Determination of an Application for an Environmental Permit under the Environmental Permitting (England & Wales) Regulations 2016

Decision document recording our decision-making process

The Permit Number is:	EPR/YP3133LL/V010
The Operator is:	Keadby Generation Limited
The Installation is located at:	Keadby Power Station, Trentside, Keadby, Scunthorpe DN17 3EF

What this document is about

This is a decision document, which accompanies a permit.

It explains how we have considered the Applicant's Application, and why we have included the specific conditions in the permit we are issuing to the Applicant. It is our record of our decision-making process, to show how we have taken into account all relevant factors in reaching our position. Unless the document explains otherwise, we have accepted the Applicant's proposals.
We try to explain our decision as accurately, comprehensively and plainly as possible. Achieving all three objectives is not always easy, and we would welcome any feedback as to how we might improve our decision documents in future. A lot of technical terms and acronyms are inevitable in a document of this nature: we provide a glossary of acronyms near the front of the document, for ease of reference.

Preliminary information and use of terms

We gave the application the reference number EPR/YP3133LL/V010. We refer to the application as "the **Application**" in this document in order to be consistent.
The number we have given to the permit is EPR/YP3133LL/V010. We refer to the permit as "the **Permit**" in this document.

The Application was duly made on 02/12/2019.
The Applicant is Keadby Generation Limited. We refer to Keadby Generation Limited as "the **Applicant**" in this document. Where we are talking about what would happen after the Permit is granted (if that is our final decision), we call Keadby Generation Limited "the **Operator**".

Keadby Generation Limited proposed facility is located at Keadby Power Station, Trentside, Keadby, Scunthorpe DN17 3EF. We refer to this as “the **Installation**” in this document.

Contents:

GLOSSARY

Baseload	means: (i) as a mode of operation, operating for >4000hrs per annum; and (ii) as a load, the maximum load under standard conditions that can be sustained continuously, i.e. maximum continuous rating
BAT	best available techniques
BAT-AEL	best available techniques associated emission limit
BATc	best available techniques reference document conclusions
Black Start	The procedure to recover from a total or partial shutdown of the UK Transmission System which has caused an extensive loss of supplies. This entails isolated power stations being started individually and gradually being reconnected to other power stations and substations in order to form an interconnected system again.
BREF	best available techniques reference document
CBA	cost benefit analysis
CCGT	combined cycle gas turbine
Derogation	as set out in Article 15(4) of the IED
DLN	Dry Low NOx
Emergency use	<500 operating hours per annum
ELV	emission limit value set out in either IED or BAT conclusions
GT	gas turbine
IED	Industrial Emissions Directive 2010/75/EC
LCP	large combustion plant – combustion plant subject to Chapter III of IED
MSUL/MSDL	minimum start up load/minimum shut-down load
NECD	National Emissions Ceiling Directive
NOx	Oxides of nitrogen
SAC	special area of conservation
SCR	selective catalytic reduction
SPA	special protection area

1. Our Decision

We have decided to issue the variation to the Applicant. This will allow it to operate the Installation, subject to the conditions in the consolidated Permit.
We consider that, in reaching that decision, we have taken into account all relevant considerations and legal requirements and that the permit will ensure that a high level of protection is provided for the environment and human health.
This Application is to operate an additional power plant on the installation which is subject principally to the Industrial Emissions Directive (IED).

2. How we reached our decision

2.1 Receipt of application

The Application was duly made on 02/12/2019. This means we considered it was in the correct form and contained sufficient information for us to begin our determination but not that it necessarily contained all the information we would need to complete that determination.

The Applicant made no claim for commercial confidentiality. We have not received any information in relation to the Application that appears to be confidential in relation to any party.

2.2 Consultation on the Application

We carried out consultation on the Application in accordance with the EPR and our statutory Public Participation Statement. We consider that this process satisfies, and frequently goes beyond the requirements of the Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, which are directly incorporated into the IED, which applies to the Installation and the Application. We have also taken into account our obligations under the Local Democracy, Economic Development and Construction Act 2009 (particularly Section 23). This requires us, where we consider it appropriate, to take such steps as we consider appropriate to secure the involvement of representatives of interested persons in the exercise of our functions, by providing them with information, consulting them or involving them in any other way. In this case, our consultation already satisfies the Act's requirements.

We advertised the Application by a notice placed on our website, which contained all the information required by the IED, including telling people where and when they could see a copy of the Application. We made a copy of the Application and all other documents relevant to our determination (see below) available to view on our Citizenspace web based consultation portal and the public register. Anyone wishing to see these documents could also do so and arrange for copies to be made.

We sent copies of the Application to the following bodies, which includes those with whom we have “Working Together Agreements”:

- Public Health England
- The Director of Public Health
- The Health and Safety Executive
- The Food Standards Agency
- National Grid
- North Lincolnshire Council – Environmental Health & Planning

These are bodies whose expertise, democratic accountability and/or local knowledge make it appropriate for us to seek their views directly. Note under our Working Together Agreement with Natural England, we only inform Natural England of the results of our assessment of the impact of the installation on designated Habitats sites.

Further details along with a summary of consultation comments and our response to the representations we received can be found in Annex 3. We have taken all relevant representations into consideration in reaching our determination.

2.3 Requests for Further Information

Although we were able to consider the Application duly made, we did in fact need more information during the determination period, a copy of the information was placed on our public register.

Supplementary Information supplied 27/08/2020 Annex C air Quality Assessment. Amended drawings, site layout air, water emissions A03 and Annex A drainage drawings, 30/09/2020 and amended site plan 05/11/2020

3. Chapter III of the Industrial Emissions Directive

Chapter III of the Industrial Emissions Directive (IED) applies to new and existing large combustion plants (LCPs) which have a total rated thermal input which is greater or equal to 50MW. Articles 28 and 29 explain exclusions to chapter III and aggregation rules respectively.
The aggregation rule is as follows:

- A Large Combustion Plant (LCP) has a total rated thermal input ≥50MW.
- Where waste gases from two or more separate combustion plant discharge through a common windshield, the combination formed by the plants are considered as a single large combustion plant.
- The size of the LCP is calculated by adding the capacities of the plant discharging through the common windshield disregarding any units <15MWth.

A “common windshield” is frequently referred to as a common structure or windshield and may contain one or more flues.

The Combined Cycle Gas Turbine (CCGT) on this site consists of an individual combustion unit with a total rated thermal input *1430MWth* making it an LCP.

Combustion plant on the installation that do not form part of an LCP and so do not come under chapter III requirements, are still listed within the Section 1.1 A(1)(a) activity listed in Schedule 1 of the Environmental Permitting regulations where they are larger than 1 MWth. In this instance the standby diesel generator will be greater than 1MWth but less than 2MWth and is therefore has been listed within the LCP activity. The generator is also within the scope of the Medium Combustion Plant Directive (MCPD) and has been listed as an MCP in the permit. This will operate for less than 500 hours per year and therefore no limits have been specified.
Chapter III lays out special provisions for LCP and mandatory maximum ELVs are defined in part 2 of Annex V for new plant, however it is worth noting that best available techniques (BAT) requirements may lead to the application of lower ELVs than these mandatory values. Mandatory ELVs cannot be exceeded even if a site specific assessment can be used to justify emission levels higher than BAT.

4. Large combustion Plant

The Application made by Keadby Generation Limited (the 'Applicant') is for the substantial variation of EPR/YP3133LL/V010 comprising the addition of a Combined Cycle Gas Turbine (CCGT) and its utilities to the installation. The site as a whole will consist of LCP202, 203 and 204 which is known as Keadby1 and the new turbine LCP682 will be known as Keadby 2.

The Permit uses the DEFRA LCP reference numbers to identify each LCP. The LCP permitted is as follows: **LCP682**

5. Net thermal input

The Applicant has stated that the Net Thermal Input of LCP682 is 1430 MWth.

This LCP consists of one 1430MWth CCGT which vents via a single stack. The unit burns natural gas.

6. Minimum start up load and Minimum shut-down load (MSUL/MSDL)

The applicant has not provided sufficient information to set the MSUL/MSDL as the plant has not been built yet. Consequently, we have set improvement condition IC10, requiring them to provide this information within 12 months of the plant starting up. Table S1.5 in the permit has been completed to reflect this too.

7. Dry Low NOx effective definition

The applicant has not provided sufficient information to set the DLN-e as the plant has not been built yet. Consequently, we have set improvement condition IC11, requiring them to provide this information within 12 months of the plant starting up. Table S1.6 in the permit has been completed to reflect this too.

We have considered that the scope of the Bref applies to the activity descriptions included in Annex 1 of the Industrial Emissions Directive (IED). Clearly combustion plant with a net thermal input of greater than or equal to 50 MW is an activity described in Annex 1 of the IED. We have determined the application on the basis that the CCGTs are in scope of the Bref and that the BAT-AEL for NOx will be specified in the permit.

8. The Installation's environmental impact

Regulated activities can present different types of risk to the environment, these include odour, noise and vibration; accidents, fugitive emissions to air and water; as well as point source releases to air, discharges to ground or groundwater, global warming potential and generation of waste and other environmental impacts. Consideration may also have to be given to the effect of emissions being subsequently deposited onto land (where there are ecological receptors). All these factors are discussed in this and other sections of this document.

For an installation of this kind, the principal emissions are those to air and water, although we also consider those to land.

The next sections of this document explain how we have approached the critical issue of assessing the likely impact of the emissions to air from the Installation on human health and the environment.

8.1 General Assessment Methodology

8.1.1 Application of Environment Agency Web Guide for Air Emissions Risk Assessment

A methodology for risk assessment of point source emissions to air, which we use to assess the risk of applications we receive for permits, is set out in our Web Guide and has the following steps:

- Describe emissions and receptors
- Calculate process contributions
- Screen out insignificant emissions that do not warrant further investigation
- Decide if detailed air modelling is needed
- Assess emissions against relevant standards
- Summarise the effects of emissions.

The methodology uses a concept of "process contribution (PC)", which is the estimated concentration of emitted substances after dispersion into the receiving environmental media at the point where the magnitude of the concentration is greatest. The guidance provides a simple method of calculating PC primarily for screening purposes and for estimating process contributions where environmental consequences are relatively low. It is based on using dispersion factors. These factors assume worst case dispersion conditions with no allowance made for thermal or momentum plume rise and so the process contributions calculated are likely to be an overestimate of the actual maximum concentrations. More accurate calculation of process contributions can be achieved by mathematical dispersion models, which take into account relevant parameters of the release and surrounding conditions, including local

meteorology – these techniques are expensive but normally lead to a lower prediction of PC.

8.1.2 Use of Air Dispersion Modelling

For LCP applications, we normally require the Applicant to submit a full air dispersion model as part of their application, for the key pollutants. Air dispersion modelling enables the process contribution to be predicted at any environmental receptor that might be impacted by the plant.

Once short-term and long-term PCs have been calculated in this way, they are compared with Environmental Standards (ES).

Where an EU ES exists, the relevant standard is the EU ES. Where an EU ES does not exist, our guidance sets out a National ES (also referred to as Environmental Assessment Level - EAL) which has been derived to provide a similar level of protection to Human Health and the Environment as the EU ES levels. In a very small number of cases, e.g. for emissions of Lead, the National ES is more stringent that the EU ES. In such cases, we use the National ES standard for our assessment.

National ESs do not have the same legal status as EU ESs, and there is no explicit requirement to impose stricter conditions than BAT in order to comply with a National ES. However, National ESs are a standard for harm and any significant contribution to a breach is likely to be unacceptable.

PCs are considered **Insignificant** if:

- the **long-term** process contribution is less than **1%** of the relevant ES; and
- the **short-term** process contribution is less than **10%** of the relevant ES.

The **long term** 1% process contribution insignificance threshold is based on the judgements that:

- It is unlikely that an emission at this level will make a significant contribution to air quality;
- The threshold provides a substantial safety margin to protect health and the environment.

The **short term** 10% process contribution insignificance threshold is based on the judgements that:

- spatial and temporal conditions mean that short term process contributions are transient and limited in comparison with long term process contributions;
- the threshold provides a substantial safety margin to protect health and the environment.

Where an emission is screened out in this way, we would normally consider that the Applicant's proposals for the prevention and control of the emission to be BAT. That is because if the impact of the emission is already insignificant, it follows that any further reduction in this emission will also be insignificant.

However, where an emission cannot be screened out as insignificant, it does not mean it will necessarily be significant.

