The Drax Power (Generating Stations) Order

Land at, and in the vicinity of, Drax Power Station, near Selby, North Yorkshire

Electric and Magnetic Fields (EMF) Assessment Report

(Submitted for Deadline 1)

The Planning Act 2008
The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 – Regulation 5(2)(q)

Drax Power Limited

Drax Repower Project

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Glossary

Abbreviation	Description
Above Ground Installation (AGI)	The Minimum Offtake Connection (MOC) which will be operated by National Grid Gas and the PIG Trap Launching station (PTF-L) which will be operated by Drax. The AGI is described as Work No. 6 in Schedule 1 of the draft DCO (Examination Library ref AS-012).
Application	The DCO Application.
The Applicant	Drax Power Ltd.
Associated Development	Associated development is defined by section 115(2) of the Planning Act 2008 as development which is associated with a Nationally Significant Infrastructure Project (NSIP). In the case of the Proposed Scheme, the term Associated Development includes: - the up to two gas insulated switchgear banking buildings (described as Work No. 4 in Schedule 1 of the draft DCO); - the natural gas receiving facility and natural gas compression building (described as Work No. 5 in Schedule 1 of the draft DCO); - the AGI (described as Work No. 6 in Schedule 1 of the draft DCO); - the Gas Pipeline (described in Work No. 7 in Schedule 1 of the draft DCO); - the electrical connections to the existing 400 kilovolt National Grid substation (described in Work No. 8 in Schedule 1 of the draft DCO); - temporary construction laydown areas (described in Work No. 9 in Schedule 1 of the draft DCO); - landscaping and biodiversity enhancement measures (described in Work No. 11 in Schedule 1 of the draft DCO); - decommissioning and demolition of sludge lagoons and construction of replacement sludge lagoons (described in Work No. 12 in Schedule 1 of the draft DCO); - removal of existing 132 kilovolt overhead line and associated towers and foundations (described in Work No. 13 in Schedule 1 of the draft DCO); - passing place on Rusholme Lane (described in Work No. 14 in Schedule 1 of the draft DCO); - the Site Reconfiguration Works (described in Work No. 15 in Schedule 1 of the draft DCO, although as at the submission of this document, the Applicant will be making an amendment to the DCO Application to remove the Site Reconfiguration Works from the Proposed Scheme); and - further associated development as set out in Schedule 1 of the draft DCO.

	These developments are associated with the NSIP i.e. Unit X and Unit Y and the battery storage facilities (described in Work Nos. 1-3 in Schedule 1 of the draft DCO).
Carbon capture readiness	Carbon Capture readiness, with respect to a combustion plant's emissions of CO_2, is achieved when the following conditions are met: (a) suitable storage sites are available (b) it is technically and economically feasible to retrofit the plant with the equipment necessary to capture that CO_2; and (c) it is technically and economically feasible to transport such captured CO_2 to the storage sites.
Carbon capture readiness reserve space	Space to be set aside to accommodate future carbon capture equipment, making the proposed plant in effect "carbon capture ready" for when the Carbon capture readiness state is achieved. The Carbon capture readiness reserve space is described as Work No. 10 in Schedule 1 of the draft DCO (Examination Library ref AS-012).
Combined Cycle Gas Turbine (CCGT)	A combined cycle gas turbine is an assembly of turbines that convert heat into mechanical energy. Combustion of a fuel within a gas turbine produces hot gases that expand over a complex series of blades that cause the turbine to rotate which in turn drives an electrical generator. The principle of combined cycle is that the exhaust gases from the turbine are used as a heat source in a heat recovery steam generator (HRSG), increasing the system's overall efficiency by utilising energy from the fuel that would otherwise be wasted.
DCO Application	The application for a DCO in respect of the Proposed Scheme.
Development Consent Order (DCO)	A Development Consent Order (DCO) is made by the Secretary of State (SoS) pursuant to the Planning Act 2008 (PA 2008) to authorise a Nationally Significant Infrastructure Project (NSIP).
Drax Power Station	The existing biomass and coal fired power generation facility at the Existing Drax Power Station Complex.
Environmental Statement	A statement that includes the information that is reasonably required to assess the environmental effects of a development and which the applicant can, having regard in particular to current knowledge and methods of assessment, reasonably be required to compile, but that includes at least the information required in the EIA Regulations 2017 and which is prepared in accordance with the latest Scoping Opinion adopted by the Secretary of State (where relevant).

Gas Pipeline	The approximately 3 km underground pipeline which connects the Gas Receiving Facility to the National Transmission System. The Gas Pipeline is described as Work No. 7 in Schedule 1 of the draft DCO (Examination Library ref AS-012).
Gas Receiving Facility (GRF)	This is required to receive the natural gas from the Gas Pipeline. The GRF is described as Work No. 5 in Schedule 1 of the draft DCO (Examination Library ref AS-012).
Gas Turbine	Gas turbines produce electricity. Air is drawn into the compressor of the gas turbine and is compressed. The fuel is then injected into the combustion chamber. The mixture of fuel and compressed air is ignited, producing gases at high temperatures. As the gas expands, it rotates the turbine to produce electricity. The gas turbines form part of Work No. 1A (which includes up to two gas turbines in connection with Unit X) and Work No. 2A (which includes up to two gas turbines in connection with Unit Y) in Schedule 1 of the draft DCO (Examination Library ref AS-012).
Heat Recovery Steam Generators (HRSG)	HRSGs recover the hot flue gases from the Gas Turbines. The heat is used to produce steam that will drive the existing steam turbines. HRSGs are required where the generating station is operating in CCGT mode. The HRSGs form part of Work No. 1A (up to two HRSGs in connection with Unit X) and Work No. 2A (up to two HRSGs in connection with Unit Y) in Schedule 1 of the draft DCO (Examination Library ref AS-012).
Laydown Area	Areas that will be used during construction for the temporary locating of construction offices, warehouses, workshops, open air storage areas and car parking. The main construction laydown areas are described in Work No. 9 in Schedule 1 of the draft DCO (Examination Library ref AS-012), whilst construction laydown areas for the construction of the AGI are described in Work Nos. 6C and D, and for the construction of the Gas Pipeline are described in Work No. 7B in Schedule 1 of the draft DCO.
Minimum Offtake Connection (MOC)	The Minimum Offtake Connection will be part of the AGI to be owned and operated by National Grid. The MOC will provide the gas connection to the National Grid Natural Transmission System. The MOC is described as Work No. 6A in Schedule 1 of the draft DCO (Examination Library ref AS-012).
National Policy Statement (NPS)	Overarching policy designated under the Planning Act 2008 concerning the planning and consenting of NSIPs in the UK.

