Little Crow
Solar Park

Little Crow Solar Park, Scunthorpe

ENVIRONMENTAL STATEMENT: TECHNICAL APPENDICES

APPENDIX 4.6

EMF ASSESSMENT

Revision:	**Submission**
APFP Reg:	**5(2)(a)**
PINS Reference:	**EN010101**
Author:	**EMF COMP**
Date:	**October 2020**

Document			
Document Properties			
Prepared By	EMF COMP		
Title	Environmental Statement: Technical Appendices – Appendix 4.6 EMF Assessment		
Document Reference	7.12 LC TA4.6		
Version History			
Date	**Version**	**Status**	**Description/Changes**

CONTENTS:

1. INTRODUCTION

1.1 The objective of this report was to assess the time-varying electromagnetic fields (EMFs) within various areas of the proposed Little Crow Solar Park, Scunthorpe DN20 0BG. This is to ensure that levels known to cause adverse health effects from EMF exposure are not exceeded for members of the public, as requested in the Scoping Opinion issued by Public Health England on 17th January 2019. This EMF Assessment was completed by Dr Richard Findlay from EMFcomp Ltd on behalf of INRG Solar (Little Crow) Ltd.

1.2 Calculations/predictions of magnetic flux densities (known as B, unit of measure - tesla) and electric fields (known as E, unit of measure - V/m) were performed in regions of the Solar Park where electromagnetic fields were expected to be significant – see Plan 1 in Appendix 1.

1.3 The relevant UK guidance and limits for public electromagnetic field exposure are outlined in Section 4. The results of the electromagnetic field assessment are described and discussed in Section 5. A summary is presented in Section 6.

2. Purpose of Document

2.1 The primary purpose of the assessment was to compare predicted field values to electromagnetic field limits, provided in the relevant UK guidance, in this case the EC Council Recommendation 1999 (EC 1999) Reference Levels. These are based on the International Committee on Non-Ionizing Radiation Protection (ICNIRP) guidelines (ICNIRP 1998). This will allow us to assess whether a hazard is present with respect to EMF exposure from Little Crow Solar Park to members of the public.

3. Description of Works

3.1 The main element of the project is the construction, operation, maintenance and decommissioning of a ground mounted solar park and associated battery energy storage system with an intended design capacity of over 50MWp (megawatts peak). The project is connected to the electricity network via a looped connection at 132kV to the Northern Powergrid ('NPG') electricity network located within the Order Limits.

4. UK Guidance and Limits

Background

4.1 Electromagnetic fields are produced whenever a piece of electrical or electronic equipment (i.e. TV, food mixer, computer, mobile phone etc.) is used. EMFs can be categorised as static electric, static magnetic and time varying electric, magnetic and electromagnetic (radio wave) fields with frequencies up to 300 GHz.

4.2 EMFs are present in virtually all occupational/residential areas, and if they are high enough, actions may need to be taken to ensure that workers and members of the public are protected from any adverse health effects.

4.3 Exposure to high levels of EMFs can give rise to short term effects that may be irritating, unpleasant or harmful. The effects that occur depend on the frequency range and intensity of the EMFs to which a person is exposed. Figure 1 shows the adverse health effects for power frequencies and related applications.

4.4 Electromagnetic fields at different frequencies affect the human body in different ways causing sensory and health effects. Indirect effects can also occur; these are caused by the presence of an object in an electromagnetic field that may become the cause of a health and safety hazard.

Table 1 Recognised Adverse Health Effects of Electromagnetic Fields.

Field & Frequency Range	Effects	Examples of Activities
Low Frequency Fields		
50 Hz		
	Health effects: Nerve stimulation, effects on the central & peripheral nervous system of the body. Tingling, muscle contraction, heart arrhythmia. **Sensory effects:** Nausea, vertigo, metallic taste in the mouth. **Indirect effects**: Interference with active or passive implanted or body worn medical devices (more information is provided later in this report), electric shocks	High voltage power lines; production and distribution of electricity.