For those pollutants which do not screen out as insignificant, we determine whether exceedances of the relevant ES are likely. This is done through detailed audit and review of the Applicant's air dispersion modelling taking background concentrations and modelling uncertainties into account. Where an exceedance of an EU ES is identified, we may require the Applicant to go beyond what would normally be considered BAT for the Installation or we may refuse the application if the applicant is unable to provide suitable proposals. Whether or not exceedances are considered likely, the application is subject to the requirement to operate in accordance with BAT.

This is not the end of the risk assessment, because we also take into account local factors (for example, particularly sensitive receptors nearby such as a SSSIs, SACs or SPAs). These additional factors may also lead us to include more stringent conditions than BAT.

If, as a result of reviewing of the risk assessment and taking account of any additional techniques that could be applied to limit emissions, we consider that emissions **would cause significant pollution**, we would refuse the Application.

8.2 Assessment of Impact on Air Quality

The Applicant's assessment of the impact of air quality is set out in Appendix C of the Application and in the response to a request for information, Supplementary Information Annex C 7.5.2 received on 27/08/2020. The assessment comprises:

- A screening assessment of emissions to air from the operation of the installation.
- Dispersion modelling of emissions to air from the operation of the installation.
- A study of the impact of emissions on nearby sensitive habitat / conservation sites.

This section of the decision document deals primarily with the dispersion modelling of emissions to air from the installation and its impact on local air quality.

Human Health Impact Assessment

The Applicant has assessed the Installation's potential emissions to air against the relevant air quality standards, and the potential impact upon local conservation and habitat sites and human health. These assessments predict the potential effects on local air quality from the Installation's stack emissions using the ADMS version 5.2 dispersion model, which is a commonly used computer model for regulatory dispersion modelling. The model used 5 years of meteorological data collected from the weather station at Robin Hood

Doncaster Airport between 2010 and 2014. This weather station is located approximately 20 km southwest of the site and the applicant states that this was chosen focusing on the surrounding land use, the surrounding terrain and relative proximity to the coast. Both the recording station and the proposed development are located inland and have similar surrounding land use, and similar flat terrain.

The operator's assessment considers the emissions associated with the operation of the site, both as a standalone installation as well as in combination with the existing Keadby I Power Station. The 'reasonable worst case' is the primary operational scenario (Scenario 1), and considers the Keady 2 variation operating continually throughout the year. Although Scenario 1 represents the 'reasonable worst case' and the basis for the permit variation application, other operating scenarios have been modelled as sensitivities to provide context for potentially more likely modes of operation. These are Scenarios 2a and 2b. To provide the necessary information for human health and ecological screening, Scenario 3 models Keady 1 operations and Scenario 4 models Keadby 1 and Keadby 2 cumulatively.

Furthermore, a sensitivity analysis of the model was carried out, observing four parameters
Scenario 5: Change of meteorological data: changed to Doncaster Airport 2015-2018;
Scenario 6: Change of meteorological data: changed to Humberside Airport 2017;
Scenario 7: Change dispersion site surface roughness to 0.2 (agricultural min); and
Scenario 8: Remove buildings.

See table below

Scenario	Keadby 1 Operation		Keadby 2 Operation		Comment
	Hours of operation/annum	Emission profile	Hours of operation/annum	Emission profile	
Scenario 1	0	N/A	8760	Emission limit as per permit variation application (Note 1)	Keadby 2 full time operations. 'Reasonable worst case'
Scenario 2a	0	N/A	6000	Emission limit as per permit variation application (Note 1)	Keadby 2 at various hours of operation
Scenario 2b	0	N/A	4000	Emission limit as per permit variation application (Note 1)	
Scenario 3	maximum annual hours 2016-2018 (Note 2, Note 3)	average of daily means 2016-2018 (Note 2)	0	N/A	For habitat screening (see *Section 4.4*)
Scenario 4	8760	maximum of daily means 2016-2018 (Note 2)	8760	Emission limit as per permit variation application (Note 1)	Cumulative short term impact
Scenario 5	0	N/A	8760	Emission limit as per permit variation application (Note 1)	Sensitivity test meteorological data Doncaster 2015-2018
Scenario 6	0	N/A	8760	Emission limit as per permit variation application (Note 1)	Sensitivity test meteorological data Humberside 2017
Scenario 7	0	N/A	8760	Emission limit as per permit variation application (Note 1)	Sensitivity test surface roughness
Scenario 8	0	N/A	8760	Emission limit as per permit variation application (Note 1)	Sensitivity test buildings

Note 1: See *Appendix A.2* for details
Note 2: Recorded values, no consideration of different emissions during start-up and shutdown has been made.
Note 3: The Environment Agency have advised that the impacts of Keadby 1 are identified during typical long term operations (ie actual hours of operation, and actual emissions). If these impacts are insignificant (ie Process Contribution less than 1% of the critical loads and critical levels), then Keadby 1 impacts do not need to be considered in combination with Keadby 2 impacts.

The following activities associated with emissions to air will be carried out within the Keadby 2 process to generate electrical power:

- combustion of natural gas in a gas turbine to directly generate electricity which is exported to the National Grid;
- release of combustion gases through a single stack.

This Air Quality Impact Assessment and Habitat Regulations Assessment (AQIA-HRA) considers the emissions associated with the operation of the variation (K2), both as a standalone installation as well as in combination with the existing Keadby I Power Station. As such, different scenarios (details presented above) have been modelled to gain and provide an understanding of the impacts associated with the operation of the Project within the context of its surroundings. As the variation entails a natural gas-fired combustion process, sulphur dioxide and particulate matter are not a material issue and will not be discussed further. The emissions of interest are oxides of nitrogen (NOx) and associated nitrogen dioxide (NO2) and ammonia (slippage from the use of Selective Catalytic Reduction (SCR)).

These emissions will result in impacts primarily on:

- Human health, through increase of ambient concentrations of:

- NO2; and NH3;

- Sensitive ecology through increased levels/loads of:

- Ambient NOx; Ambient NH3; Nutrient nitrogen deposition; and Acid deposition.

<u>Impacts on Human Health.</u>
The protection of sensitive human receptors is regulated through the following: Air Quality Standards imposed in UK law1 transposed from EU standards2; and Environmental Assessment Levels set out by the Environment Agency known as Air Quality standards. (AQS).

Assessment Criteria for Sensitive Human Receptors

The Air Quality Standards of relevance for this assessment are set out in the table below (As the Project will be operated for more than 3000 hours per year, both short-term and long-term air quality standards have been assessed).

Applicability	Pollutant	Averaging period	Assessment Criterion (µg/m^3)	Percentile
Sensitive Human Receptor	NO_2	1-hour mean, not to be exceeded more than 18 times per year	200	99.79th
		Annual mean	40	N/A
	NH_3	1-hour maximum	2500	N/A
		Annual mean	180	N/A

Significance criteria used;-

The impacts of the emissions from the Keadby 2 Project are assessed on the basis of the: Process Contribution (PC); and Predicted Environmental Concentration (PEC), the PEC being the Process Contribution (PC) added to the baseline.

Site Designation	PC, as % of AQS or CL	PEC, as % of AQS or CL	Significance
Sensitive Human Receptors			
Short Term	<10%		Insignificant
	>10%	<100%	Significant, but AQS not exceeded
	>10%	>100%	Significant, AQS exceeded
Long Term	<1%		Insignificant
	>1%	<100%	Significant, but AQS not exceeded
	>1%	>100%	Significant, AQS exceeded

The PC is now considered in the more general context of the PEC to allow for more flexible evaluation of impacts. Where the PEC exceeds the AQS, this is taken as a threshold for the potential for significant impacts.

Air Quality Monitoring and Background Concentrations

The below table sets out the baseline pollution data used in the study.

Pollutant	Annual mean AQS ($\mu g/m^3$)	Baseline concentration ($\mu g/m^3$)
NO_2	40	21.1
NH_3	180	2.32

(In order to assess short term impacts, the short term baseline concentrations have been derived by multiplying the long term derived baseline by a factor of 2)

The full Air Quality Assessment of the Impacts on Human health can be seen within the application documents and have therefore not been repeated here.

In summary:-
The operations of Keadby 2 are not predicted to result in air quality standards being exceeded for NO2 or ammonia. Whilst impacts cannot be screened out as insignificant, the impacts are a small percentage of the air quality standards. Due to the low baseline, air quality standards are not approached. When Keadby 2 operates with Keadby 1, no air quality standards are predicted to be exceeded. Indeed, the cumulative NO2 1 hour mean is <25% of the air quality standard. On this basis, there are no unacceptable impacts associated with the operation of Keadby 2 alone or when operating with Keadby 1. The Environment Agency is in agreement with this conclusion.

8.3 Impacts on designated sites

This section provides an overview of the approach and methodology of the assessment of air emissions on sites designated for their European, national and local importance. The assessment of effects on European designated sites and National and Local designated sites is summarised below with the full detailed assessment from the Operator and the Agency audit of that

assessment along with the Habitats Regulation Assessment (HRAS) forms are stored on EDRM.

The approach to the HRA follows the guidance produced by Defra / Environment Agency on screening risks from air emissions on protected areas for nature conservation.

The process comprises four main stages:
Stage 1 Screening to identify the likely effects of a project on a European Site and consider whether the effects are likely to be significant;
Stage 2 Appropriate Assessment to determine whether the integrity of the European site will be adversely affected by the project;
Stage 3 Assessment of Alternative Solutions to establish if there are any that will result in a lesser effect on the European site; and
Stage 4 Imperative Reasons of Overriding Public Interest (IROPI) and Compensatory Measures to establish whether it is necessary for the project to proceed despite the effects on the European site, and to confirm that necessary compensatory measures are in place to maintain the coherence of the Natura 2000 network.

The key issues raised are listed below.
The assessment should be based on a Reasonable Worst Case (RWC) operating scenario.
Account should be taken of designated habitats and species:

within 10 km of the Keadby site for European protected sites and species;
Thorne Moor SAC;
Humber Estuary SAC;
Thorne & Hatfield Moors SPA
Humber Estuary SPA; and
Humber Estuary Ramsar

within 2 km for Sites of Special Scientific Interest (SSSIs);
Humber Estuary SSSI.

Within 2 km for Local Wildlife Sites (LWS)1;
Keadby Wet Grassland;
Keadby Wetland;
Gunness Common;
Keadby Power Station;
Keadby Warping Drain;
Keadby Boundary Drain;
Paupers' Drain
Stainforth and Keadby Canal Corridor;
South Engine Drain, Belton;
North Engine Drain, Belton;
Three Rivers;
South Soak Drain, Keadby;
Three Rivers Marsh;
River Torne; and

Hatfield Waste Drain.

Within 500 m for protected habitats and species:
coastal saltmarsh; migratory routes for smelt, European eel, Atlantic salmon, twaite shad, alis shad, river and sea lampreys; and water vole.

In a response to written questions, Natural England provided the advice listed below
Confirmed that 3 µg/m^3 was the appropriate critical level to use to assess the effects of ammonia on the Humber Estuary SAC/SSSI. Where no critical loads are provided in APIS for invertebrates and mixed habitats at Hatfield Moors SSSI, use the most precautionary critical load (*ie* 5 kg N ha-1 Yr-1 used for assessing the bog interest features). Use 1 µg/m^3 as the critical level for ammonia for Messingham Sand Quarry SSSI as the site supports a species-rich bryophyte community. U1a is SSSI feature on the Risby Warren SSSI, and the main reason that it is no longer present is due to air pollution, so a precautionary critical level of 1 µg/m^3 should be used for ammonia. Assessment should use the critical levels and loads on APIS for Tuetoes Hill SSSI. Lichens and bryophytes are present on the site, so a critical level of 1 µg/m^3 should be used for ammonia.

Critical Levels and Loads
The critical levels and loads, used as tools for helping to assess the risk of effects of air pollution, were also obtained from APIS. The critical level is the gaseous concentration of a pollutant in the air, and the critical load relates to the quantity of pollutant deposited from air to the ground. Effects resulting from nitrogen and acid deposition have been assessed on a habitat and species specific approach against critical loads listed in APIS.
Critical levels (*e.g.* for the effects of NOx and NH3) have been assessed against environmental standards that apply either across all habitat types (*e.g.* NOx), or across lichens /bryophytes and vascular plants (*e.g.* NH3) as follows.

- NOx (all habitats) 30 µg/m^3 (annual mean) / 75 µg/m^3 (24 hr mean)
- NH3 (lichens / bryophytes) 1 µg/m^3 (annual mean); and
  NH3 (other vegetation) 3 µg/m^3 (annual mean).