Nationally Significant Infrastructure Project (NSIP)	A project meeting the criteria for a "nationally significant infrastructure project" set out in section 14 of the Planning Act 2008, and therefore requiring authorisation under the PA 2008 by way of a DCO. The Proposed Scheme constitutes a Nationally Significant Infrastructure Project (NSIP) by virtue of s.14(1)(a) and s.15 of the PA 2008 as it is an onshore generating station in England of 50 MW capacity or more.
Open Cycle Gas Turbine (OCGT)	An open cycle gas turbine converts heat into mechanical energy. Combustion of a fuel within a gas turbine produces hot gases that expand over a complex series of blades that cause the turbine to rotate which in turn drives an electrical generator.
Pipeline Area	The area required in connection with the construction, operation and maintenance of the Gas Pipeline, the AGI and the GRF, comprising the Pipeline Construction Area and the Pipeline Operational Area.
Pipeline Construction Area	The extent of land needed for the construction phase of the Gas Pipeline, the AGI, the GRF and the Rusholme Lane Area.
Pipeline Inspection Gauge (PIG) Trap Facility (PTF)	System to allow remote cleaning of long stretches of pipeline. Will have a launching (PTF-L) and a receiving (PTF-R) either side of the pipeline stretch.
Pipeline Operational Area	The area within which the Gas Pipeline, the AGI and the GRF will be situated once constructed.
Planning Inspectorate (PINS)	The government agency responsible for administering and examining applications for development consent for NSIPs under the Planning Act 2008 on behalf of the SoS.
Power Station Site	Areas within the Existing Drax Power Station Complex where: 1. The Site Reconfiguration Works are proposed to take place; 2. The temporary construction Laydown Area is to be located described in Work No. 9A in Schedule 1 of the draft DCO (Examination Library ref AS-012); 3. The Generating station equipment is proposed to be located. The generating station equipment is described as Work Nos. 1, 2, 3 and 4 in Schedule 1 of the draft DCO (Examination Library ref AS-012); 4. The Electrical connection is proposed to be located. The electrical connection is described as Work Nos. 8 and 13 in Schedule 1 of the draft DCO (Examination Library ref AS-012); and 5. The decommissioning and demolition of sludge lagoons and construction of replacement sludge lagoons is proposed to take

	place, described as Work No. 12 in Schedule 1 of the draft DCO (Examination Library ref AS-012).
Proposed Scheme	Drax Power Limited is proposing to repower up to two existing coal-powered generating units (Units 5 and 6) at the Existing Drax Power Station Complex with new gas turbines that can operate in both combined cycle and open cycle modes. The term "repower" is used as existing infrastructure, such as the steam turbine and cooling towers, that are currently used for the coal fired units would be reutilised for the new gas fired generating units/stations. The repowered units (which each constitute a new gas fired generating station) would have a new combined capacity of up to 3,600 MW in combined cycle mode (1,800 MW each), replacing existing units with a combined capacity to generate up to 1,320 MW (660 MW each). This is explained further below: Each gas generating station would have up to two gas turbines, with each gas turbine powering a dedicated generator of up to 600 MW in capacity. The gas turbines in each generating station (or unit), therefore, would have a combined capacity of up to 1,200 MW. The gas turbines in each generating station (or unit), in combined cycle mode, would provide steam to the existing steam turbine (through Heat Recovery Steam Generators (HRSGs)) which would generate up to 600 MW per unit. Each unit would have up to two HRSGs. This results in a capacity for each generating station of up to 1,800 MW and, should both units be repowered, a combined capacity of up to 3,600 MW. The new gas turbine generating units have been designated the terms "Unit X" and "Unit Y". In OCGT mode, the combined capacity would be up to 2,400MW (as in OCGT mode, there would be no HRSG capacity). Each unit would have (subject to technology and commercial considerations) a battery energy storage facility with a capacity of up to 100 MW per unit, resulting in a combined battery energy storage capacity of up to 200 MW. All battery units may be protected by the same structure. The total combined capacity of the two gas fired generating stations and two battery storage facilities (i.e. the total combined capacity of the Proposed Scheme) is therefore 3,800 MW. Drax is seeking consent for the flexibility to either: • Repower one unit (either Unit 5 or 6) and construct Unit X as a gas fired generating station; or • Repower both Units 5 and 6 and construct Unit X and Unit Y as two gas fired generating stations.

	In the single unit scenario, up to two gas turbines and up to two HRSGs and (subject to technology and commercial considerations) a battery energy storage facility of up to 100 MW storage capacity would be constructed. The maximum size of the battery storage cells and any structure built to protect them would not change, as the battery storage cells for one Unit could be one larger battery which would allow the 100 MW output to be sustained for a longer duration. However, the fuel gas station and gas insulated switchgear would be smaller. In the event that two units are repowered and two new generating stations are constructed, then construction works would be undertaken consecutively rather than concurrently. In order to repower to gas, a new Gas Pipeline would be constructed from the Existing Drax Power Station Complex to the National Transmission System (NTS) operated by National Grid. Pipeline infrastructure would be the same for both one and two unit scenarios. A gas receiving facility (GRF) comprising Pipeline Inspection Gauge (PIG) Trap Facility (PTF), Pressure Reduction and Metering Station (PRMS) and compressor station is proposed south of woodland to the east of New Road. At the connection to the NTS there will be an AGI comprising - a Pig Trap Launching station (PTF-L) which will be operated by Drax, and a Minimum Offtake Connection (MOC), which will be operated by National Grid. The Proposed Scheme includes the Site Reconfiguration Works (although as at the submission of this document, the Applicant will be making an amendment to the DCO Application to remove the Site Reconfiguration Works from the Proposed Scheme) and the Electrical connection. Drax's Proposed Scheme is described in more detail in Chapter 3 (Site and Project Description) of the ES Volume 1 (Examination Library ref APP-071). Schedule 1 of the draft DCO submitted in support of the DCO Application (Examination Library ref AS-012) lists out the elements comprised within the Proposed Scheme.
Rusholme Lane Area	Area required for passing places during the construction of the Gas Pipeline, AGI and GRF (described as Work No. 14 in Schedule 1 to the draft DCO (Examination Library ref AS-012)).

