Galloper Wind Farm Project

Environmental Statement – Chapter 28: Electric and Magnetic Fields

October 2011

Document Reference – 5.2.28

Galloper Wind Farm Limited

RWE npower renewables

SSE Renewables

ROYAL HASKONING Enhancing Society

Document title	Galloper Wind Farm Project Environmental Statement – Chapter 28: Electric and Magnetic Fields
Document short title	Galloper Wind Farm ES
Document Reference	5.2.28
Regulation Reference	APFP Regulations, 5(2)(a)
Version	15
Status	Final Report
Date	October 2011
Project name	Galloper Wind Farm Project
Client	Galloper Wind Farm Limited
Royal Haskoning Reference	9V3083/R01/303424/Exet

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Date/initials approval		KH	01.11.2011

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28 ELECTRIC AND MAGNETIC FIELDS

28.1 Introduction

28.1.1 This Chapter of the Environmental Statement (ES) assesses the potential human health impacts associated with electric and magnetic fields (EMFs) produced by the onshore electricity transmission and distribution assets of the proposed Galloper Wind Farm (GWF). All equipment that generates, distributes or uses electricity produces EMFs. The UK power frequency is 50 Hz, which is therefore the principal frequency of the EMFs produced which are also known as Extremely Low Frequency (ELF) EMFs.

28.1.2 The potential impacts of EMFs on offshore ecology are considered within **Chapter 12 Marine and Intertidal Ecology**, **Chapter 13 Fish and Shellfish Resource** and **Chapter 14 Marine Mammals**.

Electric fields

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

28.1.4 As a consequence of their design, some types of equipment do not produce an external electric field. This applies to underground cables and gas insulated switchgear (GIS), which are enclosed in a metal sheath (a protective metal layer within the cable) and have solid metal enclosures respectively. As such, electric fields are not considered further for these types of equipment in this Chapter. Where the cables become bare conductors in the cable sealing end compound an electric field will be produced. Electric fields are therefore considered for this asset only.

Magnetic fields

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

28.1.6 Magnetic fields are found in all areas where electricity is in use (e.g. offices and homes), arising from electric cabling and equipment in any given area. In UK houses, typical magnetic fields will be in the range of 0.01 – 0.2 μT, with higher values in localised areas close to electrical appliances.

28.2 Guidance and Consultation

Legislation, policy and guidance

28.2.1 National Policy Statements (NPS) provide the primary basis on which the Infrastructure Planning Commission (IPC) is required to make its decisions. In preparing this chapter the following NPS were reviewed:

- Overarching National Policy Statement (NPS) for Energy (EN-1) (DECC, 2011a);
- NPS for Electricity Network Infrastructure (EN-5) (DECC, 2011b).

28.2.2 The specific assessment requirements for EMFs, as detailed within the NPSs, are repeated in the following paragraphs. The requirements within the NPSs have been applied to this assessment and where appropriate the specific sections of this Chapter that address the issues raised are indicated. Where any part of the NPS guidance has not been followed within this assessment, it is stated after the NPS text and a justification provided. In all other cases the assessment requirements suggested within the NPSs have been applied to this assessment.

28.2.3 NPS EN-1 does not include any specific requirements for the assessment of EMFs. EN-5 does consider the potential for EMFs generated from overhead power lines, but does not provide any specific guidance for the assessment of EMFs. Section 2.10.9 of EN-5 states that:

"This NPS does not repeat the detail of the ICNIRP 1998 guidelines on restrictions or reference levels nor the 1999 EU Recommendation. Government has developed with the electricity industry a Code of Practice, 'Power Lines: Demonstrating compliance with EMF public exposure guidelines – a voluntary Code of Practice', published in February 2011 that specifies the evidence acceptable to show compliance with ICNIRP (1998) in terms of the EU Recommendation. Before granting consent to an overhead line application, the IPC should satisfy itself 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".

Although the proposed GWF development does not include any new overhead lines strung between pylons, it does include connections from underground 400kV transmission cables to the extended arms of existing overhead lines. However, for completeness, Galloper Wind Farm Ltd (GWFL) has carried out an assessment of the entire onshore infrastructure in line with the principles of the Codes of Practice, including those elements not associated with the overhead line NSIP. It is the electricity industry's policy to comply with Government policy on EMF.

