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West Burton C (Gas Fired Generating Station)

The West Burton C (Generating Station) Order

Land to the north of the West Burton B Power Station, Nottinghamshire

Combined Heat and Power Assessment

Applicant: EDF Energy (Thermal Generation) Limited
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GLOSSARY OF ABBREVIATIONS AND DEFINITIONS

ABBREVIATION	DESCRIPTION
BAT	Best Available Techniques – The available techniques which are the best for preventing or minimising emissions and impacts on the environment.
BEIS	Department for Business, Energy and Industry Strategy. The UK government department responsible for issues regarding energy supply and climate change.
CCGT	A CCGT is a combustion plant where a gas turbine is used to generate electricity and the waste heat from the flue-gas of the gas turbine is converted to useful energy in a heat recovery steam generator (HRSG), where it is used to generate steam. The steam then expands in a steam turbine to produce additional electricity.
CHP	Combined Heat and Power – a technology that puts to use the residual heat of the combustion process after generation of electricity that would otherwise be lost to the environment.
CHP-R	Combined Heat and Power – Ready – Project which is developed and designed to allow the plant to provide CHP in the future.
DCO	A Development Consent Order made by the relevant Secretary of State pursuant to the Planning Act 2008 to authorise a Nationally Significant Infrastructure Project. A DCO can incorporate or remove the need for a range of consents which would otherwise be required for a development. A DCO can also include rights of compulsory acquisition.
DECC	Department for Energy and Climate Change – the preceding UK government department responsible for issues regarding energy supply and climate change. This was replaced by the Department for Business, Energy and Industrial Strategy in July 2016.
EA	Environment Agency – a non-departmental public body sponsored by the United Kingdom government's Department for Environment,

	Food and Rural Affairs (DEFRA), with responsibilities relating to the protection and enhancement of the environment in England.
EFW	Energy from Waste – Process of generating energy in the form of electricity and/or heat from the primary treatment of waste.
EN-1	Overarching National Policy Statement for Energy.
EN-2	National Policy Statement for Fossil Fuel for Electricity Generating Infrastructure.
HCA	Homes and Communities Agency.
HRSG	Heat Recovery Steam Generator – an energy recovery heat exchanger that recovers heat from a hot gas stream. It produces steam that can be used in a process (cogeneration) or used to drive a steam turbine (combined cycle).
LEP	Local Enterprise Partnerships.
NSIP	Nationally Significant Infrastructure Projects - Defined by the Planning Act 2008 and cover projects relating to energy (including generating stations, electric lines and pipelines); transport (including trunk roads and motorways, airports, harbour facilities, railways and rail freight interchanges); water (dams and reservoirs, and the transfer of water resources); waste water treatment plants and hazardous waste facilities. These projects are only defined as nationally significant if they satisfy a statutory threshold in terms of their scale or effect.
OCGT	Open Cycle Gas Turbine – a combustion turbine plant fired by gas or liquid fuel to turn a generator rotor that produces electricity.
WBC	West Burton C Power Station.

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Executive Summary

EDF Energy (Thermal Generation) Limited is proposing to develop a gas fired peaking plant to be known as 'West Burton C' (WBC). The Proposed Development Site is located within the existing West Burton Power Station site, near Gainsborough, Nottinghamshire.

In accordance with the Planning Act 2008 (Reference 1), the Secretary of State is required to determine an application for an order granting development consent (DCO) for an energy nationally significant infrastructure project (NSIP) in accordance with the relevant National Policy Statements. For this proposal these are the Overarching National Policy Statement for Energy (EN-1) (Reference 2) and National Policy Statement for Fossil Fuel Electricity Generating Infrastructure (EN-2) (Reference 3).

EN-1 (paragraph 4.6.6) references Combined Heat and Power (CHP) Guidelines issued by Department of Energy and Climate Change (DECC) in 2006 (CHP Guidance) (Reference 4). Since publication of the CHP Guidance, the Environment Agency (EA) has published its own CHP Ready Guidance for Combustion and Energy from Waste Plants (2013) (CHP-R Guidance) (Reference 5).