Site	The Site refers to the Power Station Site, the Carbon capture readiness reserve space (which is also the location of temporary construction laydown described as Work No. 9B in Schedule 1 to the draft DCO (Examination Library ref AS-012)) and the Pipeline Area.
Site Boundary	The Site Boundary refers to the outer perimeter of the Site.
Unit X	The construction of a gas fired generating station capable of operating in CCGT and OCGT modes and which would have a generating capacity of up to 1,800 MW. Unit X would be connected to a battery storage facility, with a capability of up to 100MW. The total output from Unit X would be 1,900MW. Unit X is described in Work No. 1 of Schedule 1 to the draft DCO (Examination Library ref AS-012).
Unit Y	The construction of a gas fired generating station capable of operating in CCGT and OCGT modes and which would have a generating capacity of up to 1,800 MW. Unit Y would be connected to a battery storage facility, with a capability of up to 100MW. The total output from Unit Y would be 1,900MW. Unit Y is described in Work No. 2 of Schedule 1 to the draft DCO (Examination Library ref AS-012).

Abbreviations

Abbreviation	Term in full
AGI	Above Ground Installation
AIS	Air insulated switchyard/switchgear
APFP	Applications: Prescribed Forms and Procedures
BEIS	Department for Business, Energy & Industrial Strategy
BESF	Battery Energy Storage Facility
CCGT	Combined Cycle Gas Turbine
DCO	Development Consent Order
DECC	Department of Energy and Climate Change (now part of BEIS)
EMF	Electric and Magnetic Field
EN-1	Overarching NPS for Energy
ES	Environmental Statement
GIS	Gas Insulated Switchgear

GIS	Geographic Information System
GNU	GNU's not Unix
GRF	Gas Receiving Facility
HSE	Health & Safety Executive
HPA	Health Protection Agency
HRSGs	Heat Recovery Steam Generators
ICNIRP	International Commission on Non-Ionizing Radiation Protection
kV	Kilovolt
MOC	Minimum Offtake Connection
MVA	Mega-Volt-Ampere
MW	Megawatts
NG	National Grid
NPPF	National Planning Policy Framework
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project
NTS	National Transmission System
OCGT	Open Cycle Gas Turbine
OHL	Overhead Line
PA 2008	Planning Act 2008 (as amended)
PHE	Public Heath England
PINS	Planning Inspectorate
PRMS	Pressure Reduction and Metering Station
PTF	PIG Trap Facility
PTF-L	PIG Trap Launching station
SoS	Secretary of State

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EXECUTIVE SUMMARY

1. This Electric and Magnetic Field (EMF) Assessment Report has been prepared by WSP UK Limited on behalf of Drax Power Limited (Drax or the Applicant), to support an Application for a Development Consent Order (DCO).

2. The Proposed Scheme will provide up to 1,800 MW or up to 3,600 MW of electrical generation capacity (depending on whether one or both of Units 5 and 6 at the Existing Drax Power Station Complex are repowered). The term "repowered" means the existing coal-fired units would be decommissioned and replaced with newly constructed gas-fired units utilising the existing steam turbine and cooling system. Should one unit be repowered, then a single gas fired generating station will be constructed (known as Unit X) with a capacity of up to 1,800 MW, comprising up to two gas turbines and up to two Heat Recovery Steam Generators (HRSGs). Each unit would also have a battery storage capability of up to 100 MW (subject to technology and commercial considerations). If two units are repowered, the new gas-fired generating stations would have a combined capacity of up to 3,600 MW and a combined battery storage capacity of up to 200 MW (totalling a capacity of up to 3,800 MW).

3. Based on the data available at the time of the assessment, it has been shown that at no point do the fields exceed either the public exposure basic restriction (360 µT); or occupational exposure low action level (1000 µT). As such the proposed 400kV circuits in the assumed locations would be compliant with EMF exposure guidelines.

1 INTRODUCTION

1.1.1. This Electric and Magnetic Field (EMF) Assessment has been prepared by WSP UK Limited on behalf of Drax Power Limited (Drax or the Applicant), to support an Application for a Development Consent Order (DCO).

1.1.2. The Applicant is proposing to repower up to two of the existing six generating units at the Existing Drax Power Station Complex from coal-fired to new gas turbines that can operate in both combined cycle and open cycle modes. Each unit would (subject to technology and commercial considerations) be connected to its own battery energy storage facility. These proposals and the associated infrastructure would have a total combined capacity of up to 3,800 MW of electricity. The repowering of each unit from coal to gas involves the construction of a gas-fired generating station with a capacity of more than 50 MW. Each battery energy storage facility would also have a capacity of more than 50 MW. As such, the Proposed Scheme is classed as a Nationally Significant Infrastructure Project (NSIP) under the Planning Act 2008 (as amended) (PA 2008) (Ref. 1.1).

1.1.3. A DCO is required to construct and operate the Proposed Scheme as it falls within the definition and thresholds for a NSIP under sections 14 and 15(2) of the PA 2008. The DCO, if made by the Secretary of State (SoS), would be known as the Drax Power (Generating Stations) Order (the Order).