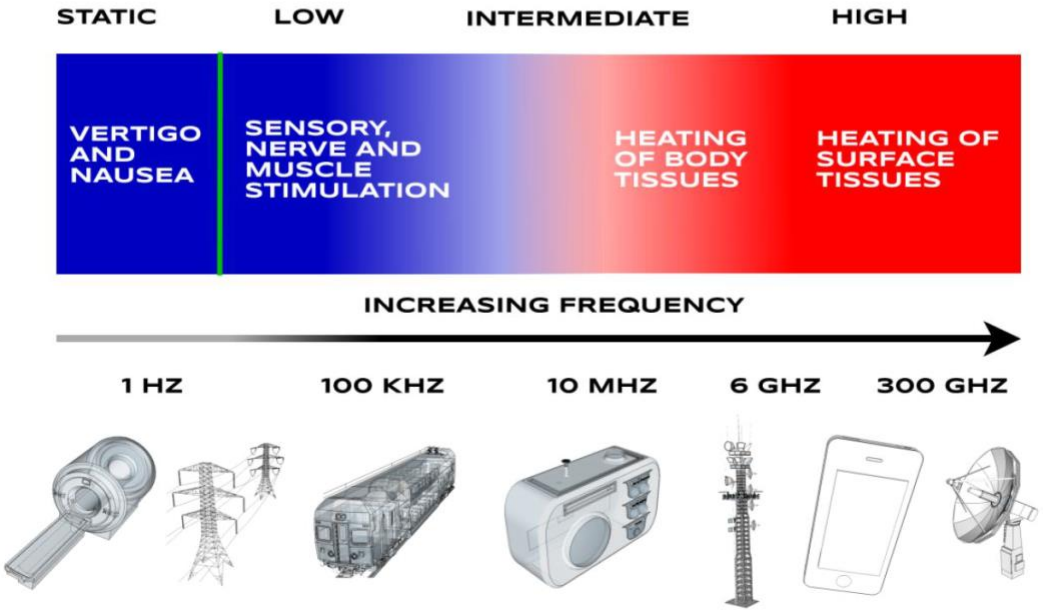


Figure 1
Adverse health effects of electromagnetic fields at various frequencies and related applications. The green line shows the power frequency with which this report is primarily concerned (50Hz).

Reference Levels

4.5 Table 1 below presents the public and electronic device exposure guideline values produced by ICNIRP, used by the EC Council Recommendation 1999 document, for comparisons with measured or calculated field values. These are relevant for members of the public. Less restrictive field limits are provided by ICNIRP for occupational exposure. This is because members of the public contain the potentially at-risk groups of children and elderly people, and because members of the public cannot reasonably be expected to protect themselves against EMF exposure.

4.6 The regions investigated within the Solar Park design were selected areas where significant field strengths were expected. The next section provides more details on this.

Table 2 EC Council Recommendation/ICNIRP Reference Levels for Limiting Exposure to Static & Power Frequency Electromagnetic Fields.

Field	Guideline
	ICNIRP 1998/2009 Public
0 Hz (magnetic)	400 mT (but 0.5 mT for 'unknown' electronic devices)
50 Hz (magnetic)	100 µT
50 Hz (electric)	5.0 kV m^{-1}

Table 1

General Electronic Device EMF Guidance

4.7 For implanted electronic devices, manuals tend to give examples of equipment that can affect such medical devices, and in some cases, separation distances between equipment and cardiac devices. For example, the manual may state that when using wireless communication devices, they should be kept at least 15 cm away from your cardiac device. The following items are examples of such wireless devices:

- Handheld cellular, mobile, or cordless telephones (wireless telephones); two-way pagers; personal digital assistants (PDAs); smartphones; and mobile email devices

- Wireless-enabled devices such as laptop, notebook, or tablet computers; network routers; MP3 players; e-readers; gaming consoles; televisions; DVD players; and headsets

- Remote keyless entry and remote car starter devices

4.8 The safety distances generally given in clinical manuals are in line with achieving compliance with the ICNIRP general public and EC Council Recommendation Reference Levels. For details of these Reference Levels for different fields and frequencies, please see Table 2.