Section 3 of this report summarises the applicable content of the CHP Guidance (Reference 4) and CHP-R Guidance and how it has been considered as part of this assessment. In particular, the CHP-R Guidance Best Available Techniques (BAT) Assessment Process for CHP and CHP-R is looked at from which it is concluded that there is no requirement for the proposed power station to be CHP or CHP-R. **Section 4** and **Section 5** of this report reinforce this conclusion by assessing the feasibility and compatibility of CHP or CHP-R for the proposed power station.

Section 4 looks at the chosen technology and operating regime for the Proposed Development and determines that CHP is not viable from a technical or an economic perspective.

Section 5 investigates the likely heat demand in the surrounding area using the Department for Business, Energy and Industrial Strategy (BEIS) Online Heat Map tool (Reference 6) and the EA's guidance of a 10km radius. The data obtained indicates the largest share of the heat load in the surrounding area comes from the domestic sector, with minimal heat load required by commercial and industrial users. The comparatively low density and age of housing in the region would make installing a new domestic district heating network technically challenging, and prohibitively expensive.

The assessment concludes that there is no justification for or need to undertake further investigation of CHP for the Proposed Development.

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1. Introduction

1.1.1 EDF Energy (Thermal Generation) Limited is proposing to develop a gas-fired peaking plant to be known as West Burton C (WBC). The Proposed Development Site is located within the existing West Burton Power Station site, near Gainsborough, Nottinghamshire. The Proposed Development would be capable of generating up to 299MW of gross electrical output, comprising up to five open cycle gas turbines (OCGT) and associated buildings, structures and plant. The Planning Statement (**Application Document Ref. 7.1**) sets out further details of the Site and Proposed Development.

1.1.2 The application for development consent will be determined in accordance with the *Overarching National Policy Statement for Energy (EN-1*) (Reference 2) and *National Policy Statement for Fossil Fuel Electricity Generating Infrastructure (EN-2)* (Reference 3). EN-1 (paragraph 4.6.6) (Reference 2), states:

"…under Guidelines issued by DECC (then DTI) in 2006 [the Combined Heat and Power (CHP) Guidance], any application to develop a thermal generating station under Section 36 of the Electricity Act 1989 must either include CHP or contain evidence that the possibilities for CHP have been fully explored to inform the [Secretary of State's] consideration of the application…"

1.1.3 This Assessment, therefore, provides information about the potential for the Proposed Development to incorporate combined heat and power (CHP).

1.1.4 CHP is the simultaneous generation of electrical power and usable heat in a single process, and is also known as co-generation. A CHP station may either supply steam direct to customers or capture heat from low-pressure steam after it has been used to drive electricity generating turbines, for hot water or space heating purposes. The heat can also be used to drive absorption chillers, thereby providing cooling.

1.1.5 CHP is considered advantageous as generating electrical power and heat together is more efficient than generating them separately it can deliver a reduction in both primary energy usage and carbon emissions.

2. Project Description

2.1.1 The Proposed Development would comprise up to five open cycle gas turbines (OCGT) capable of generating up to 299MW of gross electrical output, with associated buildings, structures and plant.

2.1.2 The gas turbine generators consist of an inlet air filter, air compressor, combustion chamber, power turbine, exhaust silencer and generator. Air is compressed in the compressor of a gas turbine and gaseous fuel is injected into the combustion chamber where the fuel burns producing hot, high-pressure gases. These gases expand across the turbine blades of the gas turbine, which drives both the compressor and the electrical generator. The hot exhaust gases are then routed via a silencer to the stack and emitted to the atmosphere. No steam would be produced as part of the electricity generation process.

2.1.3 The Proposed Development would operate for up to 1,500 hours per year on a rolling five year average. Its function would be to support the national electricity transmission system, including by providing generation at times of peak demand and to complement the intermittent nature of renewable energy sources.

2.1.4 Further detail on the Proposed Development can be found in Chapter 4 of the Environmental Statement (Volume I) (**Application Document Ref. 5.2**).