1.1.4. In accordance with the Planning Act 2008 (PA 2008), the Secretary of State (SoS) is required to determine an application for a DCO for an energy NSIP in accordance with any national policy statements which have effect in relation to the development. Of relevance to gas fired generating stations are the Overarching National Policy Statement for Energy (EN-1) (Ref. 1.4) (NPS EN-1) and the National Policy Statement for Fossil Fuel Electricity Generating Infrastructure EN-2. National Policy Statements for Gas Supply Infrastructure EN-4 and National Policy Statement for Electricity Networks EN-5 are also relevant for the Proposed Scheme. NPS EN-5 addresses the requirements to ensure the EMF effects on human health are properly assessed.

2 PROJECT DESCRIPTION

2.1 The Applicant

2.1.1. The Applicant is Drax Power Limited. Drax Power Station is owned and managed by the Applicant, who is part of the Drax Group Plc, one of the UK's largest energy producers.

2.2 Site Description

Existing Drax Power Station Complex

2.2.1. Drax Power Station is a large power station, comprising originally of six coal-fired units. It was originally built, owned and operated by the Central Electricity Generating Board and had a capacity of just under 2,000 MW when Phase 1 was completed in 1975. Its current capacity is 4,000 MW after the construction of Phase 2 in 1986.

2.2.2. Three of the original six coal-fired units are now converted to biomass (Units 1-3) and this is assessed as the current baseline in the Environmental Statement (ES) (Examination Library ref APP-071). By the latter half of 2018, four units (Units 1-4) will run on biomass with only two units (Units 5 and 6) running on coal. One or both of Units 5 and 6 will be repowered as part of the Proposed Scheme, this means the existing coal-fired units would be decommissioned and replaced with newly constructed gas-fired units utilising some of the existing infrastructure. The area within the Existing Drax Power Station Complex where development is proposed is referred to as the Power Station Site and is approximately 53.4 ha.

Pipeline Area

2.2.3. The Gas Pipeline route is approximately 3 km in length and crosses agricultural land to the east of the Existing Drax Power Station Complex. The land within the Pipeline Construction Area is 25.4 ha and the land within the Pipeline Operational Area is 2.4 ha.

2.2.4. An additional area is located on Rusholme Lane (Rusholme Lane Area) to accommodate a potential passing place for traffic during construction of the Gas Pipeline. This is considered to be part of the Pipeline Area.

Site Boundary

2.2.5. The Site is approximately 78.9 ha and lies approximately 4 m Above Ordnance Datum (AOD).

2.2.6. The Site Boundary (depicted with a red line in Chapter 1 (Introduction) Figure 1.1 of the ES (Examination Library ref APP-069)) represents the maximum extent of all potential permanent and temporary works required as part of the Proposed Scheme.

2.2.7. The Power Station Site, the Carbon capture readiness reserve space and the Pipeline Area (including the Rusholme Lane Area) have been divided into a number of Development Parcels shown on Chapter 1 (Introduction) Figure 1.3. of the ES (Examination Library ref APP-069).

2.2.8. The current land uses at these development parcels are described in Table 3-1 of the ES Chapter 3 (Site and Project Description) (Examination Library ref APP-071).

2.3 The Proposed Scheme

2.3.1. The Proposed Scheme is to repower up to two existing coal-powered generating units (Units 5 and 6) at the Existing Drax Power Station Complex with new gas turbines that can operate in both combined cycle and open cycle modes. The term "repower" is used as existing infrastructure, such as the steam turbine and cooling towers, that are currently used for the coal fired units would be reutilised for the new gas fired generating units/stations.

2.3.2. The repowered units (which each constitute a new gas fired generating station) would have a new combined capacity of up to 3,600 MW in combined cycle mode (1,800 MW each), replacing existing units with a combined capacity to generate up to 1,320 MW (660 MW each).

2.3.3. Each gas generating station (or unit) would have up to two gas turbines, with each gas turbine powering a dedicated generator of up to 600 MW in capacity. The gas turbines in each generating station (or unit), therefore, would have a combined capacity of up to 1,200

MW. The gas turbines in each generating station (or unit), in combined cycle mode, would provide steam to the existing steam turbine (through Heat Recovery Steam Generators (HRSGs)) which would generate up to 600 MW per generating station (or unit). Each generating station (or unit) would have up to two HRSGs. This results in a capacity for each generating station of up to 1,800 MW and, should both Units 5 and 6 be repowered, a combined capacity of up to 3,600 MW. The new gas turbine generating stations (or units) have been designated the terms "Unit X" and "Unit Y".

2.3.4. Each of Unit X and Unit Y would have (subject to technology and commercial considerations) a battery energy storage facility with a capacity of up to 100 MW per Unit, resulting in a combined battery energy storage capacity of up to 200 MW. All battery units may be protected by the same structure.

2.3.5. The total combined capacity of the two gas fired generating stations, Unit X and Unit Y, and two battery storage facilities (i.e. the total combined capacity of the Proposed Scheme) is therefore 3,800 MW.

2.3.6. The DCO seeks consent for the following flexibility:

- Repowering of either Unit 5 or 6 and construction of Unit X as a gas fired generating station (this would leave either Unit 5 or 6 (depending on which had been repowered) as a coal-fired unit); or
- Repowering of both Units 5 and 6 and construction of Unit X and Unit Y as two gas fired generating stations.

2.3.7. In the event that a single unit is repowered and Unit X constructed, up to two gas turbines and up to two HRSGs and (subject to technology and commercial considerations) a battery energy storage facility of up to 100 MW storage capacity would be constructed. The maximum size of the battery storage cells and any structure built to protect them would not change, as the battery storage cells for one Unit could be one larger battery which would allow the 100 MW output to be sustained for a longer duration. However, the fuel gas station and gas insulated switchgear required for the Gas Pipeline would be smaller.

