East Pye Solar

Environmental Statement

Volume 3: Appendix 17.1 – High-Level Electromagnetic Field Assessment

Revision 1

March 2026

Planning Inspectorate Reference: EN0110014

Document Reference: APP/6.3.17.1

APFP Regulation 5(2)(a)

PAGERPOWER
Urban & Renewables

High-Level Electromagnetic Field Assessment

Stantec

East Pye Solar

March 2026





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ADMINISTRATION PAGE

Issue	Date	Detail of Changes
1	April 2025	Initial issue
2	May 2025	Administrative revisions
3	November 2025	Administrative revisions

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EXECUTIVE SUMMARY

Report Purpose

Pager Power has been retained to assess the potential impact of electromagnetic fields (EMF) generated by electrical equipment pertaining to the Scheme located in Long Stratton, Norwich, UK, with respect to safe levels for human exposure. The assessment considers the proposed underground power cables, transformers, and substations.

Overall Conclusions

Levels of magnetic fields from the underground and overhead cables are predicted to be below ICNIRP reference levels.

No significant electrical fields are predicted with the underground cables.

Levels of electrical fields from the overhead 400kV cables are predicted to exceed ICNIRP reference levels. A minimum setback distance of 15m is expected is expected to be maintained for receptors pertaining to human health.

Radiation from the transformer and substations will be even less significant because the equipment is predicted to be housed in protective enclosures. The transformer and substations will be CE and/or UKCA marked, indicating that a product has been assessed by the manufacturer and deemed to meet European Union safety, health and environmental protection requirements. CE marking requirements were adopted and extended indefinitely in Great Britain until the UK left the EU in 2020. From 1 January 2021, the UKCA mark started to replace the CE mark for goods sold within Great Britain, and the CE mark has continued to be required for goods sold in Northern Ireland.

Standards in the UK

The UK Policy on public exposure limits to EMF radiation is designed to comply with the 1998 International Commission on the Non-Ionizing Radiation Protection (ICNIRP) guidelines in terms of the 1999 EU Recommendation. In 2010 ICNIRP produced new guidelines but these have not yet been incorporated into UK Policy. The public exposure limits in UK policy define reference levels for electric and magnetic fields. Where field levels exceed these reference levels in significantly occupied spaces, further investigation is warranted. Further information can be found in Sections 2 and 3 of this report.

Assessment Conclusions – 132kV and 400kV Underground Cables

Magnetic Fields

No significant impact from magnetic fields upon human health is predicted. The magnetic fields associated with the voltages of both 132kV and 400kV underground cables measure lower than the threshold considered to be a significant level to human exposure (Section 4.2.1).

Electric Fields

Electric fields are not considered significant (Section 4.2.2).

Assessment Conclusions – 132kV and 400kV Overhead Cables

Magnetic Fields

No significant impact from magnetic fields upon human health is predicted. The magnetic fields associated with the voltages of both 132kV and 400kV overhead cables measure lower than the threshold considered to be a significant level to human exposure (Section 4.3.1).

Electric Fields

The maximum electric field for a 400kV measures 10.6 kV m^{-1}; greater than the threshold of 5 kV m^{-1} to be a significant level to human exposure. Therefore, a minimum clearance distance of 15m is expected to be maintained for receptors pertaining to human health. This clearance distance should be observed during the construction, operational and decommissioning phases (Sections 4.3.2 and 4.6).

The existing overhead cabling infrastructure is assumed not to have a significant impact upon human health receptors, as it currently exists within the baseline. Considering the distances of at least 15m between the existing overhead cables, new cables forming into this infrastructure, and human health receptors, the electric field strength measures less than the reference limit of 5kV m-1.

Assessment Conclusions – Transformers and Project Substations / National Grid Substation

The most significant sources of radiation other than the underground cables are the transformer and substations.

The substations and transformer will be 'CE' marked (Conformité Européene, or European Conformity marking), and/or 'UKCA' marked (UK Conformity Assessed). CE and UKCA markings indicate that a product has been assessed by the manufacturer and determined to meet the safety, health, and environmental protection requirements of the European Union and the United Kingdom, respectively. CE marking requirements were adopted and extended indefinitely in Great Britain until the UK left the EU in 2020. From 1 January 2021, the UKCA mark started to replace the CE mark for goods sold within Great Britain, and the CE mark has continued to be required for goods sold in Northern Ireland.