5. Exposure Assessment & Discussion

Description

5.1 Little Crow Solar Park is a proposed power generation facility situated near Scunthorpe in Lincolnshire. The intended design capacity for the project is over 50MWp. For the purposes of this assessment the maximum design capacity of the PV solar element is capped at 200MWp. Additionally, as the battery storage facility will not generate significant fields this assessment is primarily concerned with the time-varying electromagnetic fields created by the solar photovoltaic panels within this development.

5.2 The site design utilises a large number of solar photovoltaic panels to generate power. This power is transferred to inverters/transformers and in to the 132kV substation, which is then either delivered to the electricity network via 132kV underground grid connection cables or transferred to the battery energy storage system to be released back to the grid when demand is higher. The battery energy storage system can also import power from the electricity network at times of low demand and release the power back to the grid when demand is higher.

5.3 Electrical currents generated within the site will be highly variable and dependent on the time of year, whether it is daytime or in the night. However, in terms of electrical current, it can be assumed that the load on the 132kV substation will be between 60 A and 600 A.

5.4 There are a large number of photovoltaic panels on the development, therefore there will be a significant number of electric cables from these to the inverters/transformers to deliver power to the 132kV substation. However, the electrical currents in these cables will be relatively low and so will not pose an electromagnetic exposure hazard to members of the public outside the Order Limits or along the public footpath.

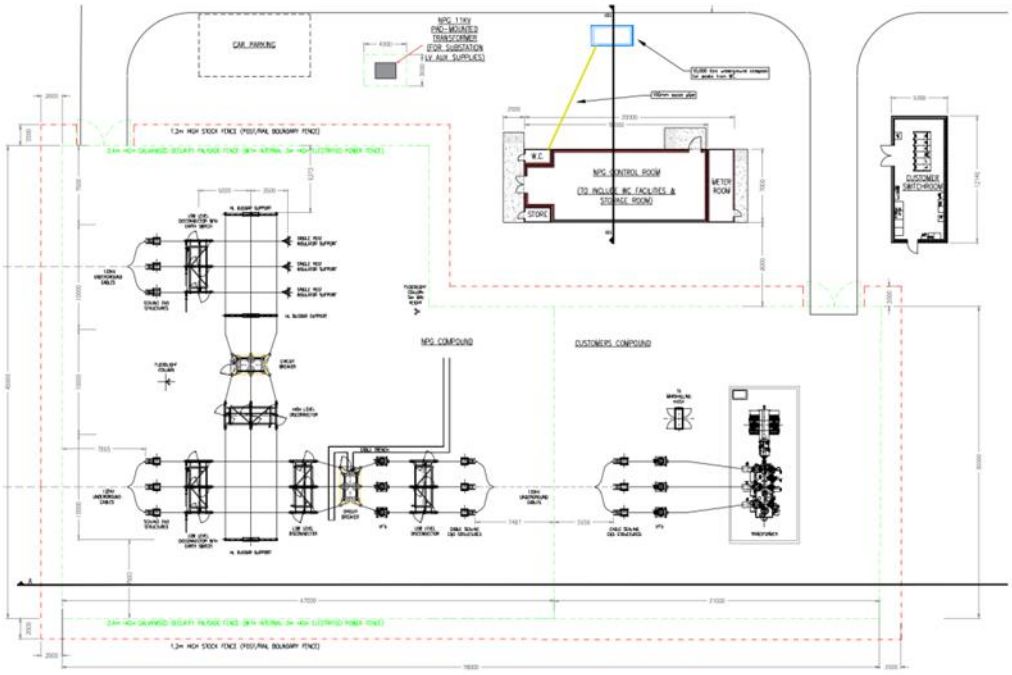


Figure 2
Details of the 132kV Substation Compound

Exposure Summary

(i) Magnetic Fields

5.5 Large time-varying magnetic fields are produced by significant electrical currents and are not readily stopped or shielded by most materials. Therefore, they are often the focus for any electromagnetic field exposure assessment of an electricity generation and distribution facility.

5.6 Significant magnetic fields will be produced within the 132kV substation compound, close to transformers/inverters, associated cabling and busbars, switchgear etc.