3. Policy Context

3.1.1 In accordance with the Planning Act 2008 (as amended by the Localism Act 2011) (Reference 1), the Secretary of State is required to determine an application for an order granting development consent (DCO) for an energy nationally significant infrastructure project (NSIP) in accordance with the *Overarching National Policy Statement for Energy (EN-1*) (Reference 2) and the relevant technology-specific national policy statement ('*National Policy Statement for Fossil Fuel Electricity Generating Infrastructure (EN-2)*' (Reference 3) in the case of this project).

3.1.2 EN-1 (paragraph 4.6.6) states:

"…*under Guidelines issued by DECC (then DTI) in 2006* [the Combined Heat and Power (CHP) Guidance]*, any application to develop a thermal generating station under Section 36 of the Electricity Act 1989 must either include CHP or contain evidence that the possibilities for CHP have been fully explored to inform the* [Secretary of State]*'s consideration of the application…*"

3.1.3 EN-1 continues, stating '*The* [Secretary of State] *should have regard to DECC's Guidance, or any successor to it, when considering the CHP aspects of applications for thermal generating stations'.*

3.1.4 DECC's guidance (paragraph 24) states '*decisions on major new power station investments, including the location and anticipated load duty of the station (e.g. base load, mid-merit, peak-lopping, support to local industry, etc.), will primarily be driven by the market'.*

3.1.5 EN-1 (paragraph 4.6.7) states that developers should '*consider the opportunities for CHP from the very earliest point and it should be adopted as a criterion when considering locations for a project'*. The value of early consultation is also emphasised, in respect of the process of identification of potential heat users (customers), with bodies such as the Homes and Communities Agency (HCA), Local Enterprise Partnerships (LEPs) and Local Authorities.

3.1.6 Since publication of the CHP Guidance (Reference 4), the Environment Agency (EA) has published its own '*CHP Ready Guidance for Combustion and Energy from Waste Plants*' (2013) (CHP-R Guidance) (Reference 5). This guidance (Section 3.3) states that the EA will highlight the need for the plant to be CHP or CHP-R and will make reference to the CHP-R Guidance as part of its responses through the DCO examination stage. The guidance goes on to state at paragraph 24 that '*it is recognised that in some cases (such as peaking plant...) the provision of CHP would not be compatible with the original operating regimes / intentions*'.

3.1.7 Insert 1 of the CHP-R Guidance details the recommended assessment process for CHP and CHP-R and states how this guidance should be used. The steps of that process are set out below alongside cross referencing to where they are addressed within this assessment.

BAT Assessment Process for CHP and CHP-R

Step 1 – Is the New Power / EFW Plant required to be CHP or CHP-R?

No – refer to **Section 4, Compatibility with Provision of CHP**, for details.

Step 2 – Are there opportunities for the supply of heat?

No – refer to **Section 5, Possibilities for CHP,** for details.

First BAT Test – Will the Power / EFW Plant be CHP at the Outset?

No – refer to **Sections 4** and **5**.

Second BAT Test – The applicant / operator should justify the degree to which the new Power / EFW Plant will be CHP-R.

For the reasons set out in **Sections 4** and **5**, the Proposed Development would not be CHP-R.

Third BAT Test – Once CHP-R Plant is operating, the operator should carry out periodic reviews of opportunities for the supply of heat (both existing and new).

For the reasons set out in **Sections 4** and **5**, there is no future opportunity for supply of heat (both existing and new) from the Proposed Development. The Proposed Development would not be CHP-R.

3.1.8 EN-1 (paragraph 4.6.8) requires proposals for thermal generation without CHP to:

- explain why CHP is not economically or practically feasible, for example if there is a more efficient means of satisfying a nearby domestic heat demand;
- provide details of any potential future heat requirements in the area that the station could meet; and
- detail the provisions in the proposed scheme for ensuring any potential heat demand in the future can be exploited.

3.1.9 These matters are considered in the subsequent sections of this assessment.

4. Compatibility with Provision of CHP

4.1 Feasibility

Economic Feasibility

4.1.1 A primary requirement of a viable and effective CHP scheme is that it should be able to service the heat demand of any user connected to, and therefore reliant on, the scheme.