The recent guidance by IAQM (2019) does, however, suggest that 200 µg/m^3 is in fact a more appropriate critical level for short-term NOx than the usual level of 75 µg/m^3. The lower critical level is more applicable when SO2 and ozone concentrations are high, but in the UK, SO2 and ozone concentrations are low typically.

<u>Screening Methodology - European Sites</u>
The screening assessment followed the approach set out below.
Modelling to predict the short and long-term Process Contributions (PC) against the respective environmental standards4. For each site PCs were categorised as **insignificant** where they were:

< 10% of the short-term environmental standard; and
< 1% of the long-term environmental standard.

In terms of nutrient and acid deposition, the most sensitive habitat type amongst the qualifying interest features was selected. If the effects on this habitat type were found to be insignificant, it was assumed that effects on other qualifying features, with less stringent critical loads, would also be insignificant.

Account was taken at this stage of the sensitivity of fauna species to potential effects on their supporting habitat. For example, European nightjar (*Caprimulgus europaeus*) is the qualifying interest feature at the Thorne and Hatfield Moors SPA. Its supporting habitat comprises coniferous woodland and dwarf shrub heath. The minimum figure of the critical load range for effects of deposited nitrogen is more sensitive for the coniferous woodland (5 kg N-1ha-1yr-1) than the dwarf shrub heath (10 kg N-1ha-1yr-1). However, APIS reports that European nightjar is not sensitive to effects on the coniferous woodland. Hence the screening has assessed the modelled PC predications against the critical load for dwarf shrub heath, rather than the coniferous woodland.

Where the most sensitive qualifying interest feature could not be screened out, the PCs were predicted at other less sensitive habitats to confirm if they were less than 1% / 10% of the critical load (min) respectively. Where qualifying interest features were only present in locations where they would clearly not be affected (*e.g.* sand dunes of the Humber Estuary European sites – nearest at approximately 47km from the stack and coastal lagoon over 50km away), they were excluded from consideration. Where there are no identified critical loads on APIS, a view was taken on how likely the feature was to be affected. In the case of water based features (*e.g.* mudflats and sand flats not covered by water at low tide and lamprey species, both qualifying interest features of the Humber Estuary SAC), the nutrient nitrogen will be influenced predominantly by water based nutrient loadings and agricultural run-off rather than from air emissions. Hence the effects of deposited nitrogen from air emissions was assessed as not applicable to these species, and screened out. The effects of pollutant types from Keadby 1 on the designated sites were considered, and only those pollutants that were not insignificant were then considered further in-combination with Keadby 2.

<u>Appropriate Assessment Methodology – European Sites</u>

Where sites could not be screened out, further consideration was given to whether adverse effects on the integrity of the sites was likely. This took account of the factors listed below.

- The extent to which the PC was greater than 1% of the critical level / load. There are no published criteria to determine whether a PC>1% will result in an adverse effect.
- The background level of each pollutant and the Predicted Environmental Concentration (PEC) (*i.e.* PC + background) and whether the background levels/loads were sufficiently low to accommodate the predicted PC loads. There are no published criteria to determine whether a PEC of any level will be insignificant, or result in an adverse effect.

- The extent of the designated area affected by PCs >1% and the variability in the occurrence of PCs >1% over that area.
- The sensitivity within a habitat type. For example, saltmarsh that is exposed for longer periods (*e.g.* mature upper saltmarsh) is likely to be more sensitive to effects from pollutant concentrations in the air than those parts of the saltmarsh that are subject to regular inundation by water (*e.g.* lower to middle saltmarsh).
- Whether the levels/loads predicted for the Reasonable Worst Case (RWC) (8760 hours of operation) would occur. Consideration was given to the predicted levels / loads from other scenarios, for example with operating hours reduced to 6000 hours and 4000 hours.
- The effects of Keadby 2 with Keadby 1 for short-term NOx (*i.e.* 24 hrs) were considered incombination.

EUROPEAN DESIGNATED SITES ASSESSMENT

The European sites included in this assessment are:
Humber Estuary SAC, SPA and Ramsar;
Thorne Moor SAC;
Hatfield Moor SAC; and
Thorne and Hatfield Moor SPA.

The qualifying features for each site are summarised, with links provided for further information in the relevant site citations and conservation objectives within the application see Air Quality Impact Assessment and Habitat Regulations Assessment, 29/11/2019.

Screening Assessment Summary
The predicted PCs for all the pollutant types on the Humber Estuary SPA, Thorne Moor SAC, Hatfield Moor SAC and Thorne and Hatfield Moors SPA are predicted to be insignificant. Hence no likely significant effects on these European sites are predicted and no further assessment is required. The data to sit along with this summary can be found in Air Quality Impact Assessment and Habitat Regulations Assessment, 29/11/2019.

The assessment has shown that the Humber Estuary SAC / Ramsar site is the only European site that cannot be screened out for the effects of air pollutants. The qualifying features of the Humber Estuary SAC affected by PCs exceeding the critical levels / loads by ≥1% comprise estuaries, Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) and *Salicornia* and other annuals colonizing mud and sand. The habitats of importance to this assessment of those features are saltmarshes (pioneer, low-mid and mid-upper). The PCs of long - term NOx, ammonia levels and deposited nitrogen are predicted to result in levels / loads that are > 1% of the critical levels / loads and short-term NOx levels are predicted also to be > 10% of the critical levels. The effects on these saltmarshes have been considered further as part of the Appropriate Assessment. Other qualifying interest features / habitats have been excluded from the assessment (*e.g.* due to their location, lack of

sensitivity, likely insignificance of effects from air emissions compared with water borne/agricultural sources especially in the river/tidal areas).

In-combination Effects - Screening

Combined levels and loads were calculated at the designated sites for which the predicted levels/loads of NOx, nitrogen deposition and acid deposition for Keadby 2 alone were not insignificant. Short-term NOx levels (i.e. 24 hrs) at the Humber Estuary SAC (and SSSI) exceeded the thresholds, with a PC of 60% of the critical level. Long-term NOx levels (i.e. annual) at the Humber Estuary SAC (and SSSI) exceeded the thresholds, with a PC of 4.6% of the critical level. The results are shown below

Predicted PC's NOx and percentage of critical level K1 &K2 cumulative.

Designated Site	*AIRBORNE POLLUTANTS*				
	Baseline ($\mu g\ m^{-3}$)	EAL ($\mu g\ m^{-3}$)	PC ($\mu g\ m^{-3}$)	PC/EAL (%)	PEC/CL (%)
Annual NOx					
Humber Estuary (SAC, Ramsar)	15.4	30	1.38	4.6%	56%
24 hour NOx					
Humber Estuary (SAC, Ramsar)	30.8	75	45.27	60.4%	101.5%

Appropriate Assessment

This section focuses on the effects of the NOx (annual mean, 24 hour), ammonia and deposited nitrogen on the Humber Estuary SAC. It describes the reasons why adverse effects are not predicted on the European sites.

Effects of NOx

Despite the predicted long-term PC levels of NOx exceeding 1% of the critical level, there are a number of reasons listed below, why an adverse effect on the Humber Estuary SAC / Ramsar site is not predicted. The area of the European site affected by NOx is dependent on the habitats exposed to air. The area of saltmarsh affected by the predicted PC levels > 1% of the critical level long-term (annual mean) is approximately 47 ha and comprises only a small proportion (approximately 6%) of the overall area of saltmarsh of the Humber Estuary SAC (over 800 ha). As not all of this saltmarsh will be affected (see below), the actual area / percentage affected is expected to be much less than this. The areas affected by the short–term (24 hour) NOx predictions is only approximately 16 ha (*i.e.* approximately 2%), although again taking account of the saltmarsh zones, the actual area / percentage is expected to be much lower. Not all the saltmarsh will be affected as greatly by NOx in the air. It is likely that effects would be greatest to the upper saltmarsh that is more exposed to the air and less frequently inundated by seawater. A detailed breakdown of the extent of upper saltmarsh is not readily available. Within the area affected, the majority of the long-term PCs are predicted to be between 1 and 1.3% of the critical level (*i.e.* only marginally over the 1% insignificance threshold). Slightly higher PCs of approximately 2-3% of the critical level are more localised and closer to the source (immediately E and

NE of the source). A similar effect is predicted for the short-term 24 hour NOx values. The predicted PCs are based on the RWC (8760 hours of operation). In practice it is unlikely that the operating hours of the plant will achieve those set out in the RWC. It is clear from the predicted PCs for other operating scenarios that the extent to which the PC exceeds 1% of the critical level (annual mean), reduces as the operating hours reduce and will be much closer to 1% of the critical level. The background NOx levels are also low, such that the PEC for the annual mean is around 55% of the critical level and for the 24 hour period is around 66%. It is likely that the saltmarsh can, therefore, accommodate some small increases in NOx levels without adverse effects. The reduction in long-term PC values, if the operating hours are reduced, are reflected in the reductions in the PECs.

<u>Predicted PC's NOx as percentage of the Critical Load for Reasonable Worst Case and other scenarios.</u>

European Site	Baseline NOx (µg m^{-3})	Critical Level (µg m^{-3})	PC (µg m^{-3}) RWC (8760 hrs)	PC /PEC as % of Critical Level RWC (8760 hrs)		PC/PEC as % of Critical Level (6000 hrs)		PC/PEC as % of Critical Level (4000 hrs)	
NOx AM				PC	PEC	PC	PEC	PC	PEC
Humber Estuary (SAC, Ramsar)	15.60	30	0.86	2.9	55	2.0	54	1.3	53
NOx 24hr									
Humber Estuary (SAC, Ramsar)	31.2	75	18.29	24.4	66	24.4	66	24.4	66

Given the above the Environment Agency required more information from the Operator re any likely impacts and was asked to provide more evidence as to why they had concluded that Short-term NOx was unlikely to cause significant pollution, see below

Short-term NOx (24hrs) – Supplementary Information August 2020

Adding the PC for short-term NOx (24 hrs) (60%) to the background at the Humber Estuary gives a PEC of 101.5%. This is, however, an extreme worst case that is only predicted under the following unique circumstances:

- Only when Keadby 1 and Keadby 2 operate 24 hour continuously and simultaneously (highly unlikely based on historical operational profiles for Keadby 1 and expected mode of operation for Keadby 2)
- Only when Keadby 1 is operating at the maximum emissions on both turbines recorded in the last 3 years

- The model only predicts this result for 1 single day in 9 years of meteorological data (0.03% of the modelled days)
- Even then, it occurs at only 1 grid point, representing at most 100 x 100m of the Humber Estuary (receptor grid location: 483575, 411929) where there may or may not be sensitive features present.

All other meteorological days modelled, i.e. 99.97% of the time, have a PEC of <100%. The model assesses against the critical level for short-term NOx of 75 µg/m^3. Recent guidance by IAQM (2019) does, however, suggest that 200 µg/m^3 is in fact a more appropriate. The lower critical level is more applicable when SO_2 and ozone concentrations are high, but in the UK, SO_2 and ozone concentrations are low typically. The predicted effects are therefore, again, a conservative estimate.

Baseline data update

During the period between submission of the permit application (Dec 2019) and the date of this supplementary submission, SSE has initiated baseline monitoring of ambient levels of oxides of nitrogen (NOx) in the vicinity of the existing Keadby 1 power station. The baseline monitoring is a requirement of the Section 36 development consent that authorises the construction of the Keadby 2 power station, not as a result of the permit application, however the results are relevant to the permit application. The ambient NOx monitoring has been undertaken at a riverside location approximately 200m upriver from the point of the predicted maximum impact set out in Section 7.5.2 of Annex C (see above for original text). The monitoring has been undertaken using an automatic monitor and diffusion tubes. The baseline monitoring commenced in February 2020 for a 12 month period. Two months of diffusion tube data are available for February and March, after which the diffusion tube survey was paused due to Covid-19. The automatic monitoring has been continued and data is available from 05 February to 08 August 2020.

A summary of the results to date:

- Diffusion tube monitoring, average for February and March: NOx: 10.7 µg/m^3
- Automatic monitoring, average from February to March: NOx: 11.9 µg/m^3
- Automatic monitoring, average from February to August: NOx: 10.7 µg/m^3

The long term NOx data is doubled in line with EA guidelines to derive the short term baseline. On the basis of the average from February and March which will be representative of the pre-Covid baseline, this results in a 24 hour baseline value of 22.6 µg/m^3. This compares with the original modelling assumed baseline of 30.8 µg/m^3, derived from the APIS database. The measured data is considered more representative of a local specific baseline than the APIS database which can only provide regional baseline data. Using the measured baseline data, the PEC from the combined Keadby 1 and Keadby 2 short term NOx maximum predicted impacts are therefore now below 100% of the Critical Level for the Humber Estuary SAC and SSSI for all of the modelled meteorological days.