5.7 These fields will be localised around this equipment, and whilst magnetic field levels are expected to exceed the EC Council Recommendation Reference Levels (relevant to members of the public) close to electrical equipment, it will not exceed Reference Levels outside of the substation enclosure.

5.8 Regarding the phase conductors underground connecting the power output from the 132kV substation to the electricity network (see Figure 3), generally these are buried at a depth of 1 metre and do not exceed Reference Levels at ground level.

(ii) Electric Fields

5.9 High electric fields are produced close to electrical equipment at a high potential. Within the 132kV substation compound, the overhead exposed busbars and any related uninsulated cables are at a high voltage (132kV) and therefore there will be significant electric fields near conductor surfaces. However, these fields will be highly localised and will not pose an electromagnetic exposure hazard to members of the public outside the Order Limits or along the public footpath. There are no other exposed busbars or other uninsulated conductors at any other part of the site, hence there will be no other significant electric fields generated.

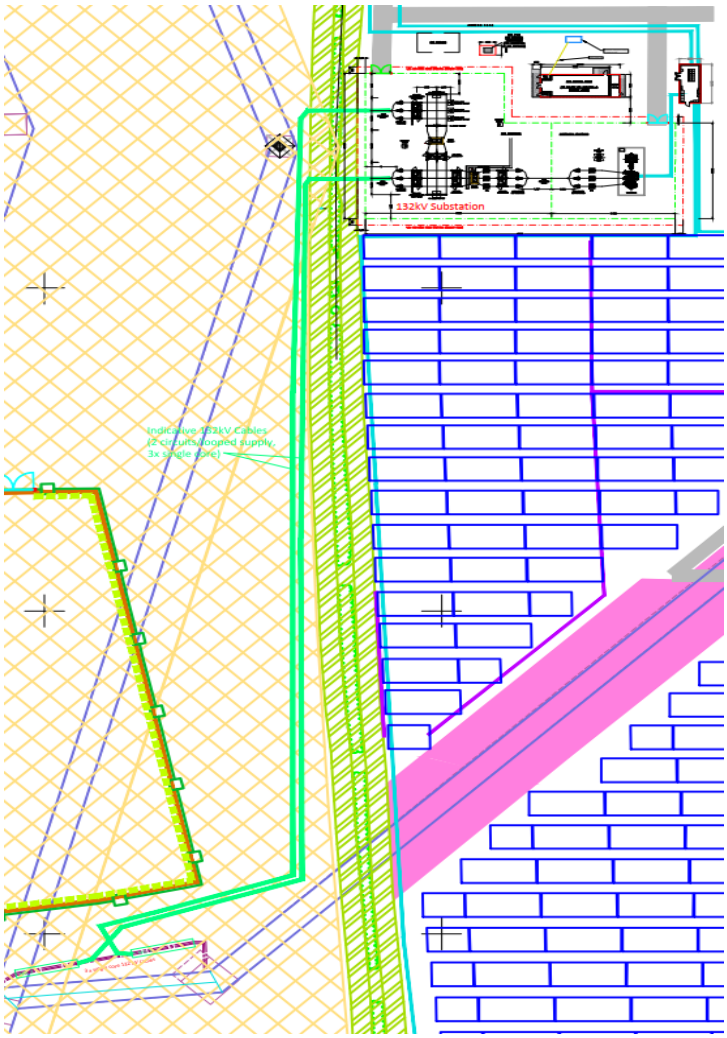


Figure 3
Details of the 132kV underground grid connection cable and its route to connection to the electricity network (shown as the thick solid green line). The Archaeological Exclusion Zone fence that also forms the boundary between the solar farm and the public footpath can be seen to the left of this

Exposure Assessment Details

(i) Magnetic Fields

5.10 Around the main transformer within the 132kV substation, magnetic fields will exceed the EC Council Recommendation Reference Levels. These fields are likely to be 300-400% of the Reference Levels on the surface of the casing and associated LV cables etc, but these fields will be highly localised, as they drop off very quickly with distance.

5.11 To demonstrate this, Figure 4 shows how low frequency magnetic fields decrease with separation distance. This shows that, in a number of metres, the magnetic field can be reduced by orders of magnitude.

