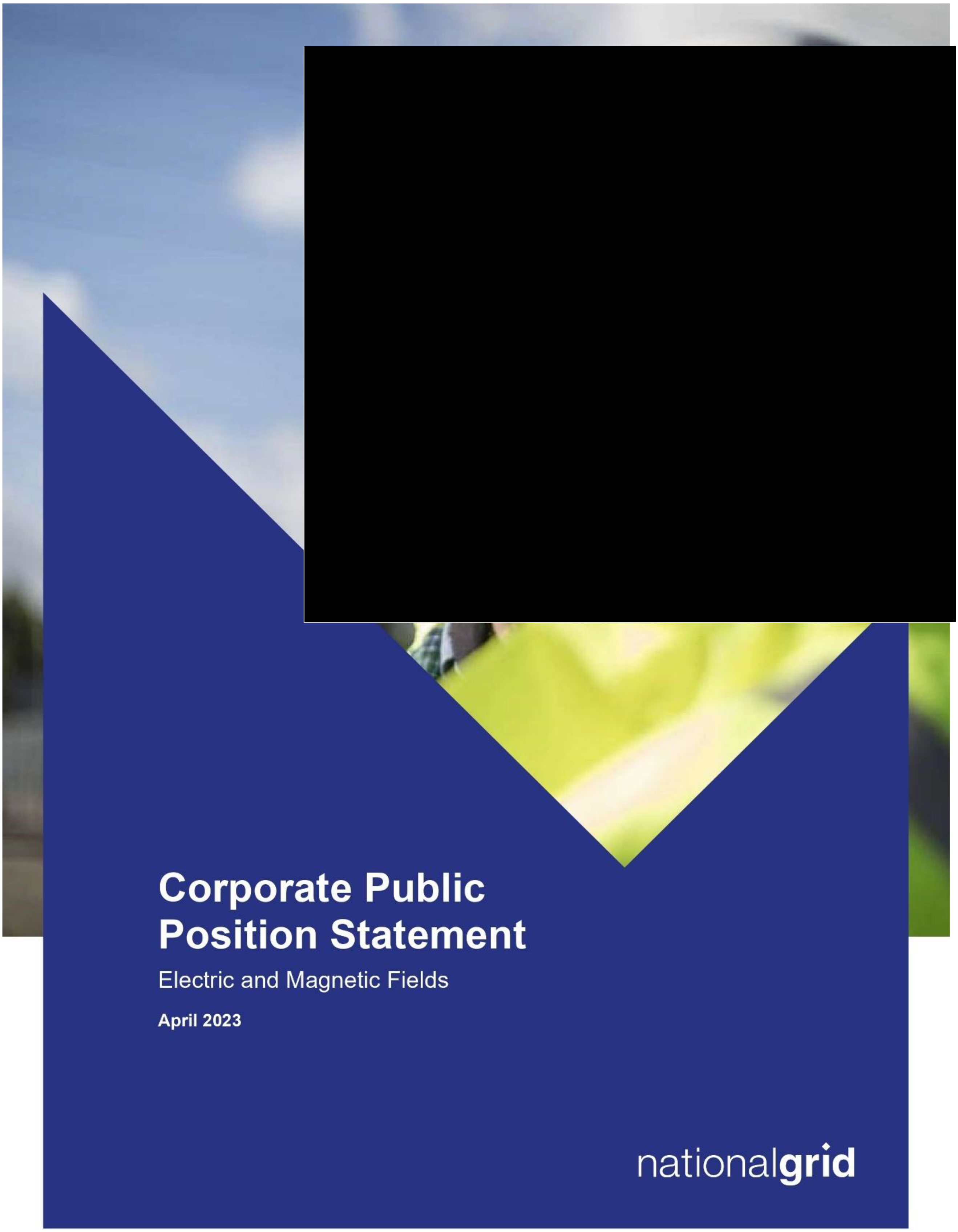
Appendix A.
National Grid's Public Position Statement on Electric and Magnetic Fields

Appendix A
National Grid's Public Position Statement on Electric and Magnetic Fields



Contents

Electric and Magnetic Fields

Objective

Electric and Magnetic Fields (EMFs) can be generated from a wide variety of sources, including distribution and transmission power lines and wireless infrastructure. National Grid recognises that there is scientific debate about whether certain adverse health effects may be linked to EMFs. As a consequence, there is public concern around the subject.