The CE marking should ensure that electrical and electronic equipment does not generate, or is not unintentionally affected by, electromagnetic disturbance.

The transformer and substations are also predicted to produce fields at a lower level than that of underground cables and overhead powerlines because the equipment is predicted to be housed in protective enclosures.

LIST OF CONTENTS

ABOUT PAGER POWER

Pager Power is a dedicated consultancy company based in Suffolk, UK. The company has undertaken projects in 63 countries internationally.

The company comprises a team of experts to provide technical expertise and guidance on a range of planning issues for large and small developments.

Pager Power was established in 1997. Initially the company focus was on modelling the impact of wind turbines on radar systems. Over the years, the company has expanded into numerous fields including:

- Renewable energy projects.
- Building developments.
- Aviation and telecommunication systems.

Pager Power prides itself on providing comprehensive, understandable, and accurate assessments of complex issues in line with national and international standards. This is underpinned by its custom software, longstanding relationships with stakeholders and active role in conferences and research efforts around the world.

Pager Power's assessments withstand legal scrutiny and the company can provide support for a project at any stage.

1 SCHEME DETAILS

1.1 Site Layout

The locations of electrical infrastructure is outlined in the Works Plans.

1.2 Electrical Infrastructure

The assessment has considered the proposed 132kV and 400kV underground cables buried within areas of the cable route corridor, connecting into the existing 400kV overhead cable infrastructure. As set out in the Design Principles, Parameters and Commitments [EN0110014/APP/7.18], the trench dimensions for the Scheme are as follows:

Low voltage cable (DC electrical cables, communication cables and low voltage AC cables) trenches will be a maximum width of 1.6m and maximum depth of 1.2m.

Interconnecting cable (high voltage cables between 33kV and 400kV) trenches will be a maximum width of 7m and maximum depth of 2m.

2 TECHNICAL BACKGROUND

2.1 Overview

All electrical equipment emits electric and magnetic radiation. Electrical infrastructure such as power cables produce both electric and magnetic fields which can potentially affect human health.

Underground cables generally cause a negligible electric field above ground but can cause a significant magnetic field which is dependent on the current in the conductors.

2.2 Electromagnetism

The movement of electric charge causes electric and magnetic fields to be produced in the space surrounding the charge. Human exposure to such fields can cause health problems if persistent and/or they are of a high strength. The magnitude of the effects is dependent on both the field strength and the exposure time.

2.3 Health Concerns – Potential Effects

The potential effects on human health caused by time-varying magnetic fields, such as those generated by alternating current (AC) cables, are due to induced current on functions of the central nervous system. There are various international bodies which provide maximum safe exposure levels to time varying electromagnetic fields. Various sources of information relating to safe exposure levels have been reviewed as part of this assessment.

The UK Policy on public exposure limits to EMF radiation is designed to comply with the 1998 International Commission on the Non-Ionizing Radiation Protection (ICNIRP) guidelines in terms of the 1999 EU Recommendation. In 2010, ICNIRP produced new guidelines but these have not yet been incorporated into UK Policy. The public exposure limits in UK policy define reference levels for electric and magnetic fields. Where field levels exceed these reference levels in significantly occupied spaces, further investigation is warranted.

Another relevant resource consulted is the *EMFs.info* webpage, where the UK electricity industry have collected the relevant studies pertaining to safe limits on exposure in the UK and elsewhere in the world (further presented in Section 3).

2.4 Radiation from Home Electrical Equipment

The World Health Organization (WHO) have published data regarding electromagnetic fields including the following typical levels for home electrical equipment, shown in Table 1 below.

Appliance	Electric field strength (Volts per metre)	Magnetic field strength (micro-Tesla) (at 1 metre)
Hair Dryer	80	0.01 – 7
Iron	120	0.12 – 0.3
Vacuum Cleaner	50	2 – 20
Refrigerator	120	0.01 – 0.25
Television	60	0.04 - 2

Table 1 *Typical emissions from home electrical equipment*

2.5 Radiation Reduction with Distance

Radiation levels reduce with distance; for example, the typical magnetic field from a vacuum cleaner reduces from 800 micro-Tesla to 2 micro-Tesla when the separation distance increases from 3 centimetres to 100 centimetres.