5.12 The smallest separation distance between the Order Limits to the north of the development and the perimeter fence of the 132kV substation enclosure is approximately 80 metres. Similarly, the separation distance between the Order Limits to the south of the perimeter fence of the 132kV substation enclosure is approximately 70 metres.

5.13 The magnetic fields described from the substation enclosure will be significantly reduced over these distances and well below 1% of the Reference Levels in areas accessible to members of the public, therefore will not present a hazard.

5.14 Regarding the phase conductors underground connecting the power output from the 132kV substation to the electricity network, these are buried at a minimum depth of 1.5 metres, and so will not exceed the Reference Levels above the conductor trench when under full load.

5.15 Additionally, the closest point that members of the public can access is approximately 6 metres from this cable trench on the outside of the Archaeological Exclusion Zone fence. Therefore, again this does not present a magnetic field exposure hazard to members of the public.

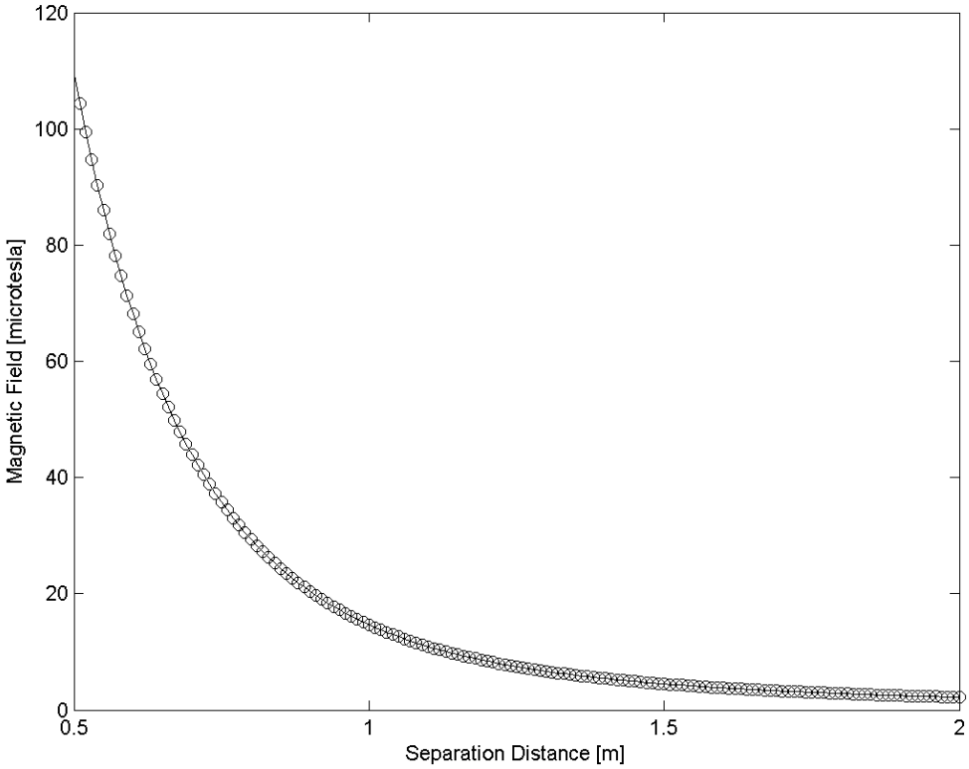


Figure 4
Typical plot showing the decrease of magnetic flux density (Magnetic Field) with distance from power frequency field sources

(ii) Electric Fields

5.16 Similarly, electric fields are likely to exceed the EC Council Recommendation Reference Levels close to conductors within the 132kV substation enclosure. However, due to the large separation distances between the substation and the Order Limits and the public footpath (i.e. areas accessible to members of the public), this will not present an electric field exposure hazard to members of the public.

5.17 Specifically, the exposed conductors within the 132kV substation enclosure will carry high voltages. These will therefore generate significant electric fields. However, earthed metal fencing around the substation enclosure combined with earthed metal casings of other large metallic structures will perturb the electric fields. This perturbation will reduce the electric field strength close to ground level. Hence, electric field levels outside the substation enclosure will be relatively small, and certainly at the Order Limits they will be below 0.1% of the Reference Levels.