2.3.8. In the event that two units are repowered and both Unit X and Unit Y are constructed, then construction works would be undertaken consecutively rather than concurrently. It is assumed for the purposes of the ES that there would be a gap of a year between construction periods, but this could be longer depending on commercial considerations. Unit Y would mirror Unit X, with up to two gas turbines and up to two HRSGs and (subject to technology and commercial considerations) a battery energy storage facility of up to 100 MW storage capacity which may be included within the structure, should one be constructed, protecting the battery for Unit X.

2.3.9. In order to repower to gas, a new Gas Pipeline would be constructed from the Existing Drax Power Station Complex to the National Transmission System (NTS) operated by National Grid. Pipeline infrastructure would be the same whether Unit X was constructed or whether Unit X and Unit Y was constructed.

2.3.10. A gas receiving facility (GRF) comprising Pipeline Inspection Gauge (PIG) Trap Facility (PTF), Pressure Reduction and Metering Station (PRMS) and compressor station is proposed south of woodland to the east of New Road.

2.3.11. At the connection to the NTS there will be an above ground installation (AGI) south of Rusholme Lane. The AGI involves a PIG Trap Launching station (PTF-L) which will be operated by Drax, and a Minimum Offtake Connection (MOC), which will be operated by National Grid.

2.3.12. A full description of the Proposed Scheme and the Site is contained in Chapter 3 (Site and Project Description) of the ES (Examination Library ref APP-071).

3 CONTEXT AND ASSESSMENT METHODOLOGY

3.1 Introduction

3.1.1. It is proposed that each of Unit X and Unit Y and their battery energy storage facility will be connected to the existing National Grid 400 kV substation. For Unit X and Unit Y the output from each generating unit would be banked using Gas Insulated Switchgear (GIS) housed in a new building close to the generating units. Connection from the GIS banking building to the existing National Grid 400 kV substation would be by underground cable for Unit X. The connection for Unit Y from the GIS banking building to the existing National Grid 400 kV substation would be by either:

- An underground cable (as described above for Unit X); or
- An underground cable that terminates in a new cable sealing end compound outside of the fence line of the existing National Grid 400 kV substation and is connected to the existing equipment using overhead conductors.

3.1.2. The cable sealing end compound will be fenced to form either an individual compound or the existing substation fence will be extended to include the new equipment.

3.1.3. Electric fields are caused by the existence of a potential difference (voltage) between energised conductors and the ground. The field strength at any position surrounding a single conductor is a function of the voltage and distance from the source to measuring or calculation point.

3.1.4. As works require alterations to an existing substation, limited works to existing overhead lines and a new underground connection, the impact of the change to electro-magnetic field (EMF) is likely to be minimal.

3.1.5. Specifically, the underground connection are assumed to be underground, insulated and shielded cables and as such, no external electric field will be produced. Electric Fields have therefore been scoped out from the rest of the analysis.

3.1.6. Magnetic fields are caused by and are directly proportional to the instantaneous phase currents within conductors. The strength of magnetic fields decreases as the distance from the source to measuring or calculation point increases. Magnetic fields from HV underground cables (such as the connection cables between the GIS banking building to the existing National Grid 400 kV substation) can be substantial and are the focus of this analysis.

Overarching National Policy Statement for Energy (EN-1) Requirements

3.1.7. The requirement for the consideration of EMFs, is detailed within section 2.10 - Electric and Magnetic Fields (EMFs) of EN-5 (Ref. 1.4).

3.1.8. With respect to the effects of EMFs, Paragraph 2.10.3 of EN-5 states:

“To prevent these known effects, the International Commission on Non-Ionizing Radiation Protection (ICNIRP21) developed health protection guidelines in 1998 for both public and occupational exposure. These are expressed in terms of the induced current density in affected tissues of the body, “basic restrictions”, and in terms of measurable “reference

levels" of electric field strength (for electric fields), and magnetic flux density (for magnetic fields)."

3.1.9. The ICNIRP guidelines (Ref. 3.4) were originally published in 1998 and revised in 2010. The ICNIRP guidelines will form the basis of the EMF Assessment with specific reference to 'public exposure' and for short term 'occupational exposure' limits in the following sub sections.

3.2 Exposure Limits

3.2.1. Public Heath England (formerly UK Health Protection Agency) indicated (Ref. 3.1) that a three-step compliance assessment should be adopted for assessing exposure to electric and magnetic fields.

- 1. Compliance with Reference (Action) levels. If the calculated field strengths at or below the reference levels, compliance is assumed, and there is no need to proceed to stage 2.
- 2. Compliance with Basic Exposure Limit levels. If the calculated field strengths are at or below the exposure limits (calculated using anatomically realistic models), compliance is assumed and there is no need to proceed to stage 3.
- 3. Detailed assessment – calculations or measurements using realistic exposure conditions, considering partial body exposure, non-uniform fields, grounding, polarisation, body posture and proximity to the source etc.

<u>For Public Exposure</u>

3.2.2. Exposures to the public should comply with the ICNIRP 1998 guidelines (Ref. 3.4) and compliance should be assessed on a cost/benefit basis and only when the time of exposure to the general public is significant. This policy is set out in the Written Ministerial Statement of 2009 (Ref. 3.2) and applied to power lines within the National Policy Statement EN-5 (Ref. 1.4).

3.2.3. The industry code of practice (Ref. 3.3) indicates that compliance should be assessed against the basic restriction exposure limits, which is 360 µT for Magnetic Fields.

Occupational Exposure

3.2.4. The ICNIRP 2010 guidelines (Ref. 3.4) for occupational exposure were adopted as an EU directive (Ref. 3.5) in 2013 and incorporated into UK law as the "Control of Electromagnetic Fields at Work Regulations 2016" (Ref. 3.6). As such, the guidelines are deemed enforceable.

Applied Limits

3.2.5. In accordance with the DECC policy statement (Ref. 3.2) and industry code of practice (Ref. 3.3), fields should be assessed at 1m above ground level; calculated or measured with maximum continuous current allowable in an intact system and nominal voltage.

