Cadoxton Power Ltd

Flexible Power Plant, Cadoxton

Air Quality Assessment

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Contents

1 Executive Summary

MLM Consulting Engineers Ltd (MLM) has been commissioned by Cadoxton Power Limited ('the Client'), to carry out an assessment of local air quality impacts associated with a Flexible Power Plant (FPP) in industrial area situated between Barry and Sully, Cadoxton, South Wales . The site lies within the administrative area of the Vale of Glamorgan Council (VGC).

The Cadoxton FPP comprises of eight no. 2.0MW_e engines and associated plant which is housed in a building. The facility generates a combined total of up to 16MW_e of electricity to feed into the National Grid. The assessment has been revised to reflect the proposed increase in operating hours to approximately 2500 hours per year.

The potential impacts of the FPP on local air quality during its operation has been assessed. Dispersion modelling has been completed to predict ground-level concentrations of pollutants at sensitive human and ecological receptor locations.

The type, source and potential impacts are identified and the measures that should be employed to minimise these impacts are described.

The assessment has found that there will be no exceedances of the relevant air quality objectives at locations of relevant exposure as a result of emissions from the operation of the FPP.

2 Limitations and Exceptions

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3 Introduction

3.1 General

MLM Consulting Engineers Ltd (MLM) has been commissioned to advise on the design process and assess the impact of air quality associated with the operation of a Flexible Power Plant (FPP) in an industrial area situated between Barry and Sully, Cadoxton, South Wales. The FPP includes eight no. $2.0MW_e$ spark ignition engines fuelled by natural gas, with exhausts through eight stacks, of 12m in height. The FPP generates a combined total of $16MW_e$ of electricity which feeds into the local distribution network owned and operated by Western Power Distribution.

The site is located between the settlements of Barry and Sully, with access via East Road, off Sully Moors Road ('Site') and lies within the administrative area of the Vale of Glamorgan Council (VGC).

The potential impacts of the FPP on local air quality during the operational phase has been assessed. The type, source and significance of potential impacts are identified and the measures that should be employed to minimise these impacts are described. The key pollutants considered in this assessment are: oxides of nitrogen (NO_x as NO_2), the primary pollutants arising from the combustion of natural gas. Other pollutants, such as sulphur dioxide (SO_2) and particulate matter (PM_{10}), sometimes associated with the operation of spark ignition engines (when run on biogas) are generated in negligible levels when using natural gas hence these are therefore not considered in the analysis.

Predicted concentrations of these pollutants are compared with relevant air quality standards and guidelines for the protection of human health and sensitive habitats.

3.2 Report Structure

The structure of the report is summarised below:

- A brief description of the site and FPP;
- A brief description of the legislation governing air quality;
- Details of the method and the input data used for the assessment;
- Results of the assessment; and,
- Conclusions.

3.3 Need for the FPP and Operating Scenario

An increasing proportion of the electricity generation capacity is coming from renewable sources. In order to manage short term fluctuations in demand and supply, the National Grid (NG) has access to a number of reserve power generators, which can be used at short notice to cover any gaps in demand and supply. Generally, a short term operating reserve (STOR) power plant will operate up to c.1000 hours per year. The latest NG Annual STOR report[1] indicates that the average running time for a STOR 'call' is 100 minutes, and that 90% of these calls are for less than 3.5 hours in duration. Notwithstanding this, and due to the contractual requirements with NG, the FPP must be available when it is called upon by NG at short notice and therefore cannot be restricted in terms of its operations. Accordingly this report (and the assessment assumptions) adopt the anticipated operating scenario.

NG's STOR is a specific balancing services tool tendered for by NG. In addition to STOR, Cadoxton Power is active in a number of other flexible generation services which can require it to operate for approximately 2500 hrs per year.

[1] Available at https://www.nationalgrid.com/sites/default/files/documents/STOR%20Annual%20Market%20Report%202016-2017_EXT.pdf

4 Site Location

The site is located within and industrial area to the east of Barry and west of Sully. The site is bordered by the B4267 Sully Moor Road to the east and East Road to the west and forms part of a wider industrial area. Much of the immediate area is concrete surfaced and bare. The approximate National Grid Reference for the site is 314577, 168709. The site location plan is shown in Figure 1.

The closest existing residences to the FPP are approximately 540m to the south east in Meadow View Court. A review of Defra's MAGIC map application was undertaken to identify sites of ecological interest within 5km of the application site. A number of sites have been identified, including Sites of Special Scientific Interest (SSSI), RAMSAR sites and Special Protection Areas (SPA). These are detailed in Section 5 and presented in Figure 2.