Control Measures

5.18 The substation enclosure fence protects members of the public from exposure to electromagnetic fields in excess of the EC Council Recommendation Reference Levels (i.e. considered potentially hazardous to health). This also applies to the situation when the Solar Farm and battery storage facility is decommissioned and the substation remains. The substation enclosure fence will continue to protect members of the public from exposure to electromagnetic fields in excess of the Reference Levels. No additional control measures are required for the protection of members of the public from field exposure outside of this fence.

Reassessment Triggers

5.19 If the site is redesigned in such a way as to significantly increase the magnitude of electrical voltages and currents on site, a reassessment of electromagnetic fields produced would be recommended. Additionally, if significant field sources, (e.g. 132kV substations etc) are moved closer to the Order Limits (e.g. within, say 10 metres of the perimeter fence), again a reassessment of electromagnetic fields produced would be recommended.

6. Summary

6.1 An electromagnetic field exposure assessment has been completed for the design of Little Crow Solar Park, a proposed power generation facility near Scunthorpe in Lincolnshire.

6.2 The project is intended to generate, store and distribute significant power utilising a large number of photovoltaic cells. High power electrical equipment can produce significant electromagnetic fields that can be harmful to health. Therefore, an assessment of the proposed site was conducted to assess any potential risks to members of the public in accessible areas outside of the Order Limits and along the public footpath.

6.3 The low frequency electric and magnetic fields produced by the site were assessed and compared with the relevant UK guidance, the Council Recommendation 1999 Reference Levels (based on the ICNIRP 1998 public Reference Levels). The assessment demonstrated that the field levels generated by the proposed Little Crow Solar Park under full load at the Order Limits and along the public footpath would be significantly less than these Reference Levels, treated as limits in this instance. Therefore, the study concluded that the electromagnetic fields produced by the Little Crow Solar Park would not present a hazard to members of the public in accessible areas outside of the Order Limits and along the public footpath.

Written by:  **Dr Richard Findlay** 16 October 2020

Dr Richard Findlay is the Managing Director of EMFcomp Limited and a specialist in radiation safety with over 25 years of experience. He provides advice, measurement and modelling services for exposure to electromagnetic fields. He obtained his PhD in physics in 1997 studying electromagnetics and has published over 20 scientific papers on electromagnetic safety in the peer-reviewed literature. He is a consulting expert for the IEEE International Committee on Electromagnetic Safety (ICES) in the US and Chair of the Society for Radiological Protection's EMF & Optical Radiation Committee in the UK. He has previously been a member of the Royal Society of Canada's Expert Committee on Electromagnetics and the UK's Health Protection Agency Expert Group on MRI. Richard is a Chartered Radiation Protection Professional (CRadP) and a Member of the Society for Radiological Protection.

7. References

EC 1999 European Council Recommendation: On the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) *Health Official Journal of the European Communications* **199** 59-70
https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:1999:199:0059:0070:EN:PDF

EU 2013 Directive 2013/35/EU of the European Parliament and of the Council of 26 June 2013 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields) (20th individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC) *Official Journal of the European Union* **L179/1** 1-21
https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013L0035&from=EN