Habitat update

Notwithstanding the updated baseline information above, 'the Environment Agency carried out further analysis using mapping systems to establish the distribution of habitat which supports the decision concluded above further information is provided on the habitats present at the modelled location of predicted maximum short term NOx impact (Keadby 1 and 2 in combination). A large proportion of the habitat affected by short term NOx concentrations in the 100 m x 100 m square lie outwith the Humber Estuary SAC (e.g. residential properties and gardens, roads and other hard standing, grassed flood embankments along the River Trent). Even inside the SAC boundary, much of the habitat comprises open water of the River Trent and this is not of concern regarding NOx. Typical saltmarsh communities habitats (i.e. pioneer and low, mid and upper) are scarce along the Humber Estuary SAC/Ramsar/SSSI site, comprising <1% of the total estuarine area. Over half the saltmarsh community on the Humber is dominated by *Phragmites australis* (common reed) and *Scirpus martimus* (sea club-rush), typically occurring at high water mark. As recorded by Natural England[1], the tidal marsh ommunity in inner part of the estuary from Trent Falls to the King George V Bridge at Gunness along the River Trent is dominated by these species with *Elymus repens* (couch grass) and account for > 50% of the total tidal vegetation in this part of the inner estuary. Photographs taken at the central point of the 100 m x 100 m square show evidence of only a narrow strip of common reeds at the base of the river embankment and a similarly narrow area of exposed mud at low tide. Common reed is a species that readily uptakes nitrogen and is known to be able to survive in both low and high nutrient environments. It is also a species that is used often in constructed wetlands to remove nitrogen from aquatic systems. The likelihood of detrimental impact at the location to designated saltmarsh communities is therefore considered extremely low.

Effects of Ammonia

Despite the predicted PC levels of ammonia exceeding 1% of the critical level and the high background levels, there are a number of reasons listed below, why an adverse effect on the Humber Estuary SAC / Ramsar site is not predicted. Many are similar to those described above for NOx.

- The area of saltmarsh affected by PC levels > 1% of the critical level comprises approximately 63ha (*ie* approximately 8% of the overall area of saltmarsh of the Humber Estuary SAC). Again, the actual areas are likely to be much less due the smaller areas of upper saltmarsh likely to be present.
- Not all the saltmarsh will be affected as greatly by NH3 in the air. As with NOx, it is likely that effects would be greatest to the upper saltmarsh that is more exposed to the air and less frequently inundated by seawater. Only a proportion of the saltmarsh present is expected to be upper saltmarsh (approximately 37 ha is above high water mark1) and hence the actual area most affected is likely to be even smaller than that stated above.

- Within the area affected, the majority of the PCs are predicted to be between 1 and 1.5% of the critical level (*i.e.* only marginally over the 1% insignificance threshold). Slightly higher PCs of approximately 2-3% of the critical level are more localised and closer to the source (immediately E and NE of the source).
- The predicted PCs are based on the RWC (8760 hours of operation). In practice it is unlikely that the operating hours of the plant will achieve those set out in the RWC It is clear from the predicted PCs for other operating scenarios that the extent to which the PC exceeds 1% of the critical level, reduces as the operating hours reduce and will be much closer to 1% of the critical level.
- The background NH3 levels are relatively high (likely to be influenced by emissions from other industrial sources and agricultural activities), such that the PEC is predicted to be around 96% of the critical load, although NOx are predicted to decrease slightly if the operating hours were less than the RWC.

<u>Predicted PC's NH3 as percentage of Critical Load for RWC and other scenarios.</u>

European Site	Baseline NH_3 (µg m^{-3})	Critical Level (µg m^{-3})	PC (µg m^{-3}) RWC (8760 hrs)	PC /PEC as % of Critical Level RWC (8760 hrs)		PC/PEC as % of Critical Level (6000 hrs)		PC/PEC as % of Critical Level (4000 hrs)	
				PC	PEC	PC	PEC	PC	PEC
Humber Estuary (SAC, Ramsar)	2.8	3	0.1	3.2	96	2.2	95	1.5	94

Effects of Deposited Nitrogen

Despite the predicted PC loads of deposited nitrogen exceeding 1% of the critical load and the high background loads, there are a number of reasons listed below, why an adverse effect on the Humber Estuary SAC / Ramsar site is not predicted. Many are similar to those described above for NOx and ammonia.

- The area of saltmarsh affected by PC levels >1% of the critical load, comprises approximately 49 ha (ie approximately 6% of the overall area of saltmarsh of the Humber Estuary SAC).
- Not all the saltmarsh will be affected as greatly by deposited nitrogen. In respect of saltmarsh, APIS states that: "Overall N deposition is likely to be of low importance for these systems as the inputs are probably significantly below the large nutrient loadings from river and tidal inputs. Recent review by Boorman & Hazelden (2012) suggests that the pioneer and low – mid saltmarsh areas are more resilient to N deposition than the mature upper areas. Any effects on N deposition are likely to found in the tall vegetation of the closed upper saltmarsh

communities where interspecific competition is greatest. These more mature areas may also be subject to direct run-off from the surrounding catchment".1

- Only a proportion of the saltmarsh present is expected to be upper saltmarsh and hence the actual area most affected is likely to be even smaller than that stated above.
- Within the area affected, the majority of the PCs are predicted to be between 1 and 1.5% of the critical level (*ie* only marginally over the 1% insignificance threshold) based on the minimum critical load Appendix C). Slightly higher PCs of approximately 2-3% of the critical level are more localised and closer to the source (immediately E and NE of the source). These percentages decrease when compared with the maximum critical loads (*ie* decreases from 2.9% to 2% for the RWC, and to 2.3% (6000 hours) and 1.3% (4000 hours) against the minimum critical load).
- The predicted PCs are based on the RWC (8760 hours of operation). In practice it is unlikely that the operating hours of the plant will achieve those set out in the RWC (8760 hours of operation). It is clear from the predicted PCs for other operating scenarios that the extent to which the PC exceeds 1% of the critical load, reduces as the operating hours reduce and will be much closer to 1% of the critical load.
- The background nutrient nitrogen loads are relatively high (likely to be influenced by water based loading (river and tidal) and those from agricultural activities), such that the PEC is predicted to be around 124% of the critical load (min), although this is predicted to reduce if the operating hours were less than the RWC.

<u>Predicted PC's Deposited Nitrogen and percentages of critical loads for Reasonable Worst Case and other scenarios</u>

European Site	Background Nitrogen Deposition (kg N / ha / yr)	Critical Load (kg N / ha / yr)		PC (kg N / ha / yr) RWC	PC as % of Critical Load (RWC 8760 Hrs)		PEC as % of Critical Load RWC (8760 hrs)		PC as % of Critical Load (6000 Hrs)	PC as % of Critical Load (4000 Hrs)
		Min	Max		Min	Max	Min	Max	Min	Min
Humber Estuary (SAC, Ramsar)	15.5	20[1]	30	0.58	2.9	2	80	54	2	1.3

1 The relevant critical load range of all these qualifying interest features for the Humber Estuary SAC / Ramsar is that for pioneer, low-mid and mid-upper saltmarshes.

European sites – summary of Appropriate Assessment

The background levels of ammonia and loads of nutrient nitrogen at the Humber Estuary SAC are already high largely as a result of agricultural practices and hence there is little capacity for increased PC levels to be accommodated. In contrast background NOx levels are low and the PECs are

likely to be able to accommodate the PC increases. Whilst the PCs for long-term effects still exceed 1% of the critical levels / loads, there are a number of reasons (listed below) why they are more likely to be close to 1% and why adverse effects on the Humber Estuary SAC are predicted to be unlikely.

- The small areas of saltmarsh affected, especially areas of upper saltmarsh that will be most susceptible to effects.
- The small exceedances of the 1% thresholds. The majority of the area affected is by levels /loads of 1–1.5% > critical level / load, with only very localised areas (immediately E and NE of the Keadby Power Station site) affected by percentages of 2-3%.
- For nitrogen deposition, these percentages are based on the more precautionary minimum critical load, and they will be lower still if compared with the maximum critical loads of the range.
- The predicted PCs and associated percentages have been based on a RWC (8760 hrs a year). In practice it is likely that the operating hours will be lower than this, and hence the percentages will be lower.
- The modelled predictions are likely to be an overestimate based on the meteorological data used, especially the short-term predictions. Hence the levels / loads are likely to be less than those shown (*ie* closer still to 1% of the critical levels / loads).

National and Locally designated sites Assessment

Assessment Approach – National and Local Sites

The approach to assessing the effects of the air emissions on nationally and locally important sites for nature conservation followed a similar approach to that described for the European sites. For the nationally important sites (*eg* Sites of Special Scientific Interest (SSSI)), the approach to determine whether the predicted PCs were insignificant or needed further assessment, mirrored that of the European sites. Locally important sites (*eg* Local Wildlife Sites (LWS), Sites of Nature conservation Importance (SNCI), Ancient Woodland) were identified within a 2 km radius around the emission source and the PC's were regarded as significant if they were < 100% of the long and short-term standards.

Assessment of National sites

The Operator identified 23 SSSI's within 15km, the Operator assessed all of the sites, the below text summaries the assessment.

The predicted PCs for long-term (annual mean) and short–term (24 hour) NOx shows that the PC is greater than 1% of the critical level only at the Humber Estuary SSSI (for both annual mean and 24 hour NOx), and levels are insignificant at the other SSSIs.

Predicted PCs NOx as Percentage of Critical Load for RWC and Other Scenarios – Humber Estuary SSSI

National Site (SSSI)	Baseline NOx (µg m^{-3})	Critical Level (µg m^{-3})	PC (µg m^{-3}) RWC (8760 hrs)	PC /PEC as % of Critical Level RWC (8760 hrs)		PC/PEC as % of Critical Level (6000 hrs)		PC/PEC as % of Critical Level (4000 hrs)	
NOx AM				PC	PEC	PC	PEC	PC	PEC
Humber Estuary	15.6	30	0.9	2.9	55	2.0	54	1.3	53
NOx 24hr									
Humber Estuary	31.2	75	18.3	24.4	66	24.4	66	24.4	66

PCs and subsequent PECs for the Humber Estuary for the RWC and examples of the effects of lower operating hours compared with RWC. The habitat affected is again is saltmarsh, but significant effects are not predicted based on the same rationale as that described for the effects on the European designations of the Humber Estuary.

Effects of Ammonia on National sites.

The critical levels listed are based on the presence of lichens / bryophytes or other vegetation as listed in APIS. This data shows that PCs greater than 1% of the critical level are predicted at 12 SSSIs. However, at all but one site (the Humber Estuary SSSI) the percentage is between 1 and 1.6%, and at the vast majority of the sites (nine), the percentages are only marginally over the 1% threshold (*ie* between 1 and 1.2%). Levels >1% of the critical level do not affect all parts of some of the sites. These percentages decrease further when the operating hours below the RWC are assessed such that by 6000 hours, the predicted PCs at all sites, except the Humber Estuary, are either 1 or 1.1%, or are insignificant.

Predicted PCs NH3 as Percentage of Critical Load for RWC and Other Scenarios

National Site (SSSI)	Baseline NH_3 (µg m^{-3})	Critical Level (µg m^{-3})	PC (µg m^{-3}) RWC (8760 hrs)	PC /PEC as % of Critical Level RWC (8760 hrs)		PC/PEC as % of Critical Level (6000 hrs)		PC/PEC as % of Critical Level (4000 hrs)	
				PC	PEC	PC	PEC	PC	PEC
Broughton Alder Woodl	2.8	1	0.01	1.0	284	0.7	-	0.5	-
Broughton Far Wood	2.5	1	0.01	1.1	246	0.7	-	0.5	-
Crowle Borrow Pits	1.9	1	0.01	1.0	194	0.7	-	0.5	-
Humber Estuary	2.8	3	0.01	3.2	96	2.2	95	1.5	94

Manton and Twigmoor	1.8	1	0.01	1.0	179	0.7	-	0.5	-
Messingham Heathl	2.3	1	0.01	1.6	228	1.1	227	0.8	-
Messingham Sand Quarry	1.7	1	0.01	1.0	173	0.7	-	0.5	-
Risby Warren	2.1	1	0.01	1.5	213	1.0	213	0.7	-
Scotton and Laughton Forest Ponds	2.3	1	0.01	1.1	227	0.8	-	0.5	-
Scotton Beck Fields	1.8	1	0.01	1.2	184	0.9	-	0.5	-
Scotton Common	1.8	1	0.01	1.1	184	0.7	-	0.5	-
Tuetoes Hills	1.6	1	0.01	1.1	163	0.8	-	0.5	-

Effects of Deposited Nitrogen on National Sites

The data shows that the predicted PCs for deposited nitrogen are ≥1% of the critical load (minimum) for 10 of the SSSIs. However, with the exception of the Humber Estuary SSSI, all are only marginally over the 1% (*ie* the greatest percentage is only 1.3% compared with the minimum critical load, and are insignificant when compared with the maximum critical load. These percentages decrease further when operating hours below the RWC are assessed and it is likely that the predicted PCs at all sites except the Humber Estuary will be insignificant.