3.2.6. The reference level values for magnetic field are summarised in Table 3-1 below. The equivalent basic exposure limits are also stated below (as indicated by the UK Health Protection Agency (Ref. 3.1)).

Table 3-1 - Magnetic Field Limits

	Public Exposure		Occupational Exposure	
	Reference Level	Basic Restriction	Low Action Level	High Action Level
Magnetic Field	100 µT	360 µT	1000 µT	6000 µT

3.3 Calculation Methodology

3.3.1. Calculations were performed using WSP's proprietary EMF calculation program running within the GNU Octave numerical processing software. This program utilises the calculation method as described by EPRI (Ref. 3.7).

3.3.2. Results were produced using a recent stable version of GNU Octave (4.4.1) which can create high quality vector graphics for field plots.

3.3.3. One-dimensional lateral profiles of electric and magnetic fields have been calculated within the area of interest by iteratively running simulations for measurement points within a plane.

3.3.4. The measurement height was set at 1 metre above the ground, in line with UK voluntary codes of practice.

3.4 Modelling Assumptions

3.4.1. In accordance with the DECC code of practice, magnetic field calculations were performed in accordance with the following assumptions:

- Overhead and underground conductors are approximated as infinitely long, straight, horizontal cylinders;
- are within an unperturbed field;
- Ignoring zero-sequence and negative-sequence currents, and currents induced in the cable sheaths, ground and overhead earth wires.

4 CIRCUIT MODELLING

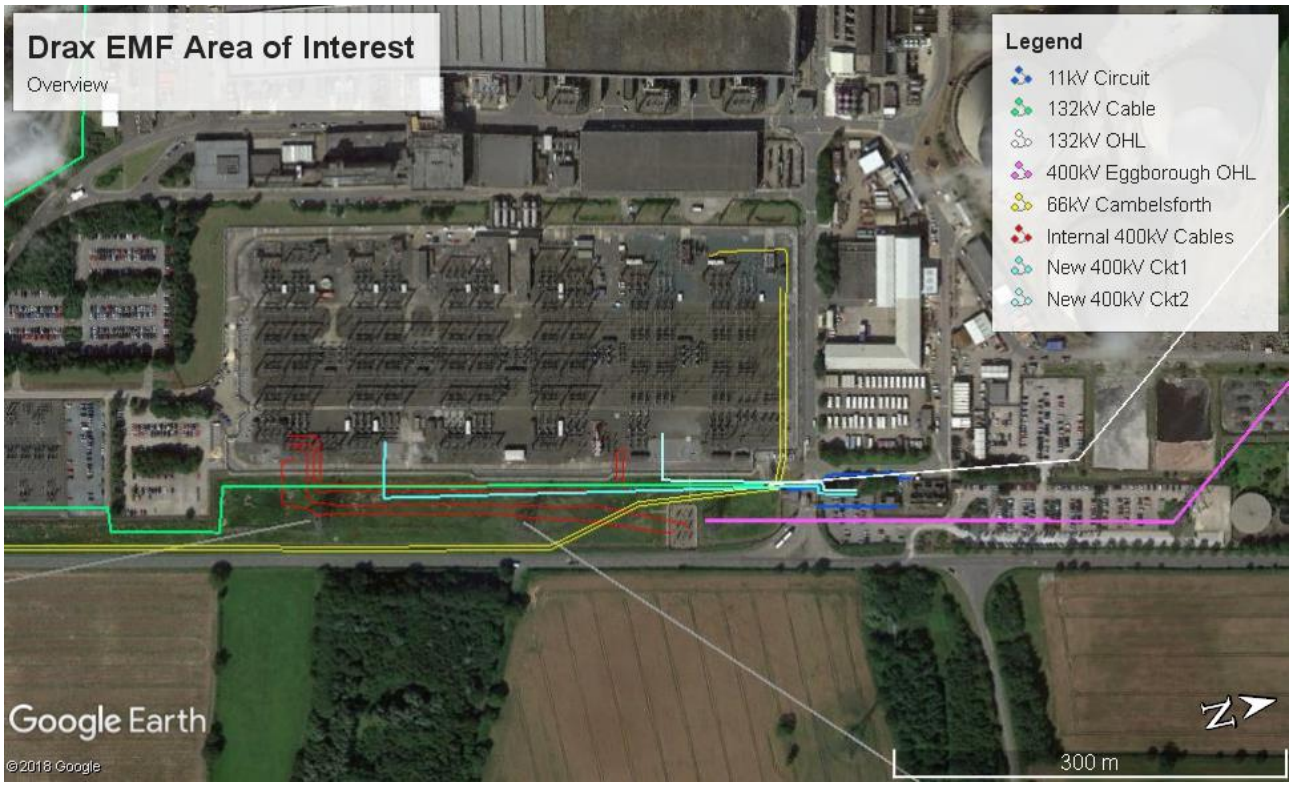
4.1 EHV Circuits

4.1.1. The exact route of the two proposed 400kV underground circuits was not finalised prior to this assessment. As such the 400kV underground circuits have been modelled in locations to produce the maximum field strength which is practicable; with due consideration to minimise existing cable crossings.

4.1.2. These cables will need to run past the gatehouse to arrive at the new Gas Insulated Switchgear (GIS) to the north. The cables which were modelled are shown in Figure 4-1 below. The assumed routes of the 400kV cables are shown in Light Blue colour.