This means radiation levels from the cables, powerlines, substations, transformers, and PV inverters will tend to reduce with distance in any direction – including towards a receptor.

3 REFERENCE LIMITS FOR ELECTROMAGNETIC FIELDS

3.1 Overview

The Electricity Networks Association[1] provides a comprehensive overview of electromagnetic fields (EMFs) and the issues associated with these on their webpage. Regarding health issues caused by EMFs they state the following:

> *However, there are suggestions that magnetic fields may cause other diseases, principally childhood leukaemia, at levels below these limits. The evidence for this comes from epidemiology studies, which have found a statistical association - an apparent two-fold increase in leukaemia incidence, from about 1 in 24,000 per year up to 1 in 12,000 per year, for the children with the top half percent of exposures. The evidence is strong enough for magnetic fields to be classified by the World Health Organization as "possibly carcinogenic". But because these studies only show statistical associations and do not demonstrate causation, and because the evidence from the laboratory is against, the risk is not established, it remains only a possibility.*

3.2 Exposure Limits in the UK

As set out in the previous section, the limits in the UK come from the 1998 ICNIRP guidelines. The original guidance in 1999 specified:

i) Basic Restrictions;

   These are the levels at which radiation is potentially harmful to humans. This is a current density[2] given in mA m^{-2} (milliamps per metre squared);

ii) Reference Level (Investigation Level);

   Provided for practical exposure assessment purposes to determine whether the basic restrictions are likely to be exceeded. Compliance with the reference level will ensure compliance with the relevant basic restriction;

iii) Field Actually Required. This is the field strength at which the basic restriction is likely to be exceeded.

The values for the above stated in the ICNIRP 1998 paper are shown in Table 2 on the following page. These are the public exposure values, not the occupational exposure values – the former is more conservative than the latter by a factor of five. The data presented in Table 2 have been referenced to within the technical assessment.

[1] This is an industry body for the companies which run the UK and Ireland's energy networks. The group comprises 14 members including National Grid

[2] Current density is the amount of electric current flowing through a unit area

ICNIRP 1998 – Public Exposure Limits				
Basic Restriction ($mA\ m^{-2}$)	Magnetic Fields Reference Level (μT)	Electric Fields Reference Level ($kV\ m^{-1}$)	Magnetic Field Actually Required (μT)	Electric Field Actually Required ($kV\ m^{-1}$)
2	100	5	360	9

Table 2 *ICNIRP Exposure Limits 1998*

3.3 Height Above Ground Used for Testing Compliance

A 1m height above ground level is used to measure the strength of electromagnetic fields. This is based on the ICNIRP 1998 Guidelines.

3.4 Safe Levels – Summary

The values of interest are those shown in Table 2 above. Effectively, this means that in locations of significant exposure time, such as residences, levels should be below:

- 100μT (magnetic fields);
- 5kV m^{-1} (electric fields).

Values exceeding the limits above, at 1 metre above ground level, would suggest that further investigation is required.

4 TECHNICAL ASSESSMENT

4.1 Overview

Data from various cable configurations have been sourced from EMFS.info. Maximum field data has been used where possible to provide a more conservative assessment.

4.2 Underground Cables

4.2.1 Magnetic Fields – 400kV

Figure 17.1 below shows the magnetic fields for 400kV underground cables relative to distance, which represents the maximum assumed voltage for underground cables for the Scheme.