At the Humber Estuary SSSI, the habitat affected is again saltmarsh and significant effects on the saltmarsh and the SSSI are not predicted based on the same rationale as that described for the effects on the European designations of the Humber Estuary.

For sites with more than one qualifying interest feature, where the features with the worst case critical loads were ≥1% of the critical load (min), a check was undertaken against other site features to assess whether they too were affected. However, in all cases, the effects at other features were found to be insignificant. The loads are insignificant at the other 13 SSSIs against both the minimum and maximum critical loads.

Two SSSIs Listed below have been excluded from the table.

- **Broughton Alder Wood**, as APIS states that the broad-leaved, mixed and yew woodland (*Alnus glutinosa - Fraxinus excelsior - Lysimachia nemorum* woodland) is not sensitive to deposited nitrogen.
- **Hatfield Chase Ditches** as the site has no sensitive features, or associated critical loads for nitrogen or acid deposition on APIS. The SSSI citation state's the designated features as standing water and canals with aquatic plant species including pondweeds and duckweeds, emergent reedbed and banks of common grasses and

herbs. As the site's designated features are predominantly based on aquatic biodiversity, the main influences are likely to be from agricultural activities, rather than from nitrogen and acid deposition from the Project's air emissions, and effects from deposited nitrogen are assessed as insignificant.

Effects of Acid Deposition on National Sites

The data shows that effects on the SSSIs sites are insignificant at all sites except Messingham Heath and Scotton and Laughton Forest Ponds. Even at these sites the predicted PCs as a percentage of the low range of the critical loads are only 1.2 and 1% respectively for the RWC, and for the high range the figure for Scotton and Laughton Forest Ponds is <1% (ie insignificant). These percentages decrease further when the operating hours below the RWC are assessed and are likely to be insignificant at both sites Broughton Alder Wood, has been excluded from as APIS states that the broad-leaved, mixed and yew woodland (*Alnus glutinosa - Fraxinus excelsior - Lysimachia nemorum* woodland) is not sensitive to acid deposition.

Predicted PC's Acid deposition and percentages of critical loads for RWC and other scenarios.

National Site (SSSI)	Qualifying Interest Feature	N PC Total (kg eq / ha / yr)	PC total as % of Critical Load Total (RWC 8760 hrs)		PEC as % or Critical Load (Min)	PC total as % of Critical Load (Min) Total (8000 hrs)	PC total as % of Critical Load (Min) Total (4000 hrs)
			Low Range	High Range			
Messingham Heath	Acid grassland (*Festuca ovina - Agrostis capillaris - Rumex acetosella* grassland)	0.007	1.2	1.2	316	0.9	0.6
Scotton and Laughton Forest Ponds	Fen, marsh and swamp (*Carex rostrata - Sphagnum squarrosum* mire)	0.005	1.0	0.9	363	0.7	0.5

Summary of Effects on National Sites

The main national site affected by the air emissions is the Humber Estuary SSSI where PCs predicted for the RWC exceed the 1% threshold for NOx (long-term annual mean) and exceed the 10% threshold (short-term 24 hours), ammonia and deposited nitrogen. Whilst the PCs at the Humber Estuary SSSI still exceed 1% of the critical levels / loads, there are a number of reasons (listed below) why they are more likely to be close to 1% and why significant effects from NOx are not predicted.

These mirror those for the Humber Estuary European sites:-

- The small areas of saltmarsh affected, especially areas of upper saltmarsh that will be most susceptible to effects.
- The small exceedances of the 1% thresholds for long-term effects. The majority of the area affected is by levels / loads of 1–1.5% > critical

level / load, with only very localised areas (immediately E and NE of the Keadby Power Station site) affected by percentages of 2 - 3%.

- For nitrogen deposition, the higher percentages are based on the more precautionary comparison with minimum critical load, and they are lower when compared with the maximum critical loads of the range.
- The predicted PCs and associated percentages have been based on a RWC (8760 hrs a year). In practice it is likely that the operating hours will be lower than this, and hence the percentages will decrease.

PCs predicted at other SSSIs are largely insignificant, or very close to 1% for the RWC (ie between 1 and 1.2%), and for nitrogen deposition all are insignificant if compared with the maximum critical load. This combined with the likelihood of operating hours being lower than the RWC, means that significant effects on the other SSSIs are not predicted. The cumulative effect of long-term NOx (annual) and short term NOx (24 hours) on the Humber Estuary SSSI is as discussed above in relation to the Humber Estuary SAC as both the Humber Estuary SAC and SSSI refers to the same saltmarsh habitat area extent in this assessment.

Assessment of Effects on Local Sites

This section summarises the predicted effects of the air emissions on local sites.

Effect of NOx and Ammonia on Local Sites

The data shows that the PCs at all of the sites are <100% of the critical level and hence are insignificant.

Predicted PCs NOx and Percentages of Critical Level – National Sites

Local Site	Baseline NOx (µg m^{-3})	Critical Level (µg m^{-3})	PC (µg m^{-3})	PC as % of Critical Level
NOx AM				
Keadby Wet Grassland LWS	18.8	30	0.2	0.7
Keadby Wetland LWS	18.7	30	0.05	0.2
South Soak Drain, Keadby LWS	18.8	30	0.01	0.03
Stainforth and Keadby Canal Corridor LWS	18.7	30	0.4	1.2
Three Rivers LWS	16.7	30	0.3	1.0
Three Rivers Marsh SNCI	18.8	30	0.2	0.7

NOx 24hr				
Keadby Boundary Drain LWS	32.6	75	7.3	9.7
Keadby Power Station SNCI	37.5	75	3.2	4.3
Keadby Warping Drain LWS	32.9	75	32.9	43.8
Keadby Wet Grassland LWS	37.5	75	15.9	21.3
Keadby Wetland LWS	37.4	75	4.8	6.4
South Soak Drain, Keadby LWS	37.5	75	0.6	0.8
Stainforth and Keadby Canal Corridor LWS	37.4	75	9.8	13.0
Three Rivers LWS	33.3	75	20.0	26.7
Three Rivers Marsh SNCI	37.5	75	8.6	11.5

Predicted PCs Ammonia and Percentage of Critical Level

Local Site	Baseline NH_3 (µg m^{-3})	Critical Level (µg m^{-3})	PC (µg m^{-3})	PC as % of Critical Level
Keadby Boundary Drain LWS	1.8	3	0.01	0.4
Keadby Power Station SNCI	1.8	3	0.01	0.3
Keadby Warping Drain LWS	1.8	3	0.12	3.9
Keadby Wet Grassland LWS	1.8	3	0.02	0.7
Keadby Wetland LWS	1.8	1	0.01	0.6
South Soak Drain, Keadby LWS	1.8	3	0.001	0.03
Stainforth and Keadby Canal Corridor LWS	1.8	3	0.04	1.4
Three Rivers LWS	1.8	3	0.03	1.1
Three Rivers Marsh SNCI	1.8	3	0.02	0.7

Summary of HRA, European, National and Locally designated sites.

The Operator considered the emissions associated with the operation of the Project, both as a standalone installation as well as in combination with the existing Keadby I Power Station. As such, different scenarios have been modelled to gain and provide an understanding of the impacts associated with the operation of the Project within the context of its surroundings. The emissions of interest are oxides of nitrogen (NOx) and ammonia (NH3, slippage from use of Selective Catalytic Reduction (SCR)), and have the potential to result in impacts to human health and sensitive habitats. The AQIA identified that the Project is not predicted to cause any exceedances of air quality standards with regards to human health. This is the case both in isolation, and when considering the in-combination effects of Keadby 1 and Keadby 2 operating simultaneously in the existing baseline environment. The assessment of effects on sites designated for their European, national and local importance for nature conservation has shown that the main site potentially affected is the Humber Estuary SAC / Ramsar and SSSI. The project is not predicted to result in adverse effects on the European designations, or significant effects on the SSSI alone, or in-combination with Keadby 1.

The assessment of effects on sites designated for their European, national and local importance for nature conservation has shown that the main site affected is the Humber Estuary SAC / Ramsar and SSSI. The project is not predicted to result in adverse effects on the European designations, or significant effects on the SSSI.

Natural England were consulted during this determination and have agreed with the Operator and Environment Agency findings.

8.4 Emissions to Water

This variation will include the addition of two new emissions to water, W10 and W11, it should be noted that W10 is the point at which cooling water from K2 joins the cooling water culvert for K1 and the ultimate discharge is W1, River Trent. The discharge from W10 will be monitored and has been assessed as having no likely significant effects alone. Surface water from the site including neutralised water from the condensate polishing plant, post pH testing will be piped via the site drainage system and collected in the detention pond, 1300m^3 located at the North West corner of K2 plant area and released via a hydro brake to Keadby common Drain. Keadby Common Drain is connected to a wider drainage network managed by the Isle of Axholme Drainage Board.

At the request of the Operator and with agreement from the EA W7 and W9 have been removed from Table S3.2, these were internal targets only for water efficiency and not ELV's. Water efficiency is already reported via REM1.

8.5 Noise Impacts

This variation will increase noise sources on site. K1 already has a Noise Management Plan that the Operator intends to update to comply with the guidance

- Best Available Techniques (BAT) Reference Document for Large Combustion Plants, 2017,
- UK Regulators' Large Combustion Plants (LCP) Best Available Techniques (BAT) Interpretation Document, v1.1, May 2018,

and to meet the requirements of the permit.
They have assessed their variation against the guidance including

Operational measures
Low-noise equipment
Noise attenuation
Noise-control equipment
Appropriate location of equipment and buildings

The operator is fully aware of the above requirements and intends to ensure compliance via their existing/updated noise management plan.

9. Application of Best Available Techniques

9.1 Scope of Consideration

In this section, we explain how we have determined whether the Applicant's proposals are the Best Available Techniques for this Installation.

- We address is the fundamental choice of combustion technology;
- We consider energy efficiency, and options for Combined Heat and Power, and the compliance with the Energy Efficiency Directive;
- We consider the cooling system proposed.

Chapter III of the IED specifies a set of maximum emission limit values. Although these limits are designed to be stringent, and to provide a high level of environmental protection, they do not necessarily reflect what can be achieved by new plant. Article 14(3) of the IED says that BAT Conclusions shall be the reference for setting the permit conditions, so it may be possible and desirable to achieve emissions below the limits referenced in Chapter III. The BAT Conclusions and a revised BREF for LCP were published in July so BAT Associated Emission Levels (AELs) are specified alongside Chapter III limits from the IED within the permit.

Operational controls complement the emission limits and should generally result in emissions below the maximum allowed; whilst the limits themselves provide headroom to allow for unavoidable process fluctuations. Actual emissions are therefore almost certain to be below emission limits in practice, because any Operator who sought to operate its installation continually at the maximum permitted level would almost inevitably breach those limits regularly, simply by virtue of normal fluctuations in plant performance, resulting in enforcement action (including potentially prosecution) being taken. Assessments based on Chapter III ELVs or BAT AELs are therefore "worst-case" scenarios.

We are satisfied that emissions at the permitted limits would ensure a high level of protection for human health and the environment in any event.

9.2 Consideration of Combustion Plant

The operator has chosen to vary their permit to add a CCGT consisting of an individual combustion unit with a total rated thermal input 1430MWth making it an LCP. The turbine has unrestricted hours and burns natural gas to produce electricity.

LCP 682 :- The main operational processes at Keadby 2 consist of

- 1 x gas turbine unit with an output capacity of up to 610MWe,
- 1 x heat recovery steam generator of approximately 710MWth and
- 1 x steam turbine unit of approximately 300MWe.

The total thermal input for the gas turbines and steam turbine is approximately 1430MWth. The gas turbine exhausts through a heat recovery boiler which has an integrated Selective Catalytic Reduction (SCR) abatement system, with the steam output passing to the condensing steam turbine. The main stack is 75m in height, with 2 x smaller stacks associated with the emergency diesel generator and Hot Water Boiler. A maximum of 910MWe (gross) electrical capacity is exported the National Grid less the parasitic load of nominally 17MW. There is an emergency back-up diesel generator 3MWth which may be called upon in the event of a power outage for both K1 and K2.