4.1.3. The figure also shows the existing circuits which have been modelled as indicated in the figure legend.

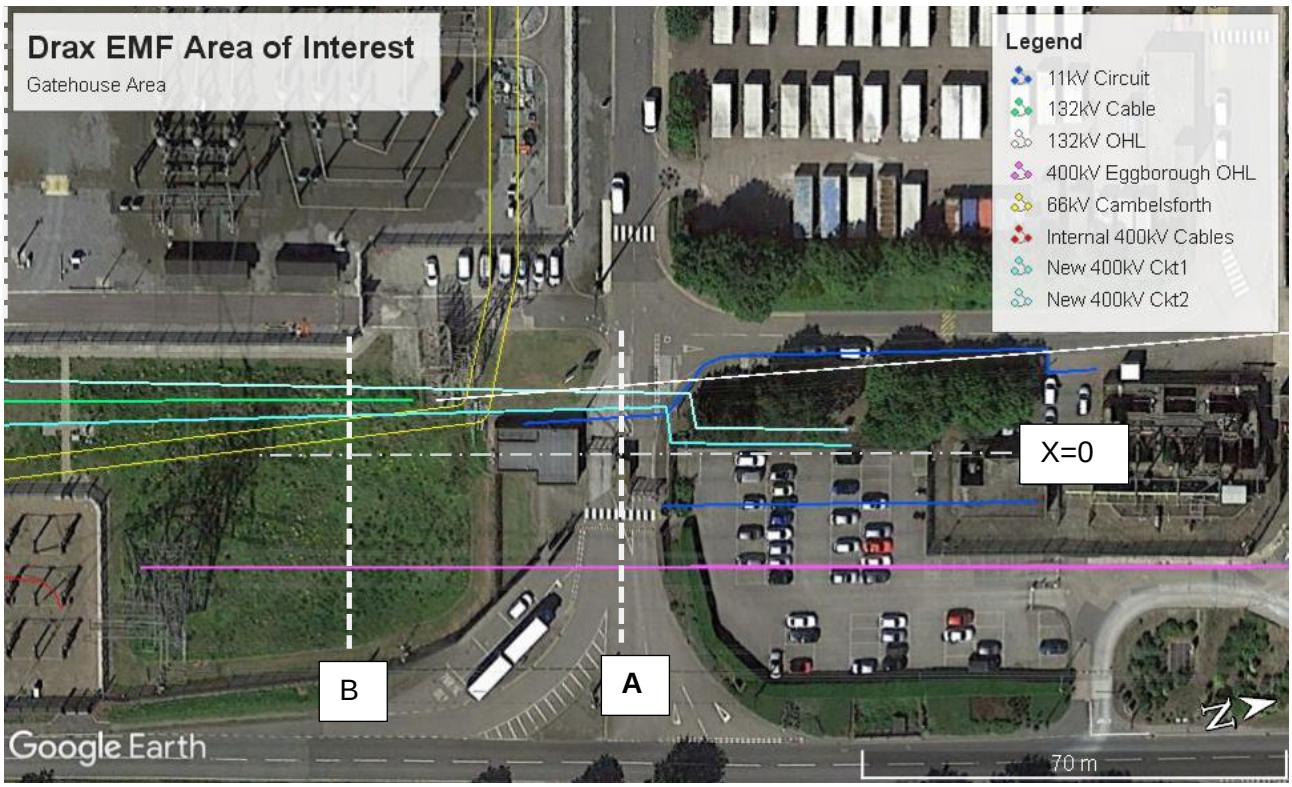
Figure 4-1 - Site Overview



4.2 Area of Interest

4.2.1. Of interest for this analysis is the area surrounding the gatehouse; where public exposure from the new cables in the proposed route will be the greatest. Two planes of calculation were assumed on the north and south of the gatehouse to incorporate the effect of the 66kV double circuits. These are indicated as vertical, white dashed lines on Figure 4-2 as shown below.

Figure 4-2 - EMF Area of Interest



4.3 Circuit Modelling

4.3.1. Circuits have been modelled at locations which are relative to the centre of the gatehouse (X=0 as shown Figure 4-2).

Proposed 400kV Circuits

At the time of conducting this assessment, data on the cable construction was not finalised; however, for the purpose of the assessment, they have been specified to provide a rating of 2000 Amps per phase. To achieve this capacity, it is likely to require 2500mm^2 Copper cables, phases spaced in the region of 400mm; and circuits separated by approximately 2 metres.

Existing 400kV Overhead Circuits

4.3.2. Data for the existing 400kV double circuit overhead line to Eggborough substation was unavailable. The line is owned and operated by National Grid.

4.3.3. National Grid (NG) data shows that these lines are constructed with “L6” towers; therefore, conductor positions were modelled in accordance with National Grid TGN 166 (Ref 4.1); and

adjusted to the minimum statutory clearance (7.6m) in accordance with the DECC code of practice.

4.3.4. From NG's ETYS (Ref. 4.2), it was found that the circuits have a rating of 2090 and 2970 MVA (3017 and 4287 Amps per phase) respectively. It is assumed that one circuit has limited capability due to being partially undergrounded between the 400kV AIS and the first tower, which can be seen from aerial photography.

132kV Overhead Line/Cable

4.3.5. A composite double circuit OHL/Cable runs near to the gatehouse. Loading was found to be 16 MVA per circuit as per data received. It was suggested that the overhead section of this circuit would be made underground; though this was unconfirmed. To provide a 'worst case' EMF assessment, it was assumed that this would be enacted, and follow the same route past the gatehouse. The cables would be modelled at 1m depth, separated by 100mm.

66kV Underground Double Circuit

4.3.6. A double circuit 66kV underground cable, owned by Northern Powergrid runs from the 2x180 MVA Transformers at the North-West corner of the Drax 400kV switchyard to Camblesforth substation. The cables are 2000sqmm. Phases are separated by 350mm; with the circuits being separated by varying distances. Cables were modelled at an assumed (typical) depth of 1 metre. Ratings or typical current flow was not available for this circuit; therefore, the loadings were assumed to be equal to the transformer ratings i.e. 180 MVA per circuit or 1575 Amps per phase to provide pessimistic values.

11kV cables

11kV cables were not modelled due to the low levels of loading.

5 RESULTS

5.1.1. The EMF results as shown in Figure 5-1 and Figure 5-2 show that at no point do the fields exceed either the public exposure basic restriction (360 µT); or occupational exposure low action level (1000 µT). As such the proposed 400kV circuits in the assumed locations would be compliant with EMF exposure guidelines.