We take the responsible management of EMFs very seriously. This public position statement sets the framework within which National Grid will manage EMFs. We will:

- Continually assess the scientific evidence in this area;
- Determine any implications for the way in which we conduct our business; and
- Explain to society what the science is telling us.

The President of Electricity Transmission is responsible for ensuring that this public position statement reflects and is compliant with current legislation and is kept up to date with new or changing legislation.

Scope

This public position statement applies to National Grid and its Subsidiary Companies. For Associate Companies, National Grid will seek to promote the adoption of statements and practices consistent with those set out in this document.

This statement covers:

- EMFs that arise from transmission and distribution power lines and associated equipment; and
- Radio-frequency EMFs that arise from wireless infrastructure, including from third-party assets.

Framework

Electric and Magnetic Fields can arise from many sources including household appliances, electrical distribution and transmission facilities and equipment, mobile telephones, and radio-transmission devices. Research is ongoing to improve our understanding of the effects of EMFs. The balance of evidence remains **against** both power-frequency and radio-frequency EMFs causing ill health. However, National Grid recognises that the World Health Organization has classified power-frequency EMFs as “possibly” carcinogenic. This scientific position is reflected in the views of the regulatory bodies in the countries in which we operate.

We also recognise that scientific developments on EMFs do not depend on international boundaries. This public position statement establishes the common threads applicable across all our operations.

This public position statement has seven central principles:

1. We recognise that the societies in which we operate hold a variety of views on EMFs. In view of the scientific position and the fact that EMFs are of concern to some, we take the matter very seriously.
2. In all our operations, as a minimum, we comply with legal requirements, including relevant EMF regulations. We also aim to follow industry guidelines or best practice in the countries and different jurisdictions in which we operate. Where other companies (such as telecommunications operators) use our assets, we require them to do the same.
3. We support the view of regulators and governments that the EMF issue warrants consideration for a precautionary approach. We look to them to decide on any measures that may be necessary, as they can evaluate the science and weigh-up costs and benefits on behalf of society as a whole.
4. To mitigate the amenity impact of new overhead transmission lines, we always endeavour to route them:
   - along formal Rights of Way in countries where they exist; or
   - away from existing buildings where they do not.

   In order to ensure safety clearances and to help us maintain our network, we do not encourage housing development immediately beneath our lines. We will work with planning bodies to promote the sustainable use of land under our lines. These steps will usually result in EMF exposures being lower than would otherwise be the case.
5. We recognise that scientific understanding of any effects of EMFs is improving. We review all relevant scientific developments in this area from across the world and assess any implications for the way in which we operate.
6. We support high-quality research into EMFs and make the results available for scientific review.
7. We communicate in an open manner with those who have an interest in EMF matters, and make available information that will help society's understanding of EMFs. We will participate openly and constructively in debate on precautionary approaches appropriate to the EMF issue.

In support of this public position statement, each Subsidiary Company will ensure that:

- A plan is put in place to ensure all relevant elements of this public position statement are implemented.
- All regulatory and legal requirements are met for both new and existing lines and infrastructure.
- All legal non-compliances or suspected non-compliances are investigated, and if appropriate. prompt corrective actions taken. Associate Companies will be encouraged to put similar arrangements in place.

Related Corporate Policies and Other Documents

- Framework for Responsible Business.
- Environment policy.
- Safety and Occupational Health policy.
- Terms of Reference of the Safety, Environment and Health Committee.

Key Contacts

This public position statement is written and maintained by the President of Electricity Transmission, to whom questions regarding its content and application should be addressed.