The operation is considered to be BAT.

The CCGT technology proposed to be installed by the operator is H class. This technology was not considered at the time of the review of the Best available techniques reference document (Bref) for large combustion plant as no plant of this type was operating so there was no data available. Therefore, this technology has not been considered in the conclusions to the Bref (BATc). This technology has a greater energy efficiency than that required by the BATc due to the higher operating temperature resulting in lower carbon dioxide emissions than existing CCGT technology, but with a consequential increase in emissions of nitrogen oxides (NOx). The Operator has fitted SCR and the overall efficiency of K2 is expected to be 62.5%.

9.3 Consideration of emission control measures

We have reviewed the techniques used by the operator and compared these with the relevant guidance notes. The CCGT will be fitted with dry low NOx burners along with SCR (selective catalytic convertor) to minimise emissions of NOx.

Emissions of oxides of nitrogen have been considered in detail within Section 8 of this document and are considered unlikely to have a significant effect on humans or ecology.

We consider that the emission limits included in the installation permit reflect the BAT for the sector.

9.4 Energy efficiency

9.4.1 Consideration of energy efficiency.

We have considered the issue of energy efficiency in the following ways:

1. The use of energy within, and generated by, the Installation which are normal aspects of all EPR permit determinations. This issue is dealt with in this section.
2. The applicability of the combined heat and power ready (CHP-R) guidance to the installation.
3. The extent to which the Installation meets the requirement of Article 14(5) of the Energy Efficiency Directive which requires new thermal electricity generation installations with a total thermal input exceeding 20 MW to carry out a cost-benefit assessment to "*assess the cost and*

benefits of providing for the operation of the installation as a high-efficiency cogeneration installation".

4. The extent to which the Applicant has demonstrated energy efficiency in line with the BAT AEELs set out in the BAT Conclusions.

9.4.2 Use of energy within the Installation

The primary considerations of energy efficiency for this site relates to the initial selection of combustion plant as set out in section 9.2 above.

9.4.3 Combined Heat and Power Ready

Our CHP Ready Guidance - February 2013 considers that BAT for energy efficiency for new combustion power plant is the use of CHP in circumstances where there are technically and economically viable opportunities for the supply of heat from the outset.
The term CHP in this context represents a plant which also provides a supply of heat from the electrical power generation process to either a district heating network or to an industrial / commercial building or process. The Installation will generate electricity only and has been specified to maximise electrical output with little or no use of waste heat. Whilst it is considered that CHP is technically feasible for all types of new plants, it is recognised that in some cases (such as peaking plant) the provision of CHP would not be compatible with original operating regimes / intentions. In this case the Applicant has stated that the CCGT was chosen as the most suitable high efficiency technology choice based on a BAT assessment and that the chosen technology uses all energy generating electricity.

Energy Usage

Energy source	Typical annual energy consumption (MWh)
Natural gas	The proposed plant will achieve a World-Class efficiency of no less than 62.5% (at full output, LHV basis) by using the latest gas turbine combined cycle technology. Typical usage: 36 GWh/d (including gas heating system) Maximum usage: 39.4 GWh/day
Grid electricity (during maintenance down time)	The electrical load required from the grid to keep the plant in standby and ready for a new start is approximately 2.0 - 4.0 MW.

9.4.4 Compliance with Article 14(5) of the Energy Efficiency Directive

The operator submitted a Combined Heat & Power Assessment as part of this application to vary the permit. The CHP Guidance required that CHP Assessments examine the information available on the UK CHP Development Map. The CHP Assessment found that no large heat loads were identified from examination of the UK CHP Development Map within the CHP search area.

9.4.5 Permit conditions concerning energy efficiency

The Operator is required to report energy usage and energy generated under condition 4.2 and table S4.2 in Schedule 4. This will enable the Environment Agency to monitor energy efficiency at the Installation and take action if at any stage the energy efficiency is less than proposed.

There are no site-specific considerations that require the imposition of standards beyond indicative BAT, and so the Environment Agency accepts that the Applicant's proposals represent BAT for this Installation.

9.4.6 Compliance with energy BAT AEELs set out in BAT Conclusions

An energy efficiency level associated with the best available techniques (BAT-AEEL) refers to the ratio between the combustion unit's net energy output(s) and the combustion unit's fuel/feedstock energy input at actual unit design. The net energy output(s) is determined at the combustion unit boundaries, including auxiliary systems (e.g. flue-gas treatment systems), and for the unit operated at full load.

BAT AEELs (%)			Plant efficiency (%)		
Net electrical efficiency	**Net total fuel utilisation**	**Net mechanical efficiency**	**Net electrical efficiency**	**Net total fuel utilisation**	**Net mechanical efficiency**
LCP682: CCGT burning natural gas					
46 - 54	**None**	**None**	**62.5**	**NA**	**NA**

We consider this plant exceeds BAT AEELs.

9.4.7 Choice of Cooling System

The current practice for operation of GTs is to exhaust the combustion gases via the Heat Recovery Steam Generator (HRSG), but cooling is required. The proposed cooling system is in the form of a bank of 12 cell hybrid cooling towers. In the cooling cells, cooling of heated water will transfer the heat out of the system by direct heat transfer between the hot water and cooling air. The cooled water (including water that has evaporated and then condensed) will then be recirculated back through the cooling system. A small portion of the water will be lost from the system through evaporation (1-3%) and blowdown, and this will be replaced by adding additional make-up water abstracted from the Stainforth and Keadby Canal.

Comparison of types of systems

Cooling Option	ACC	Wet Cooling – natural draught	Wet cooling – forced draught	Hybrid Air Cooling
Generation Efficiency	Worst	Best	Best	Average
Emissions (noise and air)	Worst	Best	Average	Average
Carbon Emissions	Worst	Best	Average	Average
Impact on local water environment	Best	Worst	Average	Average
Capital Cost	Average	Worst	Average	Average
Visual Impact	Average	Worst	Average	Best

In comparing other systems other than avoiding some of the environmental effects entailed by air cooling and direct cooling, the main reasons for the choice of indirect water cooling were as follows.

- Indirect cooling using a hybrid cooling towers has a low volume requirement for water that can be met sustainably from a nearby source.
- The water quality of the source is sufficiently good to meet operational needs without extensive pre-treatment such as the use of space consuming settlement ponds.
- Some current infrastructure will be used.
- A modern hybrid cooling tower has a relatively low profile and plume abatement thus reducing its visual prominence.

For the reasons given above we consider the system meets BAT.

10. Emission limits

The operator has proposed limits in line with part 2 annex V of the IED and BAT AELs set out within the BAT Conclusions for Large Combustion Plant. As discussed in section 8 above, emissions at these limits will not cause significant pollution. Consequently we have accepted the proposed limits and incorporated them into table 3.1 of the permit. Annex V of the IED is a backstop and these limits are included where there is no tighter limit specified within the BAT Conclusions.

The BAT Conclusions specify that the AELs will apply when dry low NOx (DLN) is effective. We have specified an improvement condition IC11 requiring the operator to define an output load or operational parameters and provide a written justification for when the dry low NO_x operation is effective. The report shall also include the NO_x profile through effective dry low NO_x to 70% and then to full load.

The Operator is also required to propose achievable emission limit values (ELV) for NO_x and CO expressed as a daily mean of validated hourly averages from Minimum start-up load (MSUL) to baseload through improvement condition IC10.

Parameter	Reference Period	Annex V mg/m^3	BAT AEL	Permit limit mg/m^3

NO_x	95%ile of hourly averages	100	-	75
	Monthly averages	50	-	50
	Daily average or average over the sampling period	55	50	45.4[Note1]
	Yearly average	-	35	34.1[Note2]
CO	95%ile of hourly averages	200	-	200
	Monthly averages	100	-	100
	Daily average or average over the sampling period	110	-	110
	Yearly average	-	40	100[Note 3]

Note 1 this ELV is based on efficiency allowances from the LCP BREF: daily average NOx = 40 x (62.5%/55%) =45.4 mg/Nm3

Note 2 this ELV is based on efficiency allowances from the LCP BREF: Yearly average NOx = 30 x (62.5%/55%) = 34.1 mg/Nm3

Note 3 Interpretation Document v1.1, Section 4(a) allows that operators justify CO emission limits above the indicative BAT-AEL in the BREF as long as they still comply within IED Chapter III requirements, i.e. Annex V Table 6 – an emission limit for CO of 100mg/Nm3.

With respect to Note 3 above, the operator has given their justification for the above limits Unlike NOx, CO increases exponentially as the gas turbine approaches the emission compliance boundary defined by the combustion system. For this reason, hourly CO emissions are often close to the current 100mg/m3 ELV when a plant is operating at its stable operating limit (SEL) and gas turbine load is at its minimum. A reduction in the ELV would therefore necessitate raising SEL which in turn would impact on the commercial viability of the plant remaining operational at night. A potential consequence would be increased "two-shifting" and hence an increase in the total annual emissions of both CO and NOx attributable to the greater number of plant starts. From a holistic perspective, it is believed therefore that an ELV for CO to 30mg/m3 could actually have a negative environmental impact.

11. Monitoring & Reporting

11.1 Gas fired plant:

Sulphur dioxide emissions from natural gas firing of gas turbines and boilers will be reported as six monthly concentrations on the basis of the fuel sulphur content without continuous or periodic monitoring since only trace quantities of sulphur are present in UK natural gas. For gas turbines we have not required any reporting as the dust emissions will always be reported as zero. This is

because natural gas is an ash-free fuel and high efficiency combustion in the gas turbine does not generate additional particulate matter. The fuel gas is always filtered and, in the case of gas turbines, the inlet air is also filtered resulting in a lower dust concentration in the flue than in the surrounding air.

The IED Annex V ELVs and BAT Conclusions AELs for oxides of nitrogen and carbon monoxide apply to CCGTs.

11.2 Standards:
Standards for assessment of the monitoring location and for measurement of oxygen, water vapour, temperature and pressure have been added to the permit.
A row has been included in table S3.1 which requires the operator to confirm compliance with BS EN 15259 in respect of monitoring location and stack gas velocity profile in the event there is a significant operational change (such as a change of fuel type) to the LCP.

11.3 Notifications:
A breach of permit condition is NOT implicit in notification under Part C.

11.4 Resource efficiency metrics:
A more comprehensive suite of reporting metrics has been added to the permit template for Electrical Supply Industry (ESI) plant. Table S4.2 "Resource Efficiency Metrics" has been added requiring the reporting of various resource parameters, as this is an ESI power plant. This table is being used for all ESI plant.

12. Meeting the requirements of the IED

The table below shows how each requirement of the IED has been addressed by the permit conditions.

IED Article Reference	IED requirement	Permit condition
30(6)	If there is an interruption in the supply of gas, an alternative fuel may be used and the permit emission limits deferred for a period of up to 10 days, except where there is an overriding need to maintain energy supplies. The EA shall be notified immediately.	N/A – plant runs on natural gas only
32(4)	For installations that have applied to derogate from the IED Annex V emission limits by means of the transitional national plan, the monitoring and reporting requirements set by UK Government shall be complied with.	N/A – applies to existing plant only
33(1)b	For installations that have applied to derogate from the IED Annex V emission limits by means of the Limited Life Derogation, the operator shall submit annually a record of the number of operating hours since 1 January 2016.	N/A – applies to existing plant only
37	Provisions for malfunction and breakdown of abatement equipment including notifying the EA.	2.3.10 & 4.2.2

IED Article Reference	IED requirement	Permit condition
38	Monitoring of air emissions in accordance with Ann V Pt 3	3.5, 3.6
40	Multi-fuel firing	N/A – no multi fuel firing
41(a)	Determination of start-up and shut-down periods	2.3.6 Schedule 1 Table S1.5
Ann V Pt 1(1)	All emission limit values shall be calculated at a temperature of 273,15 K, a pressure of 101,3 kPa and after correction for the water vapour content of the waste gases and at a standardised O2 content of 6 % for solid fuels, 3 % for combustion plants, other than gas turbines and gas engines using liquid and gaseous fuels and 15 % for gas turbines and gas engines.	Schedule 6, Interpretation
Ann V Pt 1	Emission limit values	3.1.2 Schedule 3, Table S3.1a and b
Ann V Pt 1	For plants operating less than 500 hours per year, record the used operating hours	N/A
Ann V Pt 1(6(1))	Definition of natural gas	Schedule 6, Interpretation
Ann V Pt 2	Emission limit values	3.1.2 Schedule 3, Table S3.1a & b
AnnV Pt 3(1)	Continuous monitoring for >100MWth for specified substances	3.5, 3.6 Schedule 3, Table S3.1a & b
AnnV Pt 3(2, 3, 5)	Monitoring derogations	3.5.1 Schedule 3, Table S3.1a & b
AnnV Pt3(4)	Measurement of total mercury (NA for natural gas)	3.5.1 Schedule 3, Table S3.1a & b
AnnV Pt3(6)	EA informed of significant changes in fuel type or in mode of operation so can check Pt3 (1-4) still apply	2.3.1 Schedule 1, Table S1.2
AnnV Pt3(7)	Monitoring requirements	3.5.1 Schedule 3, Table S3.1a & b
AnnV Part 3(8,9,10)	Monitoring methods	3.5, 3.6
AnnV Pt 4	Monthly, daily, 95%ile hourly emission limit value compliance	3.5.1 Schedule 3, Table S3.1a & b
AnnV Pt7	Refinery multi-fuel firing SO_2 derogation	3.5.1 Schedule 3, Table S3.1a & b

13. Meeting the requirements of the BAT Conclusions

This annex provides a record of decisions made in relation to each relevant BAT Conclusion considered potentially applicable to the installation. This table should be read in conjunction with the permit.