Figure 5-1 - North of Gatehouse [A]

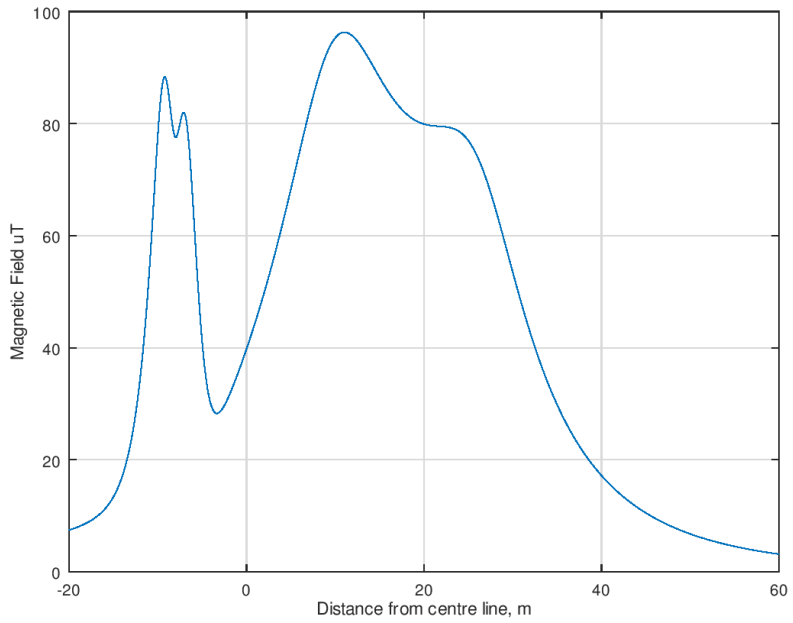
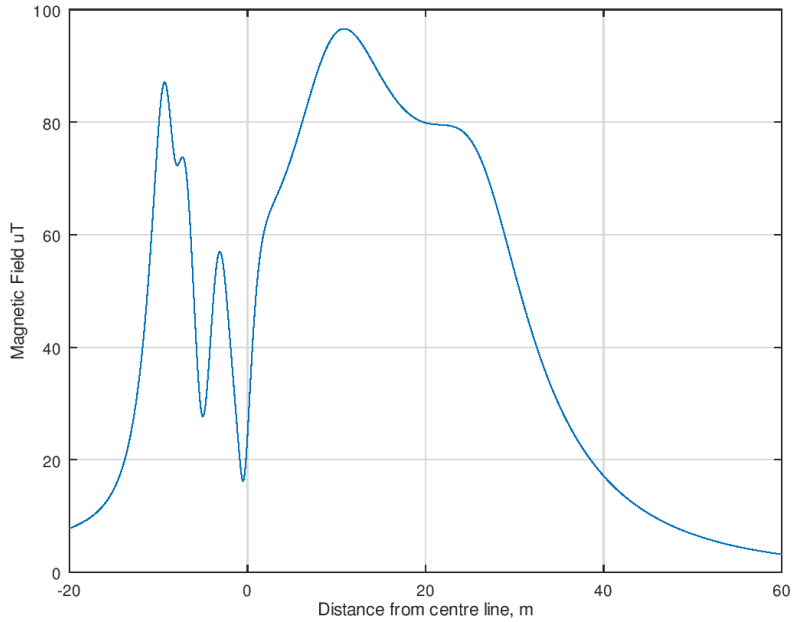


Figure 5-2 - South of Gatehouse [B]



6 CONCLUSION

6.1.1. This EMF Assessment Report has demonstrated that the proposed 400kV circuits will be compliant with public exposure and occupational exposure limits and is in accordance with the ICNIRP Guidelines.

6.1.2. This does not release Drax Power from the remaining conditions of The Control of Electromagnetic Fields at Work Regulations 2016 and other legislation of the Health and Safety Executive as is the responsibility of all employers.

6.1.3. This can include but is not limited to:

- Limiting Exposure
- Exposure Assessments of other areas; and action plans
- Risk Assessments
- Provide information and training
- Surveillance and Medical Examinations

6.1.4. This EMF Assessment may require repetition if there are material changes to the proposed routing of circuits.

REFERENCES

- Ref. 1.1 The Planning Act 2008 (as amended).
- Ref. 1.2 The Infrastructure Planning (Applications: Prescribed Forms and Procedures) 2009.
- Ref. 1.3 The Planning Inspectorate Advice Note 6: Preparation and submission of application documents (Version 7, dated February 2016).
- Ref. 1.4 Department of Energy & Climate Change. National Policy Statement for Electricity Networks Infrastructure (EN-5). 2011.
- Ref. 3.1 HPA. Application of ICNIRP Exposure Guidelines for 50 Hz Power Frequency Fields.
- Ref. 3.2 Written Ministerial Statements: Friday 16 October 2009. [Online] http://www.publications.parliament.uk/pa/cm200809/cmhansrd/cm091016/wmstext/91016m0001.htm.
- Ref. 3.3 Power Lines: Demonstrating compliance with EMF public exposure guidelines - A voluntary code of practice. 2012.
- Ref. 3.4 ICNIRP. GUIDELINES FOR LIMITING EXPOSURE TO TIME-VARYING ELECTRIC, MAGNETIC, AND ELECTROMAGNETIC FIELDS (UP TO 300 GHz). [Online] 1998. http://www.icnirp.de/documents/emfgdl.pdf.
- Ref. 3.5 European Parliament, Council. DIRECTIVE 2013/35/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the minimum health and safety requirements regarding the exposure of workers to the risks. 2013.
- Ref. 3.6 The Control of Electromagnetic Fields at Work Regulations. [Online] http://www.legislation.gov.uk/uksi/2016/588/pdfs/uksi_20160588_en.pdf.
- Ref. 3.7 Transmission line reference book, 345 kV and above (Electric Power Research Institute, 1982)
- Ref 4.1 TGN(E) 166, Electrical Parameters and Impedance Characteristics of Plant, Lines and Cables, National Grid. 2002
- Ref 4.2 Electricity Ten Year Statement (ETYS), National Grid, 2017