The lead expert for this public position statement and the first point of contact is Dr Hayley Tripp, EMF Specialist, Electricity Transmission.

Monitoring and Compliance

The President of Electricity Transmission is responsible for ensuring that this public position statement is effectively communicated throughout its lifecycle.

The President of Electricity Transmission will ensure that compliance with this public position statement is reviewed periodically. Any changes needed to ensure its effectiveness will be drawn to the attention of the Board's Safety, Environment and Health Committee and to the Board itself.

Each Subsidiary Company will ensure that it has the necessary arrangements in place to monitor and report compliance against this public position statement periodically. Each Associate Company will be encouraged to put in place similar arrangements to enable compliance to be reported periodically.

In line with good corporate governance practices, we will review this public position statement periodically.

The Corporate Environmental Audit Programme will be used from time-to-time to determine the level of compliance with all, or aspects of, this public position statement.

Definitions

Associate Company: A company whose equity share capital is 20% or more, but not more than 50%, beneficially owned by a National Grid company or companies.

Subsidiary Company: A company that is a subsidiary of National Grid provided that a National Grid company holds or controls a majority of the voting rights in it or the right to appoint or remove a majority of its directors.

Review Cycle

This Public Position Statement came into effect in 2003.

It was last reviewed in April 2023.

The next review will take place no later than April 2025.

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Appendix B. Certificate of Conformity of National Grid Transmission System with EMC Requirements

nationalgrid

Appendix B
Certificate of Conformity of National Grid Transmission System with EMC Requirements

Technical Certificate 05R110 issued by
Hursley EMC Services Ltd

Appointed by the Secretary of State for Trade and Industry as a UK EMC Competent Body

HURSLEY EMC SERVICES

TECHNICAL CERTIFICATE

PRODUCT TITLE: NGT Electricity Transmission Network

MANUFACTURED BY: National Grid Transco (NGT) plc
Manufacturers Address: NGT House, Warwick Technology Park, Gallows Hill, Warwick CV34 6DA UK

Applicants Nam[redacted]f NGT plc.

Product Description: The NGT Electricity Transmission Network (consisting of some 14,000 Km of high voltage supply lines) is the high voltage electricity transmission system in England and Wales.

Technical Statement: The Technical Construction File (TCF), "NGT Electricity Transmission Network" (dated 2005), describes the general construction, conformity procedures and EMC test rationale for the Electricity Network. This Technical Construction File, in so far as is technically viable, is based on testing to international standards, specifically EN50121-2:2000 and CISPR 18 for emissions. These standards were used as the most suitable guide for the emissions testing in lieu of any other practical or harmonized product related standards. Given the size of the equipment, testing was performed in-situ at several representative sites and is therefore an approximation to the standards. The results of the tests applied and described in the test reports along with the EMC detail supplied in the TCF indicate that the product complies with the standards.
Taking into consideration the technical rationale provided in the TCF and the results of the site measurement reports, Hursley EMC Services is satisfied the TCF does demonstrate compliance with the essential protection requirement of EC Directive 89/336. NGT operates a certified ISO 9001 quality management system covering both the operation and installation procedures for the Electricity Network. Due to its size and nature along with quality procedures used for installations the NGT Electricity Transmission Network would seem inherently immune to normal EMC phenomena.
This route to compliance with respect to the provisions of EC Directive 89/336 is in accordance with section 42(c) of the UK Statutory Instrument 1992 No 2372 (The Electromagnetic Compatibility Regulations). This application and certificate applies only to the NGT Electricity Transmission Network for the UK as described in the Technical Construction File.

COMPETENT BODY CONFORMITY STATEMENT

Hursley EMC Services Ltd. certifies that the National Grid Transco plc TCF demonstrates that the NGT Electricity Transmission Network conforms to the protection requirements of European Council Directive 89/336 and its amendments. This directive is on the approximation laws of the Member States relating to electromagnetic compatibility.

Signed: [redacted]
EMC Technical Manager

Approved: [redacted]
EMC Quality Manager

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Issue Date: 17th March 2005

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