The conditions in the permit through which the relevant BAT Conclusions are implemented include but are not limited to the following:

BAT Conclusion requirement topic	Permit condition(s)	Permit table(s)

Environmental Management System	1.1.1	S1.1
BAT AELs	3.1.1 and 3.5.1	S3.1a & b
Monitoring	2.3, 3.5 and 3.6	S1.1, S1.5, S1.6 and S3.1b
Energy efficiency	1.2 and 2.3	S1.2
Noise	3.4 and 2.3	S3.4
Other operating techniques	1.2	S2.3

The Table below has been compiled to include all operating modes/fuels used on site assuming CCGT unlimited hours unless otherwise specified. See appropriate headings within the assessment column. (Other plant and fuels which are not used on site but are included in the BAT conclusions have been removed from the table below).

14. Large Combustion Plant Best available techniques reference document conclusions (BATc)

We have reviewed the permit application against the revised BAT Conclusions for the large combustion plant sector published on 31st July 2017.

This includes BAT Conclusions 1 – 17 (excluding 5 as no FGD on site) applicable to all sites and 40, 42 and 44 which are also applicable to this site, CCGT burning natural gas.

The BAT AELs for emissions of NOx and CO have been included in table S3.1 of the permit.

Best Available Techniques (BAT) Reference document for Large Combustion Plant (LCP)

Section	Subsection	BAT#	BAT Text	Requirements	Comments
General BAT Conclusions	Environmental Management system (EMS)	1	In order to improve the overall environmental performance, BAT is to implement and adhere to an environmental management system (EMS) that incorporates the features presented in the BREF.	**In order to improve the overall environmental performance, BAT is to implement and adhere to an environmental management system (EMS) that incorporates all of the following features:** i. commitment of the management, including senior management; ii. definition of an environmental policy that includes the continuous improvement of the installation by the management; iii. planning and establishing the necessary procedures, objectives and targets, in conjunction with financial planning and investment; iv. implementation of procedures (a) Structure and responsibility (b) Training (c) Communication (d) Employee involvement (e) Documentation (f) Efficient process control (g) Maintenance programmes (h) Emergency preparedness and response	The Keadby site EMS will be updated to include the Keadby 2 operations. We are satisfied that the Operator having recently carried out the BAT review for K1 will comply with BAT1.

				(i) Safeguarding compliance with environmental legislation v. checking performance and taking corrective action, paying particular attention to: (a) monitoring and measurement (see also the Reference Document on the General Principles of Monitoring) (b) corrective and preventive action (c) maintenance of records (d) independent (where practicable) internal and external auditing in order to determine whether or not the EMS conforms to planned arrangements and has been properly implemented and maintained; vi. review of the EMS and its continuing suitability, adequacy and effectiveness by senior management; vii. following the development of cleaner technologies; viii. consideration for the environmental impacts from the eventual decommissioning of the installation at the stage of designing a new plant, and throughout its operating life; viii. consideration for the environmental impacts from the eventual decommissioning of the installation at the stage of designing a new plant, and throughout its operating life; ix. application of sectoral benchmarking on a regular basis. etc - see BAT Conclusions	
	Monitoring	2	BAT is to determine the net electrical efficiency and/or the net total fuel utilisation and/or the net mechanical energy efficiency of the gasification, IGCC and/or	(1) In the case of CHP units, if for technical reasons the performance test cannot be carried out with the unit operated at full load for the heat supply, the test can be supplemented or substituted by a calculation using full load parameters	Performance testing will be conducted according to recognised standards at various stages during commissioning and acceptance testing. The scope of installed instrumentation includes tariff metering of both fuel gas energy and electrical export; a high fidelity of routine testing & analysis is therefore envisaged.

			combustion units by carrying out a performance test at full load (1), according to EN standards, after the commissioning of the unit and after each modification that could significantly affect the net electrical efficiency and/or the net total fuel utilisation and/or the net mechanical energy efficiency of the unit. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.		
	Monitoring process parameters for emissions to air and water	3	BAT is to monitor key process parameters relevant for emissions to air and water including those given in the table	Stream | Parameter(s) (Monitoring) Fuel gas | Flow (Period or continuous determination) Flue-gas | Oxygen content, temperature, and pressure (Period or continuous measurement) Flue-gas | Water vapour content (Period or continuous measurement) Waste water from flue-gas treatment | Flow, pH and temperature (Continuous measurement)	Flue-gas oxygen and water vapour content will be monitored in addition to stack temperature. Stack flowrate will be calculated using oxygen level and fuel gas flowrate.
	Monitoring of emissions to air	4	BAT is to monitor emissions to air with at least the frequency given below and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision	|Monitoring associated with NH_3 NOx N_2O CO SO_2 SO_3 Gaseous chlorides HF Dust Metals and metalloids	The following substances will be monitored by CEMS according to the relevant stated EN standards: NOx NH_3 CO

			of data of an equivalent scientific quality.	Hg TVOC Formaldehyde CH_4 PCDD/F	
	General environmental and combustion performance		In order to improve the general environmental performance of combustion plants and to reduce emissions to air of CO and unburnt substances, BAT is to ensure optimised combustion and to use an appropriate combination of techniques.	Fuel blending and mixing Maintenance of the combustion system Advanced control system Good design of the combustion equipment Fuel choice	The Keadby 2 gas turbine is a highly optimised design and will be operating advanced control systems and maintenance regimes to minimise emissions to air of CO and reduce unburnt fuel. Fuel blending and mixing is not considered applicable to a CCGT.
	General environmental and combustion performance		In order to reduce emissions of ammonia to air from the use of selective catalytic reduction (SCR) and/or selective non-catalytic reduction (SNCR) for the abatement of NO_X emissions, BAT is to optimise the design and/or operation of SCR and/or SNCR (e.g. optimised reagent to NO_X ratio, homogeneous reagent distribution and optimum size of the reagent drops).		The Keadby 2 power station will use SCR as required. Ammonia emissions will be managed as follows - The SCR will be used to remove NO_x from the exhaust gas leaving the turbine before it is emitted to the atmosphere. This is achieved by reacting the NO_x with ammonia (NH_3) in the presence of a catalyst to produce nitrogen and water. Aqueous ammonia (19%) (NH_4OH) will be used as reducing agent, which will be available from the on-site ammonia storage. Exhaust gas is used both as a heat source for vaporizing the aqueous ammonia, as well as a dilution medium to provide better dispersal and transport of the ammonia. The

					required amount of aqueous ammonia will be controlled based upon operating conditions with a flow control valve. The extracted flue gas flow will be maintained by using gas fans with redundancy. After the mixer, the gas / ammonia stream is fed to the AIG. The AIG is designed to guarantee an even ammonia distribution across the boiler to ensure the required performance of the NOx removal catalyst.
		8	In order to prevent or reduce emissions to air during normal operating conditions, BAT is to ensure, by appropriate design, operation and maintenance, that the emission abatement systems are used at optimal capacity and availability.		See above
		9	In order to improve the general environmental performance of combustion and/or gasification plants and to reduce emissions to air, BAT is to include the following elements in the quality assurance/quality control programmes for all the fuels used, as part of the environmental	Initial full characterisation of the fuel used including at least the parameters listed below and in accordance with EN standards. ISO, national or other international standards may be used provided they ensure the provision of data of an equivalent scientific quality; Regular testing of the fuel quality to check that it is consistent with the initial characterisation and according to the plant design specifications. The frequency of testing and the parameters chosen are based on the variability of the fuel and an assessment of the relevance of pollutant releases (e.g. concentration in fuel, flue-gas treatment employed);	The fuel being used by Keadby 2 is natural gas from the national grid gas supply. The natural gas supplied is subject to minima/maxima parameter as agreed in the conditions of supply with the gas grid operator. The Keadby 1 EMS will be updated to include the additional requirements relating to Keadby 2.

			management system (see BAT 1):	Subsequent adjustment of the plant settings as and when needed and practicable (e.g. integration of the fuel characterisation and control in the advanced control system	
		10	In order to reduce emissions to air and/or to water during other than normal operating conditions (OTNOC), BAT is to set up and implement a management plan as part of the environmental management system (see BAT 1), commensurate with the relevance of potential pollutant releases, that includes the following elements:	• Appropriate design of the systems considered relevant in causing OTNOC that may have an impact on emissions to air, water and/or soil (e.g. low-load design concepts for reducing the minimum start-up and shutdown loads for stable generation in gas turbines) • Set-up and implementation of a specific preventive maintenance plan for these relevant systems; • Review and recording of emissions caused by OTNOC and associated circumstances and implementation of corrective actions if necessary; • Periodic assessment of the overall emissions during OTNOC (e.g. frequency of events, duration, emissions quantification/estimation) and implementation of corrective actions if necessary.	The Keadby 2 systems are designed to monitor and minimise emissions during all operational phases, not just steady operation.
		11	BAT is to appropriately monitor emissions to air and/or to water during OTNOC.	The monitoring can be carried out by direct measurement of emissions or by monitoring of surrogate parameters if this proves to be of equal or better scientific quality than the direct measurement of emissions. Emissions during start-up and shutdown (SU/SD) may be assessed based on a detailed emission measurement carried out for a typical SU/SD procedure at least once every year, and using the results of this measurement to estimate the emissions for each and every SU/SD throughout the year.	The Keadby 2 systems are designed to monitor and minimise emissions during all operational phases, not just steady operation. Total emissions during start up and shut down will be reported annually as required by the permit.
	Energy Efficiency	12	In order to increase the energy efficiency of combustion, gasification and/or IGCC units operated ≥ 1 500 h/yr, BAT is to use an appropriate combination	Techniques Combustion optimisation Optimisation of the working medium conditions Optimisation of the steam cycle Minimisation of energy consumption Preheating of combustion air Fuel preheating	The Keadby 2 CCGT utilises new technologies to achieve efficiency levels in excess of the BREF range at 62.5%. Techniques used: Combustion optimisation

			of the techniques given below	Advanced control system Feed-water preheating using recovered heat Heat recovery by cogeneration (CHP) CHP readiness Flue-gas condenser Heat accumulation Wet stack Cooling tower discharge Fuel pre-drying Minimisation of heat losses Advanced materials Stream turbine upgrades Supercritical and ultra-supercritical steam conditions	Optimisation of the working medium conditions Optimisation of the steam cycle Minimisation of energy consumption - yes although no variable speed pumps Preheating of combustion air - N/A, would reduce useful power! Fuel preheating - Yes Advanced control system - Yes Feed-water preheating using recovered heat - NA Heat recovery by cogeneration (CHP) – CHP study identified no applicable local heat and power demand CHP readiness - Yes Flue-gas condenser - Not compatible with required dispersion of flue gas plume Heat accumulation – NA only applicable to CHP plants Wet stack – NA only applicable to plant with FGD Cooling tower discharge – NA only applicable to plant with FGD Fuel pre-drying – NA only applicable to biomass and peat fuelled plants Minimisation of heat losses – NA only applicable to solid-fuel-fired combustion units Advanced materials - Yes Stream turbine upgrades – New plant, no upgrades required Supercritical and ultra-supercritical steam conditions - No
	Water usage and emissions to water	13	In order to reduce water usage and the volume of contaminated waste	Techniques Water recycling Dry bottom ash handling	The cooling approach is a hybrid cooling tower. Although there are some evaporation/blowdown losses through controlling water chemistry (at maximum load, approximately