4.1.2 The application of the CHP concept to a peaking plant like WBC is not economically feasible because the profile for the generation of electrical energy from the station cannot be guaranteed to coincide with the required heat demand profile of any potential consumer. The role of peaking plant in supporting the national electricity transmission system at times of peak or unexpected demand (including forced outages of other thermal generating stations), and in complementing the intermittent nature of renewable energy sources, means that the load regime for the plant is inherently unpredictable. Periods of electricity generation would typically be for 1-2 hours on occasional days, and be of limited duration over the year (i.e. no more than 1,500 hours per year on a rolling 5 year average out of a potential 8,760 hours in a year).

4.1.3 By contrast, when heat demands exist in the locality, it is generally steady and persists over at least several months of the year, for example residential heating or industrial or commercial uses.

4.1.4 Any agreement between the Applicant and local customers for the supply of heat from the Proposed Development would have to guarantee that heat would be available for certain periods of the year and in sufficient quantities to satisfy the agreed demand. This agreement is also likely to include financial penalties if heat was not able to be supplied when contractually obliged to do so. Therefore, the disconnect between the relatively constant demands for heat from residential and industrial users and the inherently unpredictable supply from a peaking station, such as WBC, means that the CHP model is not appropriate or applicable in this situation.

Technical Feasibility

4.1.5 Conventionally, CHP plants using gas turbines are configured in combined cycle gas turbine (CCGT) mode (i.e. excess heat from the gas turbine exhaust is used to create steam in a heat recovery steam generator (HRSG), which in turn is then used for additional power and heating purposes. OCGT plants do not produce steam as part of the electricity generating process; therefore, the provision of CHP capability would require the addition of steam raising plant. The provision of CHP capability to a plant of this type would reduce its suitability for operation in peaking mode and bring additional technical challenges, potentially hindering project development.

4.1.6 Compared to CCGT, OCGT units typically have a smaller capital cost per kW installed. This is largely because CCGT plants are more complex in their operation, requiring much more plant and equipment (e.g. a HRSG and other steam raising plant) to operate. Although this increased capital cost is offset by gains in efficiency, CCGT plants are also typically designed to operate at continuous load, with fewer shut-downs and start-ups.

4.1.7 WBC is being developed as a peaking plant, with a very specific purpose of flexibly meeting peaks in demand, rather than to support base (i.e. continuous) load. Therefore, it would not be appropriate to reconfigure the development in order to accommodate CHP.

4.1.8 CCGT plants typically have efficiencies of around 55-60% (compared with 35-40% for OCGT). Maximum gains in efficiency, however, are only realised when the plant has reached its operating temperature and is running continuously at full load. Comparatively, the Proposed Development would be an OCGT peaking plant expected to operate for up to 1,500 hours per year on a rolling five year average. The plant needs to be designed to be as flexible as possible to meet national grid demands and therefore a fast response open cycle unit is required. Whilst a CCGT is more efficient it cannot start up as quickly as an OCGT and is not appropriate for use in the Proposed Development.

4.1.9 For these reasons it is considered that the Proposed Development would not be suitable to act as a CHP plant and it does not need to comply with the requirements of CHP-R.

4.2 Meeting Future Heat Requirements

4.2.1 Industry is often a large consumer for process heat and is, therefore, considered the largest and most economical user of CHP. Opportunities are also identified in commerce (e.g. hotels, leisure centres, large corporate buildings) and public services (e.g. hospitals, universities, prisons, defence installations, administrative offices and ancillary college or hospital accommodation). There is also sometimes the potential for CHP where heat can be used in absorption chilling to deliver cooling in industry, commerce and the public sector for example in data centres.

4.2.2 Efficient CHP plants are usually designed to meet the demands of an identified heat load and not for meeting demands from the National Grid. An efficient CHP plant would utilise electrical power and heat for a local process plant, with the electrical power balance exported to the grid. For the reasons set out, the Proposed Development would not be suitable for meeting a requirement of this nature.

4.2.3 If a satisfactory steady heat load exists, the potential benefits of CHP schemes can be realised with electricity being generated in direct proportion to the heat load. However, the size of a CHP scheme is determined by the local heat load which can be supplied at a common point. For this reason, the majority of CHP schemes are small (less than 5 MWe). These small units can offer high fuel

utilisation when fully supplying the heat load. However, during periods when the heat load is low or absent, the electrical efficiency of these units is low compared to conventional power stations.