Other guidance

28.2.4 There are no statutory limits on EMFs in the UK. It is the responsibility of the Health Protection Agency (HPA) to recommend guidelines for exposure to EMFs. In 2004 it recommended that the UK adopt the 1998 guidelines from the International Commission on Non-Ionizing Radiation Protection (ICNIRP) (1998). The Government accepted this recommendation and these are therefore the guidelines that currently apply in the UK in line with the terms of the EU recommendation 1999/519/EC.

28.2.5 In order to demonstrate compliance with the exposure guidelines, Industry and Government published the Code of Practice *Power Lines: Demonstrating compliance with EMF public exposure guidelines* (DECC, 2011c).

28.2.6 There is also a second Code of Practice, *Optimum Phasing of high voltage double-circuit Power Lines* (DECC, 2011d), which sets out the principles for optimum phasing of overhead lines. Although the Application will include grid connection works which are being treated as an 'electric line above ground' Nationally Significant Infrastructure Project (NSIP) in their own right under the Planning Act 2008, the application is not proposing a new overhead line, simply connections to an existing overhead line which has optimised phasing. As no new overhead line is being proposed an assessment against the optimum phasing code of practice is not considered further.

28.2.7 There has been extensive research in an attempt to establish whether or not long term exposure to fields at lower levels than the ICNIRP guidelines might be a cause of ill health in humans, and this research has been extensively reviewed by bodies such as the HPA (NRPB, 2004) and the World Health Organization (WHO) (WHO, 2007). There is some evidence to suggest that high magnetic fields may be associated with an increased risk of one particular disease, childhood leukaemia. However, the weight of scientific evidence is against electric and magnetic fields causing ill health in humans at levels below the ICNIRP guideline limits. The Government has addressed this uncertainty by adopting precautionary measures (set out in the Codes of Practice), which the electricity industry follows.

Consultation

28.2.8 As part of ongoing consultation, key stakeholders were invited to respond to a Scoping Document produced as part of the EIA process (Scottish and Southern Energy Renewables & RWE Npower Renewables, 2010). **Table 28.1** summarises issues that were highlighted by the consultees in the IPC Scoping Opinion (IPC, 2010) and indicates which sections of the assessment address each issue.

28.2.9 Further consultation was undertaken through statutory Section 42 consultation under the Planning Act 2008 (see **Chapter 7 Consultation**) via the submission of a Preliminary Environmental Report (PER). Community consultation under Section 47 has also been carried out in parallel with the

Section 42 statutory consultation. **Table 28.1** summarises issues that were highlighted in the consultation period.

28.2.10 Full details of responses received are presented in the IPC Scoping Opinion report (IPC, 2010) and the Consultation Report that accompanies the DCO for this Application.

Table 28.1 Summary of consultation and issues

Date	Consultee	Summary of issue	Section where addressed
August 2010	Suffolk Coastal District Council (Scoping Opinion)	Details of all power lines/cabling from the site and a comprehensive assessment of the Electro-magnetic radiation field, which will be generated, should be provided.	This assessment has been undertaken following the principles of the DECC Codes of Practice and assessed against ICNIRP guidelines.
August 2010	Health Protection Agency (Scoping Opinion)	The HPA considers that the onus is on the applicant to conduct an assessment of EMF compliance with the ICNIRP guidelines and Government Codes of Practice. Compliance with the ICNIRP guidelines should be highlighted	
July 2011	Health Protection Agency (Section 42)	EMF - Additional information to demonstrate compliance with ICNIRP required including: • Should reflect worst case loading; • Statement as to why electric field calculations omitted; and • Evidence that this has taken on board the Government Codes of Practice.	The worst case loading has been assumed within this assessment, as detailed in Section 28.5. Electric fields have been considered for the bare conductors of the cables sealing ends only as all other equipment will not produce external electric fields.

Date	Consultee	Summary of issue	Section where addressed
			The principles set out in Codes of Practice have been used to perform this assessment
July 2011	Beach hut licensee (Section 42d)	Concerns regarding the potential EMF effect where the cables pass under the beach huts.	The equipment associated with the proposed GWF development is compliant with public exposure guidelines for EMFs. Further details are included within Section 28.7.