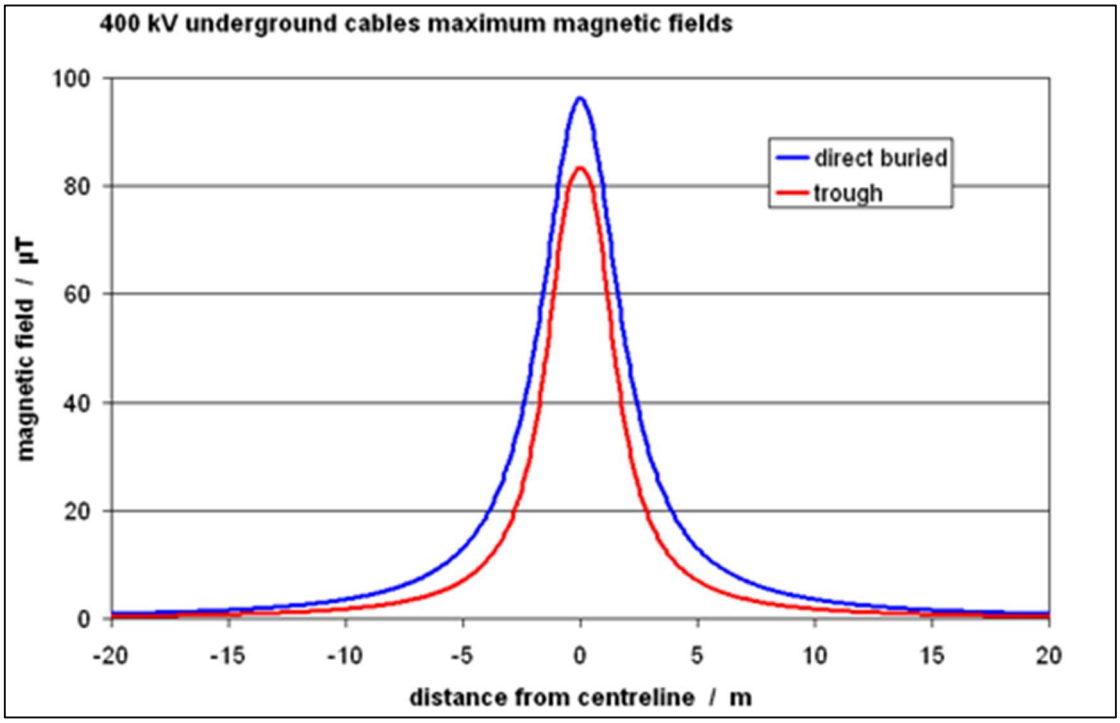

Figure 17.1 *Typical magnetic fields associated with 400kV underground cables*

The maximum magnetic field at 1m above ground, directly above the centreline, for an underground cable measures 95 micro-Tesla; lower than the threshold of 100 micro-Tesla to be a significant level to human exposure. The magnetic field strength for underground cables diminishes rapidly in a short distance, reaching approximately 0 micro-Tesla within 20m from the cable centre line.

4.2.2 Magnetic Fields – 132kV

Figure 17.2 below shows the magnetic fields for 132kV underground cables relative to distance.