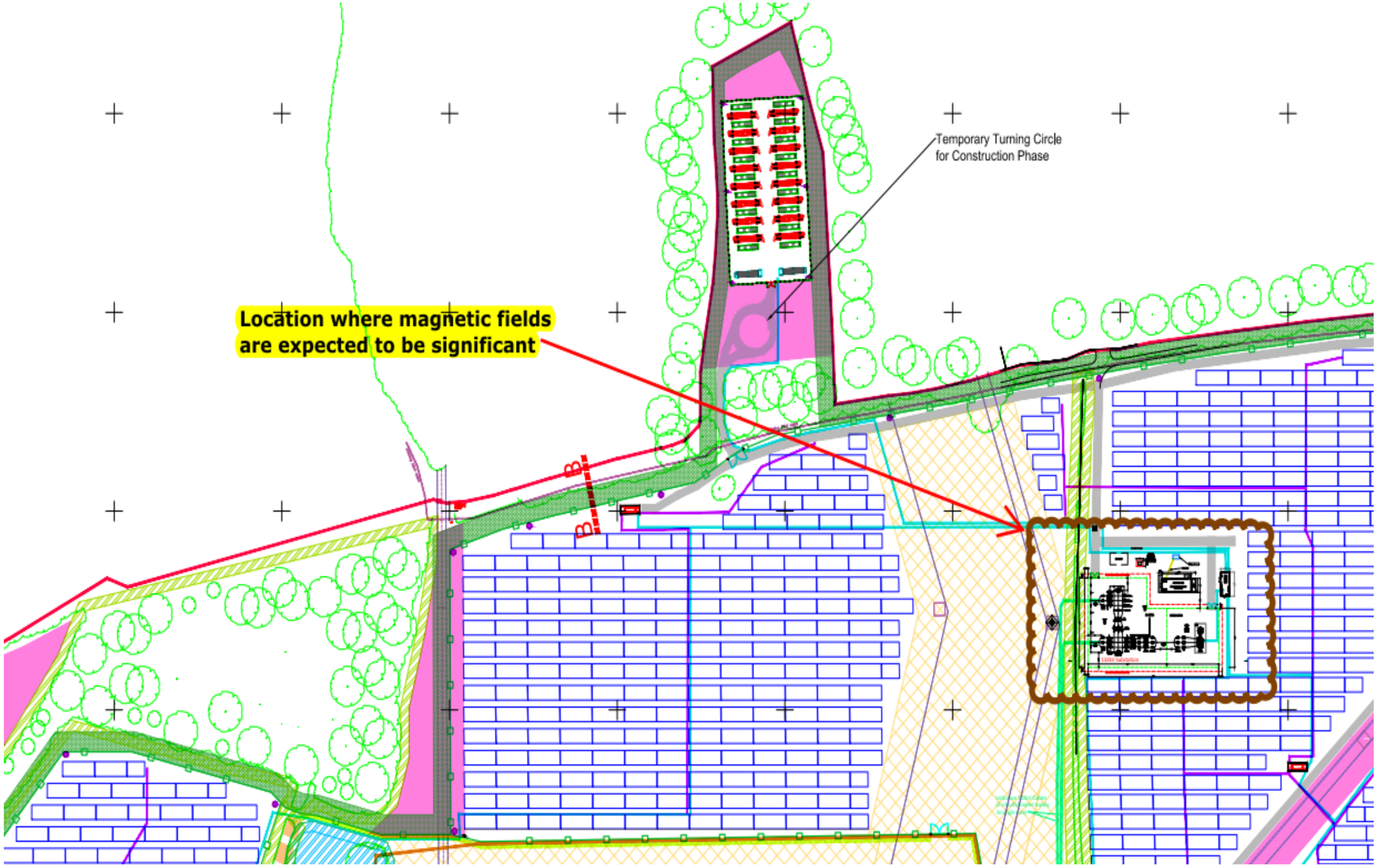
HSE 2016 The Control of Electromagnetic Fields at Work Regulations 2016
www.legislation.gov.uk/uksi/2016/588/pdfs/uksi_20160588_en.pdf

ICNIRP 1998 Guidelines for limiting exposure to time varying electric, magnetic and electromagnetic fields (up to 300 GHz) *Health Phys.* **74** 494-522
https://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf

ICNIRP 2009 Guidelines on limits of exposure to static magnetic fields Health Phys. **96** 504-514
https://www.icnirp.org/cms/upload/publications/ICNIRPstatgdl.pdf

ICNIRP 2010 Guidelines for limiting exposure to time varying electric, magnetic fields (1 Hz to 100 kHz) *Health Phys.* **99** 818-836
https://www.icnirp.org/cms/upload/publications/ICNIRPLFgdl.pdf

Appendix 1


Temporary Turning Circle
for Construction Phase
Location where magnetic fields
are expected to be significant