			water discharged, BAT is to use one or both of the techniques given.		19600 tonnes per day of water), the cooling water will be recycled in the tower – typically four cycles of concentration, meaning that the ratio of mineral concentration in the source water to that in the circulating water must be maintained. In addition to the application of the cooling tower, where water is re-used by recirculation instead of once through cooling system, water is reused from following systems: • the cooling water system from the boiler blow down system (up to approx. 42 t/d) and • the reverse osmosis plant (up to approx.16 t/d) Dry bottom ash handling is not applicable as a technique for CCGT.
		15	In order to reduce emissions to water from flue-gas treatment, BAT is to use an appropriate combination of the techniques given below, and to use secondary techniques as close as possible to the source in order to avoid dilution.	*Technique* Optimised combustion and flue-gas treatment systems Adsorption on activated carbon Aerobic biological treatment Anoxic/anaerobic biological treatment Coagulation and flocculation Crystallisation Filtration Flotation Ion exchange Neutralisation Oxidation Precipitation Sedimentation Stripping	There is no flue-gas treatment on site, hence no emissions to water.
	Waste Management	16	In order to reduce the quantity of waste sent for disposal from the	*Technique* Generation of gypsum as a by-product Recycling or recovery of residues in the	As a gas fired CCGT, there are minimal wastes generated by the process. The existing K1 waste

			combustion and/or gasification process and abatement techniques, BAT is to organise operations so as to maximise, in order of priority and taking into account life-cycle thinking: a) waste prevention, e.g. maximise the proportion of residues which arise as byproducts; b) waste preparation for reuse, e.g. according to In order to reduce the quantity of waste sent for disposal from the combustion and/or gasification process and abatement techniques, BAT is to organise operations so as to maximise, in order of priority and taking into account life-cycle thinking: a) waste prevention, e.g. maximise the proportion of residues which arise as by products; b) waste preparation for reuse, e.g. according to the specific requested quality criteria; c) waste recycling; d) other waste recovery (e.g. energy recovery),	construction sector Energy recovery by using waste in the fuel mix Preparation of spend catalyst for reuse	management procedures will be amended to include the K2 waste streams and the plant will continue to periodically review waste generation to identify opportunities to further minimise waste and/or identify management routes further up the waste hierarchy.

			by implementing an appropriate combination of techniques.		
	Noise emissions	17	In order to reduce noise emissions, BAT is to use one or a combination of the techniques	*Techniques* Operational measures Low-noise equipment Noise attenuation Noise-control equipment Appropriate location of equipment and buildings	Keadby 2 has committed to a noise management plan.
	Energy Efficiency	40	In order to increase the energy efficiency of natural gas combustion, BAT is to use an appropriate combination of the techniques given in BAT 12 and below.	Technique: Combined cycle, CCGT ≥600MWth, Type of combustion unit | BATAEELs	See BAT 12
	NO_x, CO, NMVOC and CH_4 emissions to air	41	In order to prevent or reduce NO_X emissions to air from the combustion of natural gas in boilers, BAT is to use one or a combination of the techniques given below	*Technique* Air and/or fuel staging Flue-gas recirculation Low-NOx burners Advanced control system Reduction of the combustion air temperature SNCR SCR	Not applicable, there is no supplementary firing in the HRSG.
		42	In order to prevent or reduce NO_X emissions to air from the combustion of natural gas in gas turbines, BAT is to use one or a combination of techniques	*Technique* Advanced control system Water/steam addition Dry low-NO_x burners (DLN) Low-load design concept Low-NO_x burners (LNB) Selective catalytic reduction (SCR)	The Keadby 2 CCGT uses SCR and DLN burners to minimise NOx emissions from the combustion of natural gas. Keadby 2 CCGT will use the efficiency uplift in BREF Table 10.24 to uplift both the yearly average and daily BAT-AEL averages for NOx as permitted by footnote 8. The respective emission limit values are therefore: 34.1 mg/Nm_3 (yearly average) and 45.5 mg/Nm_3 (daily average).

		43	In order to prevent or reduce NO_X emissions to air from the combustion of natural gas in engines,		Not applicable, there are no gas engines at Keadby.
		44	In order to prevent or reduce CO emissions to air from the combustion of natural gas, BAT is to ensure optimised combustion and/or to use oxidation catalysts	As an indication, the yearly average CO emission levels for each type of existing combustion plant operated $\geqslant$ 1 500 h/yr and for each type of new combustion plant will generally be as follows: • New CCGT of $\geqslant$ 50 MWth: < 5–30 mg/Nm3. For plants with a net electrical efficiency (EE) greater than 55 %, a correction factor may be applied to the higher end of the range, corresponding to [higher end] x EE / 55, where EE is the net electrical energy efficiency of the plant determined at ISO baseload conditions. In the case of a gas turbine equipped with DLN burners, these indicative levels correspond to when the DLN operation is effective.	The Keadby 2 emissions of CO will meet the IED Chapter III requirements of 100 mg/Nm3 for CO. LCP Interpretation Document v1.1, Section 4(a) allows that operators justify CO emission limits above the indicative BAT-AEL in the BREF as long as they still comply within IED Chapter III requirements, ie Annex V Table 6 – an emission limit for CO of 100mg/Nm3.

Annex 2: Decision checklist

Aspect considered	Decision
Receipt of application	
Confidential information	A claim for commercial or industrial confidentiality has not been made. The decision was taken in accordance with our guidance on confidentiality.
Identifying confidential information	We have not identified any other information provided as part of the application that we consider to be confidential. The decision was taken in accordance with our guidance on confidentiality.
Consultation/Engagement	
Consultation	The consultation requirements were identified in accordance with the Environmental Permitting Regulations and our public participation statement. The application was publicised on the GOV.UK website. We consulted the following organisations: • North Lincolnshire Council • Health and Safety Executive • National Grid • Public Health England • Natural England • Severn Trent Water The comments and our responses are summarised in Annex 3.
The facility	
The regulated facility	We considered the extent and nature of the facility at the site in accordance with RGN2 'Understanding the meaning of regulated facility' and Appendix 2 of RGN 2 'Defining the scope of the installation'. The extent of the facility is defined in the site plan and in the permit. The activities are defined in Table S1.1 of the permit.
The site	
Extent of the site of the facility	The operator has provided plans which we consider are satisfactory, showing the extent of the site of the facility. A plan showing the extent of the facility is included in the permit.
Site condition report	The operator has provided a description of the condition of the site, which we consider is satisfactory. The decision was taken in

Aspect considered	Decision
	accordance with our guidance on site condition reports and baseline reporting under the Industrial Emissions Directive. Additional land has been included in this variation. GWCL were consulted in this process and raised no concerns.
Biodiversity, heritage, landscape and nature conservation	The application is not within the relevant distance criteria of a site of heritage, landscape or nature conservation, and/or protected species or habitat. However, the applicant has assessed the impact of emissions on sites beyond the screening distances. We have assessed the application and its potential to affect all known sites of nature conservation, landscape and heritage within 15 km (European sites and SSSIs) and 2 km (local wildlife sites) of the installation as part of the permitting process (See section 8 of Key Issues above). We consider that the application will not affect any sites of nature conservation, landscape or heritage. We have consulted Natural England on the application who agreed with the operators assessment and our audit. The decision was taken in accordance with our guidance.
Environmental risk assessment	
Environmental risk	We have reviewed the operator's assessment of the environmental risk from the facility. The operator's risk assessment is satisfactory. See Key Issues above.
Operating techniques	
General operating techniques	We have reviewed the techniques used by the operator and compared these with the relevant guidance notes and we consider them to represent appropriate techniques for the facility. The operating techniques that the applicant must use are specified in Table S1.2 in the environmental permit.
Operating techniques for emissions that screen out as insignificant	Emissions of carbon monoxide and ammonia have been screened out as insignificant, and so we agree that the applicant's proposed techniques are BAT for the installation. We consider that the emission limits included in the installation permit reflect the BAT for the sector.
Noise management	We have reviewed the noise impact assessment in accordance with our guidance on noise assessment and control. The operator has a noise management plan in place

Aspect considered	Decision
Permit conditions	
Raw materials	We have specified limits and controls on the use of raw materials and fuels.
Improvement programme	Based on the information on the application, we consider that we need to impose an improvement programme. We have provided explanation for the inclusion of improvement conditions in the body of this document above.
Emission limits	We have imposed ELVs for emissions to air in accordance with those required by the IED and the BATc for the proposed gas fired plant (See Key Issues section 9 above). We have removed some historical water discharge ELV's in the emission limits for the existing plant as these were found to be internal targets and not appropriate to be used as limits this was carried out at the request of the operator in conjunction with the area officer. Explanations of the limits to air are in Section 10 above.
Monitoring	We have decided that monitoring should be added for the following parameters in respect of the proposed gas plant, using the methods detailed and to the frequencies specified: Nitrogen oxides Carbon monoxide Ammonia Water vapour Stack temperature Stack pressure These monitoring requirements have been imposed in order to ensure the plant is operated without causing pollution of the environment or harm to human health. We made these decisions in accordance with the IED and the BATc. We have not amended the monitoring requirements for the existing plant in respect of emissions to air or water.
Reporting	We have not made any changes to the reporting requirements. The existing reporting requirements apply to the proposed gas plant operation as well as to the existing plant. We made these decisions in accordance with the IED, the BATc and our guidance.

Aspect considered	Decision
Operator competence	
Management system	There is no known reason to consider that the operator will not have the management system to enable it to comply with the permit conditions.
Financial competence	There is no known reason to consider that the operator will not be financially able to comply with the permit conditions.
Growth Duty	
Section 108 Deregulation Act 2015 – Growth duty	We have considered our duty to have regard to the desirability of promoting economic growth set out in section 108(1) of the Deregulation Act 2015 and the guidance issued under section 110 of that Act in deciding whether to grant this permit. Paragraph 1.3 of the guidance says: "The primary role of regulators, in delivering regulation, is to achieve the regulatory outcomes for which they are responsible. For a number of regulators, these regulatory outcomes include an explicit reference to development or growth. The growth duty establishes economic growth as a factor that all specified regulators should have regard to, alongside the delivery of the protections set out in the relevant legislation." We have addressed the legislative requirements and environmental standards to be set for this operation in the body of the decision document above. The guidance is clear at paragraph 1.5 that the growth duty does not legitimise non-compliance and its purpose is not to achieve or pursue economic growth at the expense of necessary protections. We consider the requirements and standards we have set in this permit are reasonable and necessary to avoid a risk of an unacceptable level of pollution. This also promotes growth amongst legitimate operators because the standards applied to the operator are consistent across businesses in this sector and have been set to achieve the required legislative standards.

Annex 3: Consultation

The following summarises the responses to consultation with other organisations and our notice on GOV.UK for the public and the way in which we have considered these in the determination process.

Responses from organisations listed in the consultation section

Response received from Public Health England
Brief summary of issues raised
We request that the Environment Agency takes account of the following concerns when considering appropriate permit conditions: **Accident management plan**. The environmental risk assessment includes some accidental scenarios but we recommend the applicant is required to produce an accident management plan which systematically identifies all hazards and possible scenarios that could lead to public exposures, along with appropriate mitigation measures. **Emissions to air and operating conditions**. We would expect the applicant to evaluate emissions to air from all emission points, to demonstrate that combined effects are not a concern in relation to public health. This should include some consideration of emissions from back-up generators or sufficient justification that the maintenance schedule is insignificant in relation to air quality impacts. **Substances emitted to air.** We would expect to see in the H1 all potential substances of concern evaluated in order to identify which specific chemicals need detailed dispersion modelling (note this might be available in the H1 file which we haven't seen, but we would expect these results to be presented in a report), and considering all emission points as described in the previous bullet point. For example, in table 4.1 of the supporting information document, BAT4 describes a list of emissions to air that should be monitored. Note that emissions from the back-up generators would be different, to include particulate matter for example.
Summary of actions taken or show how this has been covered
All of the above concerns raised have been met using standard conditions within the permit.

Response received from Severn Trent Water
Brief summary of issues raised
No issues raised
Summary of actions taken or show how this has been covered
None required.

Response received from Natural England
Brief summary of issues raised
No issues raised

Summary of actions taken or show how this has been covered
Natural England assessed the HRAS form and agreed with the Operators and our conclusions of no significant impact from this variation.

No responses were received from the following organisations:

- North Lincolnshire Council
- Health and Safety Executive
- National Grid