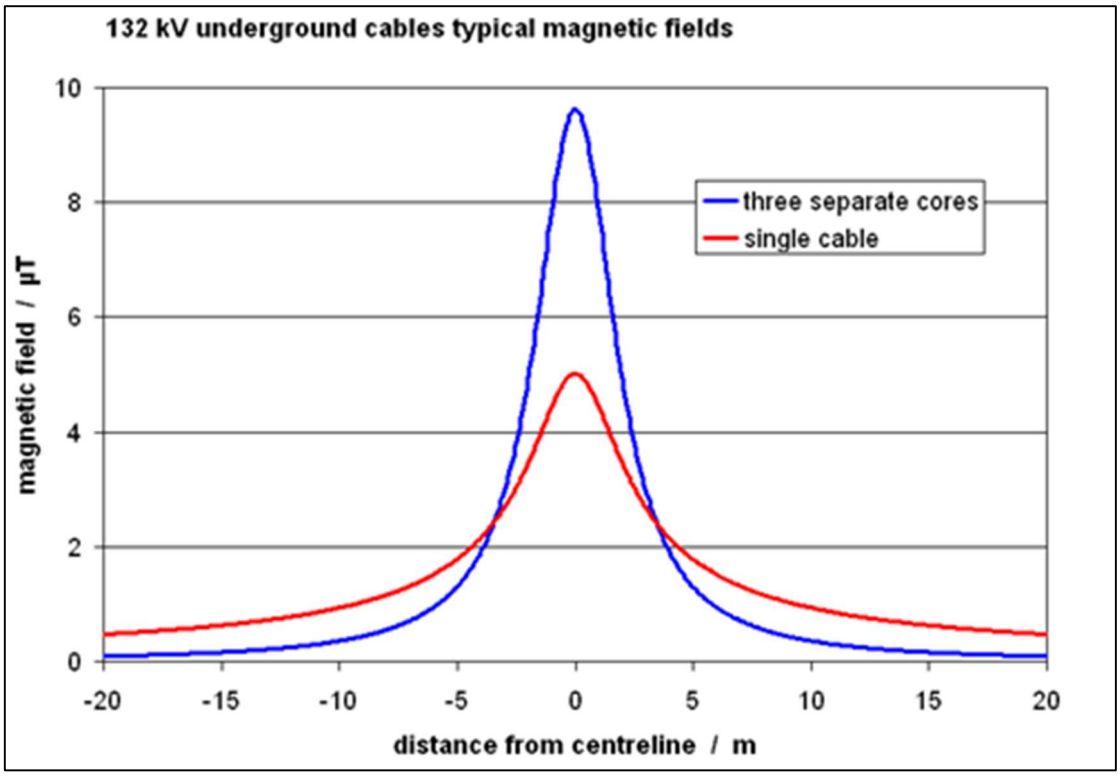

Figure 17.2 *Typical magnetic fields associated with 132kV underground cables*

The maximum magnetic field at 1m above ground, directly above the centreline, for an underground cable measures 9 micro-Tesla; lower than the threshold of 100 micro-Tesla to be a significant level to human exposure. The magnetic field strength for underground cables diminishes rapidly in a short distance, reaching approximately 0 micro-Tesla within 20m from the cable centre line.

4.2.3 Electric Fields – 400kV and 132kV

EMFS.info states[3]:

> *'Electric fields from underground cables are contained within the cable's protective insulation and sheath, so there are no external electric fields.'*

Therefore, no electric field pertaining to the underground cables for the Scheme is considered significant.

[3] Source: emfs.info 'https://www.emfs.info/electricity-system-and-sources/cables#:~:text=Underground%20cables%20produce%20EMFs%20in,are%20no%20external%20electric%20fields.'

4.3 Overhead Cables

4.3.1 Magnetic Fields – 400kV

Figure 17.3 below shows the magnetic fields for a 400kV overhead powerline in an L12 lattice pylon design, which is typical in the UK, with the minimum ground clearance and the highest allowed loads, which represents the maximum voltage for the existing and proposed overhead cables to be utilised by the Scheme.