28.3 Methodology

Study area

28.3.1 The onshore development footprint (as shown in **Figure 1.3**) encompasses the GWF substation (comprising the GWF compound and transmission compound) and sealing end compounds and associated laydown areas and access tracks. It also includes the footprint of the cable corridor above Mean Low Water Springs (MLWS) to the GWF substation including the onshore transition bays, and the cabling between the GWF substation and the sealing end compounds.

28.3.2 The spatial scope of the assessment extends 50m around all operational electrical assets to include the areas where people might be present. Field strength is assessed at 1m above ground level.

Assessment of impacts

28.3.3 The assessment considers EMFs produced by the onshore electricity transmission and distribution assets of the proposed GWF. These include three 3 phase 132kV cable circuits connecting the wind turbines generators

(WTGs) to a new 132kV onshore GIS substation (multi-cored cable circuits between MLWS and the transition bays and single cored in trefoil from the transition bays to the GWF compound), 400/132kV transformers, associated 400kV underground cabling and two 400kV cable sealing ends. The exact cable depths are yet to be determined; therefore all calculations were performed for worst case conditions at a minimum 0.9m burial depth.

28.3.4 As set out in the introduction, electric fields were not considered for equipment enclosed in metal sheaths or which have solid metal enclosures. This assessment therefore only considers electric fields associated with the bare conductors in the cable sealing end compound area.

28.3.5 Magnetic fields have been assessed at 1m above ground level and compared with UK Government exposure guideline levels. Calculations were carried out using the modelling package EFC-400 v5.2.

28.3.6 The ICNIRP guidelines (1998) are based on the avoidance of known adverse effects of exposure to EMF at frequencies up to 300 GHz, which includes the 50 Hz EMF associated with electricity transmission. This equates to public exposure limits for uniform exposure of 9.0kV/m for electric fields and 360 μT for magnetic fields. A significant effect is defined as levels which exceed these public exposure limits in line with the terms of the EU recommendation (1999/519/EC).

28.3.7 In order to demonstrate compliance with the exposure guidelines, Industry and Government have published a Code of Practice, *Power Lines: Demonstrating compliance with EMF public exposure guidelines* (DECC, 2011c).

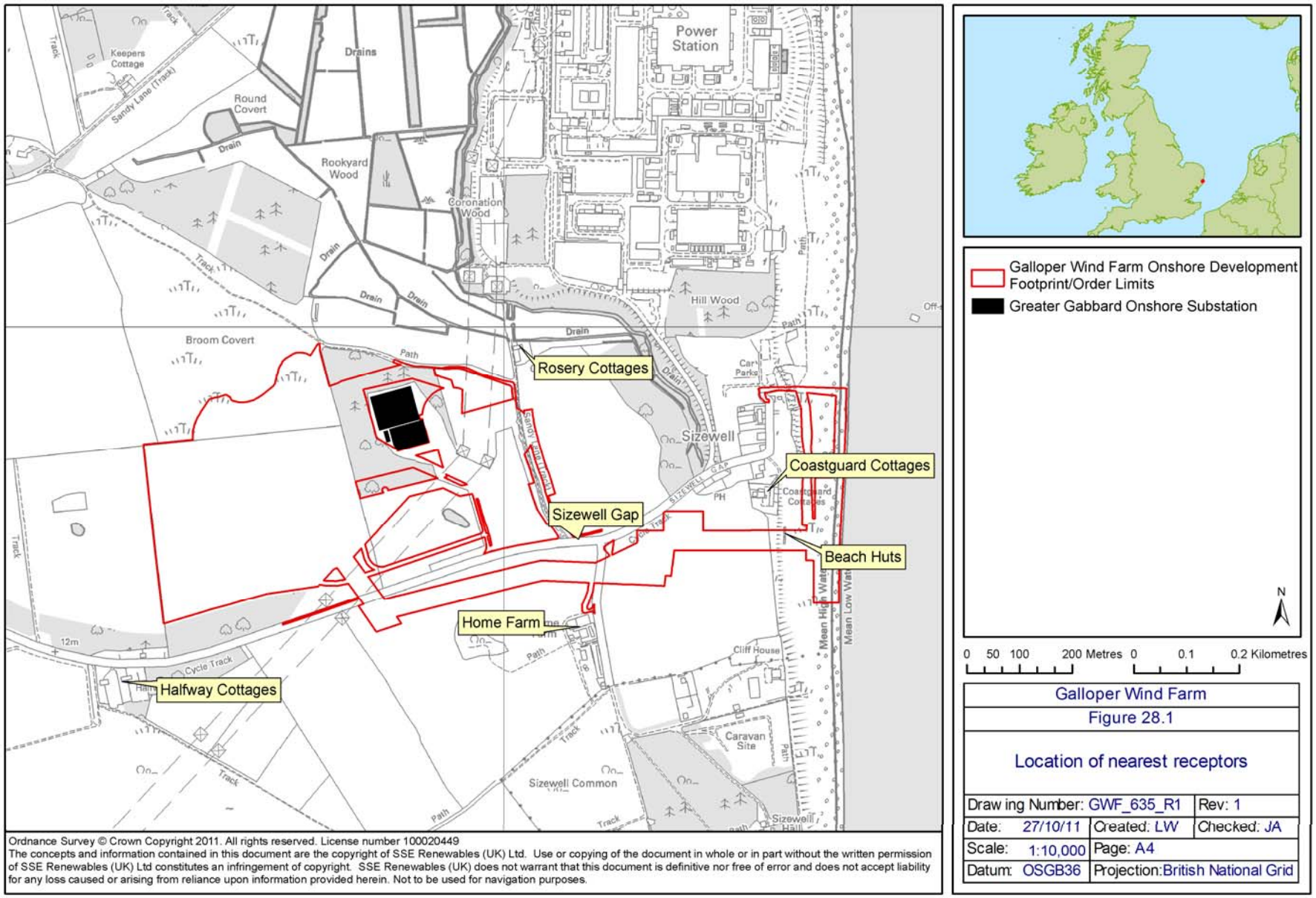
28.3.8 As part of the Code of Practice, the Energy Networks Association maintains a list of types of equipment where the design is such that it is not capable of exceeding the ICNIRP exposure guidelines, i.e. a list of equipment that is therefore compliant with the guidelines. This list includes 132kV underground cables, but calculated fields are included for completeness.