4.2.4 In addition, due to the high cost of transporting heat in insulated pipes, it is unusual for a CHP scheme to be viable if the heat consumers are spaced apart and/or located far from the heat source. Normally the heat users would need to be within 1 to 2km of the heat source. It is noted that the closest material potential heat user to the WBC Plant is 4km away at the nearby town of Gainsborough. There are other smaller settlements/villages nearer to the plant but due to their size, are not considered viable.

4.3 Provisions for Ensuring Future Heat Demand Can Be Exploited

4.3.1 Because of the unpredictable operating regime required of a peaking power station, it is deemed impractical to supply only occasional heat to potential consumers.

4.3.2 Moreover, the inclusion of provisions to ensure that future heat demand can be exploited would increase capital expenditure of the project further. Such provisions could include space to install steam raising plant after the GT exhaust, close to the proposed power station. Although land is available, future expansion may be constrained by the topography and current use of the area surrounding the site for use by existing infrastructure (i.e. construction and access roads).

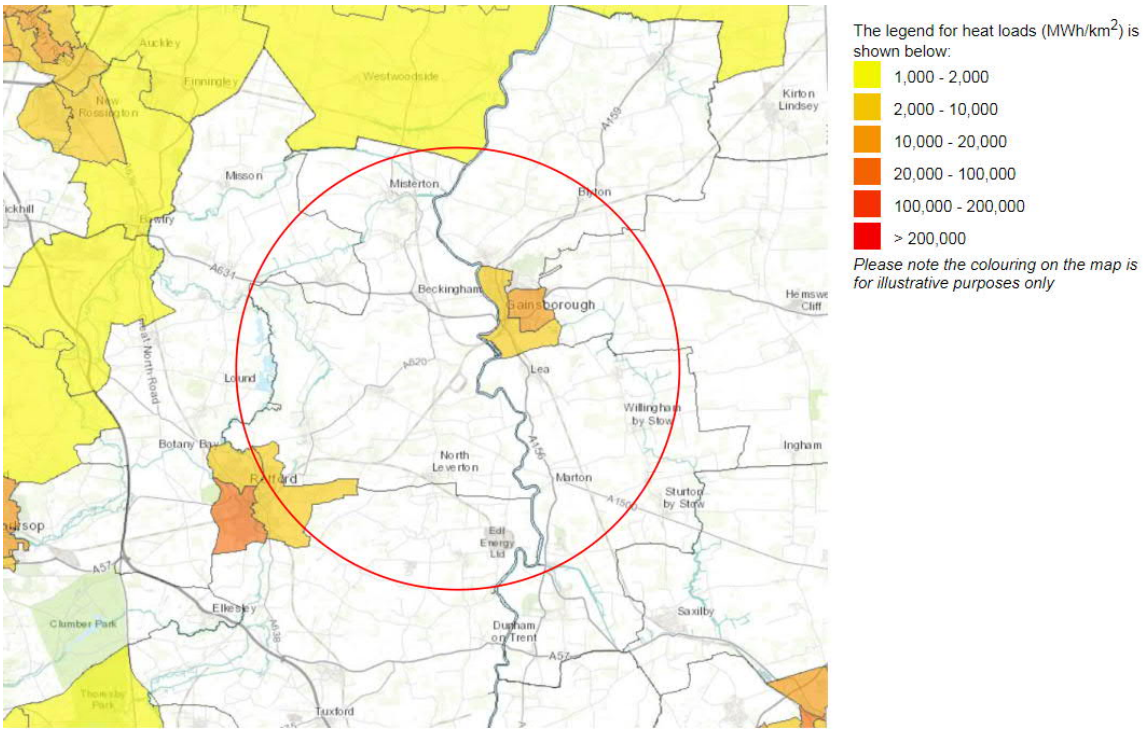
5. Possibilities for CHP

5.1 Initial CHP Investigation

5.1.1 To understand the likely heat demands in the vicinity of the Proposed Development, an assessment using the BEIS online heat map (Reference 6) was carried out.