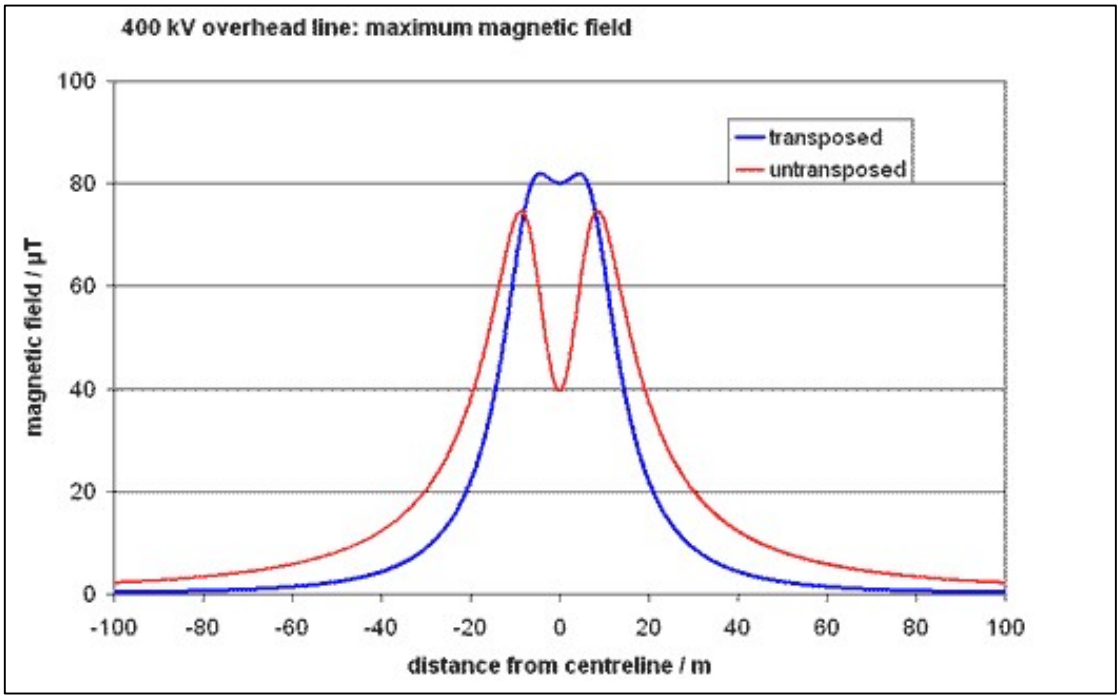

Figure 17.3 *Typical magnetic fields associated with 400kV overhead cables*

The maximum magnetic field measures 82 micro-Tesla; lower than the threshold of 100 micro-Tesla to be a significant level to human exposure. The magnetic field strength for overhead cables diminishes rapidly in a short distance, reaching approximately 0 micro-Tesla within 80m.

4.3.2 Electric Fields

Figure 17.4 below shows the electric fields for a 400kV overhead powerline.

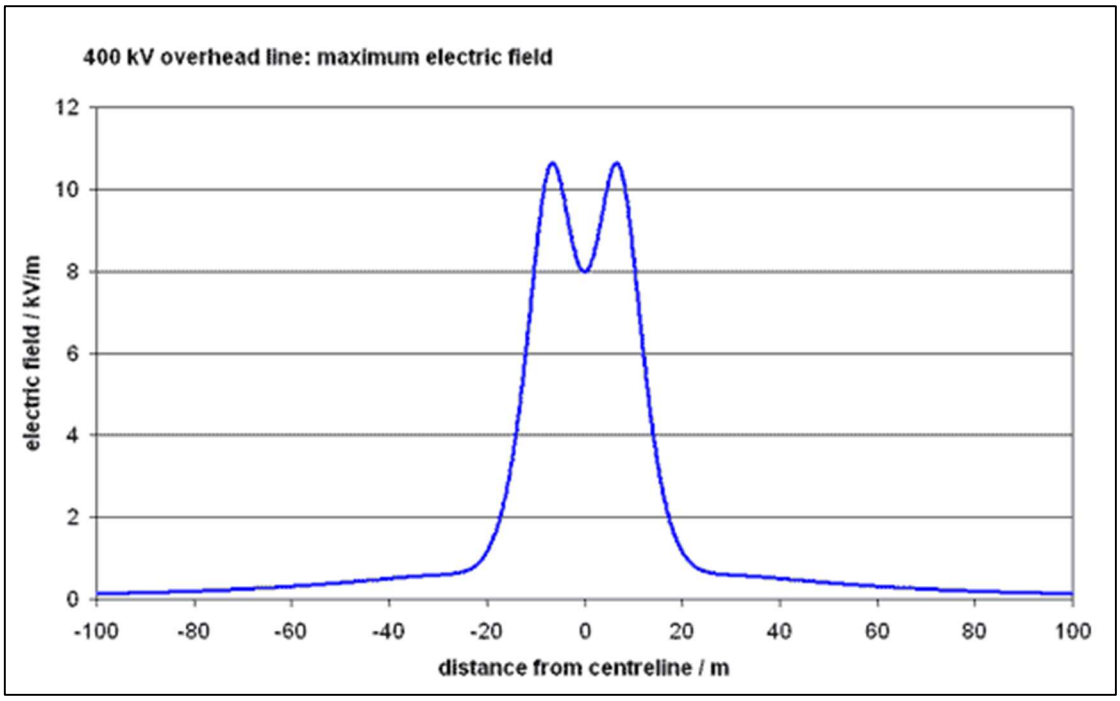

Figure 17.4 *Typical electric fields associated with 400kV overhead cables*

The maximum electric field measures 10.6 kV m^{-1}; greater than the threshold of 5 kV m^{-1} to be a significant level to human exposure. The electric field strength for overhead cables diminishes rapidly in a short distance, deteriorating to less than 5 kV m^{-1} within 15m, and reaching approximately 0 kV m^{-1} within 100m.