There are no Local Authority boundaries within 1km of the FPP site. The nearest neighbouring local authority is Cardiff City Council (CCC), approximately 5km to the north-east.

A FPP, operated by PeakGen Power Ltd ('PGP') has been identified to the south of Cadoxton FPP. It is understood that the site comprises 10 diesel generators with a power output of $24MW_e$. There are no other Specified Generators operating >50 hours per year within 1km of the FPP site. Cumulative impacts have been considered within Section 9 of this report.

5 Standards and Policy Relevant to Air Quality

5.1 International Legislation and Policy

The European Directive (2008/50/EC)[2] ('Directive 2008/50/EC') of the European Parliament and of the Council of 21st May 2008, sets legally-binding Europe-wide limit values for the protection of public health and sensitive habitats. The Directive streamlines the European Union's air quality legislation by replacing four of the five existing Air Quality Directives within a single, integrated instrument.

The pollutants included are sulphur dioxide (SO_2), nitrogen dioxide (NO_2), particulate matter of less than 10 micrometres (µm) in aerodynamic diameter (PM_{10}), particulate matter of less than 2.5µm in aerodynamic diameter lead ($PM_{2.5}$), lead (Pb), carbon monoxide (CO), benzene (C_6H_6), ozone (O_3), polycyclic aromatic hydrocarbons (PAHs), cadmium (Cd), arsenic (As), nickel (Ni) and mercury (Hg).

Directive 2008/50/EC makes it clear that the ambient air quality standards shall not be enforced where there is no regular public access and fixed habitation:

'2. Compliance with the limit values directed at the protection of human health shall not be assessed at the following locations:

(a) Any locations situated within areas where members of the public do not have access and there is no fixed habitation;

(b) In accordance with Article 2(1), on factory premises or at industrial installations to which all relevant provisions concerning health and safety at work apply;

(c) On the carriageway of roads; and on the central reservations of roads except where there is normally pedestrian access to the central reservation.'

The Industrial Emissions Directive (2010/75/EU)[3] ('IED') covers combustion plant with a capacity of greater than 50MWth. As such, the plant will not be regulated under IED. However, the medium combustion plant Directive (MCPD), which came into force on 18th December 2015, relates to combustion plant of a certain size (1-50MWth) and is regulated in terms of emissions to air, where it is not already covered by other Directives (such as IPPC, for example). The proposed scheme will be encompassed within the MCPD.

The principal requirements of the MCPD are that:

- All combustion plant of a certain size is regulated in terms of emissions to air, where it is not already covered by other Directives (such as IPPC, for example);
- That such plant is logged on a register and regulated by an 'appropriate authority' (likely to be the Environment Agency(EA) or Local Authorities);
- The emission concentrations are limited to those stated in the tables. Where they located in a 'Zone' where the air quality Directive is being exceeded, more stringent limits would apply; and
- Member states may wish to exempt plant which is operating on an intermittent basis as long as the total operational hours remain within the threshold.

The precise implications of the UK decision to exit the European Union on the potential adoption of legislation such as the MCPD is unclear at the time of writing.

[2]Directive 2008/50/EC of the European Parliament and of the Council. May 2008. Official Journal of the European Union

[3]Directive 2010/75/EU on industrial emissions. Official Journal of the European Union

The Environmental Permitting (England and Wales) (Amendment) Regulations 2018 SI 110 (henceforth the EPR) were published in January 2018 to transpose the requirements of the Medium Combustion Plant Directive (MCPD). The MCPD sets out rules to control emissions of sulphur dioxide (SO2), nitrogen oxides (NO_x) and dust into the air. The MCPD regulates pollutant emissions from the combustion of fuels in plants with a rated thermal input equal to or greater than 1 megawatt (MWth) and less than 50MWth and effectively forms a new tier of regulation for plant formerly below the trigger thresholds for permitting regulation.

5.2 Air Quality Strategy for England, Scotland, Wales & Northern Ireland

The Government's policy on air quality within the UK is set out in the Air Quality Strategy (AQS)[4] established for England, Scotland, Wales and Northern Ireland (AQS) published in July 2007, pursuant to the requirements of Part IV of the Environment Act 1995. The AQS sets out a framework for reducing hazards to health from air pollution and ensuring that international commitments are met in the UK. The AQS is designed to be an evolving process that is monitored and regularly reviewed.

The AQS sets standards and objectives for ten main air pollutants to protect health, vegetation and ecosystems.