5.1.2 **Figure 5-1** shows the results of the assessment of BEIS's Online Heat Map tool. The EA guidance suggests that for all plants less than 300MW a search radius of 10km is used. No individual large industrial heat loads were identified within this area.

Figure 5-1 Approximate total heat load within a 10 km radius around the Project site



5.1.3 **Table 5-1** shows the potential heat loads within the 10km search area. It identifies that the largest potential heat users are domestic, with an approximate requirement of 327,000 MWh. The second largest potential heat users are small industrial users, with an approximate requirement of 17,000 MWh. The third largest potential heat users are education users, with an approximate requirement of 6,300 MWh. Remaining heat requirements of other potential users in the area are all under 5,000 MWh.

Table 5-1 - Total heat loads within the CHP search area

SECTOR	SHARE	TOTAL MWH
Communications and Transport	0.04%	156
Commercial Offices	0.69%	2,518
Domestic	89.86%	327,147
Education	1.73%	6,295
Government Buildings	0.14%	503
Hotels	0.51%	1,855
Health	0.30%	1,093
Other	0.21%	750
Small Industrial	4.62%	16,825
Retail	0.83%	3,034
Sport and Leisure	0.33%	1,213
Warehouses	0.73%	2,671
Total heat load in area		**364,060**

5.1.4 Although there appears to be a large heat load in the area for domestic heat users, this is unlikely to represent a viable CHP opportunity for the reasons set out in **Section 4** in particular the intermittent running of peaking plant and the distance from the Site. In addition to these points, the comparatively low density (spread out) and age of housing in the region would make installing a new domestic district heating network technically challenging, with consequential cost implications.

5.1.5 The closest material heat loads are in the nearby town of Gainsborough, approximately 4km away. As discussed in **Section 4** this makes a CHP scheme unlikely to be economically viable due to the high cost of transporting heat in insulated pipes. Further to this, the heat load is the area is sparse and widely dispersed, making a CHP scheme impractical and prohibitively expensive.

5.1.6 Therefore, whilst consideration of the potential for the provision of CHP was considered as part of the site selection studies, as the proposal is for gas peaking plant, the provision of CHP was not the principal factor in the site selection process. This is recognised by EN-2 (paragraph 2.2.1), which states that '*it is for energy companies to decide which applications to bring forward and the government does not seek to direct applicants to particular sites for fossil fuel generating stations'.* It is further recognised in the CHP-R Guidance (paragraph 24), '*that in some cases (such as peaking plant...) the provision of CHP would not be compatible with the original operating regimes / intentions'*.

6. Conclusions

6.1.1 This assessment, developed in line with the CHP Ready Guidance for Combustion and Energy from Waste Power Plants, shows that there are five prohibitive barriers to the application of CHP for WBC:

- From local searches there are no suitable heat users of applicable scale to the unpredictable heat available within a search area up to 10km from the proposed development.
- No potential future heat requirements in the area have been identified and none that would match the operational pattern of a peaking power station are anticipated.
- The intermittent and peaking modes of operation of an OCGT are incompatible with the likely continuous demands of heat users.
- The Proposed Development has no steam cycle from which to extract waste heat for off-site users.
- The plant is not expected to operate for more than 1,500 hours per year on a rolling 5 year average and therefore an equivalent standby or backup generating plant would be required to feed any off site heat user when the plant is not operating.

6.1.2 For these reasons the Proposed Development is not considered to be viable for CHP opportunities.

7. References

1 The Planning Act 2008 (as amended).
2 Department for Energy and Climate Change (DECC, now BEIS). 2011. The Overarching National Policy Statement for Energy. (NPS EN-1).
3 Department for Energy and Climate Change (DECC, now BEIS). 2011. The National Policy Statement for Fossil Fuel Electricity Generating Infrastructure (NPS EN-2).
4 Department of Trade and Industry. 2006. Guidance on Background Information to Accompany Notifications under Section 14 (1) of the Energy Act 1976 and Applications under Section 36 of the Electricity Act 1989.
5 Environment Agency. 2013. CHP Ready Guidance for Combustion and Energy from Waste Power Plants. V1.0.
6 Department for Energy and Climate Change (DECC, now BEIS). Online UK CHP Development Map. http://chptools.decc.gov.uk/developmentmap