4.4 Transformer and Substations

The most significant sources of radiation other than the underground cables are the transformers and Project Substations / National Grid Substation.

The transformers and Project Substations / National Grid Substation should be CE marked (Conformité Européene, or European Conformity marking), and/or 'UKCA' marked (UK Conformity Assessed). CE and UKCA marking indicates that a product has been assessed by the manufacturer and deemed to meet the safety, health and environmental protection requirements of the European Union and the United Kingdom , respectively. CE marking requirements have been adopted and extended indefinitely in Great Britain until the UK left the EU in 2020. From 1 January 2021, the UKCA mark started to replace the CE mark for goods sold within Great Britain, and the CE mark has continued to be required for goods sold in Northern Ireland. This will be confirmed prior to installation.

In this case, the relevant EU Directive for CE marking is[4] Electromagnetic Compatibility Directive 2014/30/EU, which should ensure that electrical and electronic equipment should not generate, or be affected by, electromagnetic disturbance.

The relevant EU Directive for CE marking is[5] Electromagnetic Compatibility Directive 2014/30/EU, and the relevant UK Statutory guidance for UKCA marking is the Electromagnetic Compatibility Regulations 2016[6]. This legislation should ensure that electrical and electronic equipment should not generate, or be affected by, electromagnetic disturbance.

Additionally, the transformers and PV inverters are also predicted to produce fields at a lower level than that of underground cables as the equipment will be housed in a protective enclosures.

4.5 Comparative Assessment

4.5.1 Magnetic Fields

The maximum magnetic field produced by appliances such as vacuum cleaners can reach up to 20 micro-Tesla. It would follow that appliances with larger voltages would produce fields at a higher level; however, the 400kV underground cables do not produce significantly larger fields and are within the acceptable exposure limits.

The Project Substations / National Grid Substation and transformer will produce magnetic fields at levels lower than the underground cables, thus lower than or comparable to the household appliances previously mentioned.

4.5.2 Electric Fields

The maximum electric field produced by larger household appliances such as refrigerators is 0.12kV m^{-1}. Existing safety measures mitigate exposure to these fields, ensuring acceptable exposure limits.

4.6 Recommended Minimum Clearance Distances

A clearance distance of 15m from overhead cables is therefore recommended for receptors pertaining to human health. This clearance distance should be observed during the construction, operational and decommissioning phases.

The existing overhead cabling infrastructure is assumed not to have a significant impact upon human health receptors, as it currently exists within the baseline. Considering the distances of at least 15m between the existing overhead cables, new cables forming into this infrastructure, and human health receptors, the electric field strength measures less than the reference limit of 5kV m-1.

4.7 Cumulative Effects

When assessing the cumulative effects of electromagnetic fields, the worst case is based upon the addition of source ‘a’ and source ‘b’ (i.e. ‘a+b’); however, it is important to note that this is

[4] Source: https://ec.europa.eu/growth/sectors/electrical-engineering/emc-directive_en
[5] Source: https://ec.europa.eu/growth/sectors/electrical-engineering/emc-directive_en
[6] Source: https://www.gov.uk/government/publications/electromagnetic-compatibility-regulations-2016/electromagnetic-compatibility-regulations-2016-great-britain

only true for magnetic fields that are exactly in line. When electromagnetic fields are not in line, the sum of these is less than 'a+b'.

The typical electromagnetic fields for infrastructure associated with the Scheme is shown to be within and below the acceptable exposure limits. The cumulative effects are not significantly impacted by the use of household items. Electrical household appliances will add to the overall exposure of electromagnetic fields; however, due to the lower voltages of the appliances and are not used constantly, these levels should remain below the recommended exposure limit, as only a temporary addition to the resultant electromagnetic field levels will incur.

Considering all sources of radiation, the cumulative magnetic and electric fields are predicted to be significantly below the acceptable exposure limits.

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