28.4 Existing Environment

28.4.1 The GWF export cable landfall is just south of the Sizewell Nuclear Power Station complex at Sizewell beach. The onshore cable corridor passes east to west through a 75m wide strip of public access beach / dune habitat, which includes a block of beach huts. The route continues landward through agricultural land, passing within 50m of Coastguard Cottages and within 80m of Home Farm, until reaching the proposed GWF substation site, which sits largely in agricultural land and partly within woodland and pasture grassland.

28.4.2 The GWF substation is located approximately 300m from the nearest property (Rosery Cottages). The sealing end compounds (which connect the 400kV cables from the substation to the existing overhead lines) are located

within grassland to the east of Sizewell Wents and are located approximately 200m from Rosery Cottages. These locations are shown on **Figure 28.1**.



28.5 Assessment of Impacts - Worst Case Definition

28.5.1 The proposed onshore development footprint is as presented in **Figure 1.3**.

28.5.2 Flexibility within the GWF compound applies to the finished floor level and the type and location of equipment and buildings within the GWF compound. The distances to receptors used in this assessment are based on the closest point from each compound and hence this flexibility is not relevant to the EMF assessment.

28.5.3 Flexibility within the cable corridor permits the permanent works to lie within the limits of the cable corridor shown in **Figure 1.3**. Since this assessment considers the proximity to receptors from the outermost edge of the entire cable corridor this flexibility is not relevant to this assessment.

28.5.4 Flexibility within the sealing end compounds is restricted to the exact location of the equipment within the defined sealing end compound envelope. In practice the locations of all equipment within the sealing end compounds are restricted by the need to connect the underground cables to the overhead lines and to maintain electrical clearances. Since the assessment of EMF considers proximity of receptors to the nearest point from the entire sealing end compound envelope, this flexibility is not relevant to this assessment.

28.5.5 The 132kV and 400kV cables will be buried to a minimum depth of 0.9m throughout the cable corridor although in some sections, particularly relating to those areas where directional drilling is employed, the cables may be deeper than this. This assessment assumes a cable burial depth of 0.9m throughout the length of the cable corridor.

28.5.6 The assessment assumes 400kV cable corridors will have one cable per phase at 1m horizontal cable centres and a single circuit design which is worst case. The 132kV cables will be installed as three multi-core cables with 10m circuit separation from the landfall to the transition bays, and then will switch to nine single core cables arranged in trefoil (three groups of three cables laid together) from the transition bays to the substation.

28.5.7 The assessment assumes the cables will operate at the worst case loading i.e. that the wind farm is operating at its rated capacity for 100% of the time and the current through the cable is at this rated capacity. In reality periodic maintenance of WTGs and wind variability means that it is unlikely that the cables will operate at 100% capacity. For the 400kV cables the assessment uses the maximum rating of the cable.

28.6 Assessment of Impacts during Construction

28.6.1 During construction, prior to energisation, any EMFs generated by construction equipment are insignificant. As such there will be **no impact** during construction.

28.7 Assessment of Impacts during Operation

Impact on human health associated with EMFs

28.7.1 The proposed GWF compound will be a GIS substation, potentially with air-cored reactors. Substations with no air-cored reactors are deemed to be compliant with exposure guidelines, as per the Code of Practice (DECC, 2011c). Evidence demonstrating compliance of this equipment is maintained by the Energy Networks Association (ENA)[1]. At the pre-consent stage GWF has insufficient information on the potential design of air-cored reactors, if utilised, to perform a full assessment. However, in the event that air-cored reactors are used, GWF will ensure that the ICNIRP public exposure limit is not exceeded at the perimeter of the substation. Under normal operating conditions the new substation will not result in a measurable change in the background magnetic field[2] at the nearest residential properties located over 200m away (refer to **Table 28.2**).

28.7.2 The 132kV cables entering and exiting the substation will be sources of magnetic fields. The maximum magnetic field produced by the 132kV cables is estimated to be 2.84μT, assuming the cables are maintained at 0.9m depth (refer to **Table 28.2**). This value is considered to be compliant with exposure guidelines, as per the Code of Practice (DECC, 2011c).

28.7.3 The 400kV cables entering and exiting the substation and cable sealing ends will also be sources of magnetic fields. Calculations of predicted magnetic fields demonstrate that the highest field produced by the 400kV cables connecting the super grid transformer to the 400kV cable sealing ends is 324μT. Calculations were performed in accordance with the conditions set out in the Code of Practice (DECC, 2011c); using the maximum rating of a 400 kV cable at 1m above ground and ignoring harmonics. The nearest residential property is approximately 200m from the cables and sealing end compounds, where the magnetic field will have dropped to background levels (refer to **Table 28.2**). As such, the fields are compliant with the public exposure guidelines.

28.7.4 The bare conductors of the cable sealing end compounds will produce an electric field. Due to the size of the compound, height of conductors and the earthed metal fence surrounding the compound the electric field will be small and shielded by the perimeter fence. Measurements around the existing 400kV sealing end compounds indicate that the typical fields are below 1 kV/m, i.e. well below the exposure limit of 9.0kV/m.

28.7.5 **Table 28.2** shows the calculated magnetic fields from the 132kV and 400kV cable circuits at various distances. These calculations have assumed one cable per phase at 1m horizontal cable centres buried 0.9m below ground for the 400 kV circuits. The 132 kV cables assume single cored cables arranged

[1] http://energynetworks.squarespace.com/electric-and-magnetic-fields

[2] Typically background magnetic fields will be in the range of 0.01 – 0.2 μT

in trefoil with 10m circuit separation. The fields produced by the substation equipment and cables will decrease quickly with distance. At the substation boundary the cables and conventional substation equipment will not exceed ICNIRP public exposure guidelines. The design of the air-cored reactors will be such that the ICNIRP public exposure guideline limit are not exceeded

Table 28.2 Calculated magnetic fields from cable configurations at 1m above ground.

	Calculated magnetic field at 1m above ground					ICNIRP exposure limit
	Maximum Calculated field	10m from central circuit	50m from central circuit	100m from central circuit	200m from central circuit	
132kV cables	2.84μT	0.42μT	0.01μT	<0.01μT	<0.01μT	360μT
400kV cables	324μT	13.9μT	0.57μT	0.15μT	0.04μT	

28.7.7 The closest receptors will be those nearest to the cable corridors, including those beach huts located directly above the cable corridor between landfall and the transition bays, Coastguard Cottages, and Home Farm. The maximum calculated field at the beach hut location is 2.84μT, however this is based on a cable burial depth of 0.9m. In reality the cable is likely to be located at approximately 10m depth at the beach huts, which would significantly reduce the magnetic field. The closest property (Coastguard Cottages) will be 50m from the 132 kV cable corridor. The maximum calculated field here is 0.01μT.

28.7.8 The estimated worst case EMF values are below the ICNIRP public exposure exposure limits. As such there will be **no impact** to human health attributable to EMFs.

28.8 Assessment of Impacts during Decommissioning

28.8.1 Once GWF ceases generating electricity it will no longer produce any EMFs. As such, there will be **no impacts** related to EMFs during the decommissioning of GWF.

28.9 Inter-relationships

28.9.1 No EMF impacts are anticipated as a results of the construction, operation and decommissioning of GWF. As such, there are no inter-relationships with other parameters to consider.

28.10 Cumulative Impacts

28.10.1 No EMF impacts have been identified for the construction, operation and decommissioning of GWF.

28.10.2 The Greater Gabbard Offshore Wind Farm (GGOWF) substation has a similar landfall location, cable corridor and substation location to that of GWF. Magnetic fields can combine with the fields already present in the area from other sources, which vary with time depending on electricity usage. The way in which the fields combine with each other is complex, however, in this situation, where all the fields are well below guideline levels, it is not necessary to consider the details of this, as the combined field will also be below guideline levels.

28.10.3 Overall, no cumulative EMF impacts are predicted as a result of the construction, operation or decommissioning of GWF.

28.11 Monitoring

28.11.1 An EMF assessment of the GWF compound will be carried out at the detailed design stage to ensure that the ICNIRP public exposure limit is not exceeded at the perimeter of the compound, if air-cored reactors are proposed. Given that no significant EMF impacts have been assessed, no specific monitoring of EMFs is proposed.

28.12 Summary

28.12.1 The equipment associated with the proposed GWF development is compliant with public exposure guidelines for EMFs, and therefore there will be no significant EMF effects resulting from this project. There is some scientific evidence of possible effects at lower levels, and the electricity industry takes this evidence seriously and recognises that it can generate public concern. However, the evidence has been extensively reviewed, and the UK Government have not considered it appropriate to implement any restrictions or guidelines on the basis of this evidence. The proposed project meets the requirements of NPS EN-5 which cover the ICNIRP public exposure guidelines and the relevant Government Codes of Practice.

Table 28.3 Summary of the impact assessment for EMFs

Description of Impact	Impact	Mitigation Measure	Residual impact
Construction Phase			
Health impacts from electric and magnetic fields	No impact	n/a	n/a
Operation Phase			
Health impacts from electric and magnetic fields	No impact	n/a	n/a
Decommissioning Phase			

Description of Impact	Impact	Mitigation Measure	Residual impact
Health impacts from electric and magnetic fields	No impact	n/a	n/a

28.12.2 No EMF impacts have been identified for the construction, operation and decommissioning of GWF. No cumulative EMF impacts have been identified as a result of the interaction between fields produced by GGOWF and GWF cables.

28.13 References

Department of Energy and Climate Change (2011a) Overarching National Policy Statement (NPS) for Energy (EN-1)

Department of Energy and Climate Change (2011b) NPS for Electricity Network Infrastructure (EN-5)

Department of Energy and Climate Change (2011c) Power Lines: Demonstrating compliance with EMF public exposure guidelines. A voluntary Code of Practice

Department of Energy and Climate Change (2011d) Optimum Phasing of high voltage double-circuit Power Lines. A voluntary Code of Practice

Galloper Wind Farm Ltd (2011) Galloper Wind Farm Preliminary Environmental Report

IPC (2010). Scoping opinion proposed Galloper Wind Farm Project, August 2010. Available at http://infrastructure.independent.gov.uk/wp-content/uploads/2010/09/Galloper-scoping-opinion_web.pdf

International Commission on Non Ionising Radiation Protection (1998) Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic and Electromagnetic Fields

Scottish and Southern Energy Renewables & RWE Npower Renewables (2010) Galloper Wind Farm Project Scoping Study

National Radiological Protection Board (NRPB) (2004). Review of the scientific evidence for limiting exposure to electromagnetic fields (0-300 GHz). Doc NRPB, 15(3), 1-215.

World Health Organisation (2007) Environmental Health Criteria Monograph No 238 on Extremely Low Frequency Fields

EU Council Recommendation of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) (1999/519/EC)