The air quality standards are long-term benchmarks for ambient pollutant concentrations which represent negligible or zero risk to health, based on medical and scientific evidence reviewed by the Expert Panel on Air Quality Standards (EPAQS) and the World Health Organisation (WHO). These are general concentration limits, above which sensitive members of the public (eg children, the elderly and the unwell) might experience adverse health effects.

The air quality objectives (AQOs) are medium-term policy based targets set by the Government which take into account economic efficiency, practicability, technical feasibility and timescale. Some objectives are equal to the EPAQS recommended standards or WHO guideline limits, whereas others involve a margin of tolerance, ie a limited number of permitted exceedances of the standard over a given period.

For some pollutants there is both a long-term (annual mean) standard and a short-term standard. In the case of NO_2, the short-term standard is for a 1-hour averaging period. These periods reflect the varying impacts on health of differing exposures to pollutants.

The FPP is gas-fuelled, resulting in a relatively ‘clean’ combustion and therefore the only pollutants of relevance are oxides of nitrogen and carbon monoxide. Heavy metals, hydrogen halides and oxides of sulphur are not relevant in this case as they would be in the event that the fuel was heavy oils, diesel or waste, for example.

5.3 Local Air Quality Management (LAQM)

Part IV of the Environment Act 1995[5] also requires local authorities to periodically review and assess the quality of air within their administrative area. The Reviews have to consider the present and future air quality and whether any AQOs prescribed in Regulations are being achieved or are likely to be achieved in the future.

Where any of the prescribed AQOs are not likely to be achieved the authority concerned must designate that part an Air Quality Management Area (AQMA).

For each AQMA, the local authority has a duty to draw up an Air Quality Action Plan (AQAP) setting out the measures the authority intends to introduce to deliver improvements in local air quality in pursuit of the AQOs. Local authorities are not statutorily obliged to meet the objectives, but they must show that they are working towards them.

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[4]The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. 2007. Department for Environment, Food and Rural Affairs

[5]Environment Act 1995. Stationary Office

The Department of Environment, Food and Rural Affairs (DEFRA) has published technical guidance for use by local authorities in their Review and Assessment work. This guidance, referred to in this chapter as The Local Air Quality Management Technical Guidance 2016[6] document (LAQM.TG (16)), has been used where appropriate in the assessment.

5.4 Welsh Planning Policy

5.4.1 Well-Being of Future Generations Act 2015

The Wellbeing of Future Generations Act (Wales) Act 2015[7] sets out a 'sustainable development principle' requiring planning decisions to comply with the 7 well-being goals:

- A prosperous Wales;
- A resilient Wales;
- A healthier Wales;
- A more equal Wales;
- A Wales of cohesive communities;
- A Wales of vibrant culture and thriving Welsh language; and
- A globally responsible Wales.

The 'Sustainable Development Principle' as discussed in Paragraph 5 (1) sets out that public bodies *"must act in a manner which seeks ensure that the needs of the present are met without compromising the ability of future generations to meet their own needs."*

Amongst other responsibilities, Paragraph 5(2) states that *"in order to act in that manner, a public body must take account of "the importance of balancing short term needs with the need to safeguard the ability to meet long term needs, especially where things done to meet short term needs may have detrimental long term effect"*… and *"how deploying resources to prevent problems occurring or getting worse may contribute to meeting the body's well-being objectives, or another body's objectives."*

5.4.2 Planning Policy Wales (PPW)

Planning Policy Wales (PPW) Edition 9[8], November 2016 sets out the most up to date prevailing National Framework for planning guidance in Wales. That said, in light of the 'Well-being of Future Generations (Wales) Act 2015', Ministers are proposing to revise Planning Policy Wales (PPW) and a consultation on a Draft 'Edition 10' was launched on 12 February 2018 running until 18 May 2018. A draft version of this document is now available.

At the heart of the document is sustainable design. Paragraph 2.31 states that:

"Good design promotes environmental sustainability. Developments should seek to maximise energy efficiency and the efficient use of other resources, maximise sustainable movement, minimise the use of non-renewable resources, encourage decarbonisation and prevent the generation of waste and pollution. An integrated and flexible approach to design, including early decisions regarding location, density, layout, built form, the choice of materials and site treatment will be an appropriate way of contributing to resilient development."

[6] Local Air Quality Management Technical Guidance LAQM.TG (16). April 2016. Department for Environment, Food and Rural Affairs

[7] Available at https://gov.wales/topics/people-and-communities/people/future-generations-act/?lang=en

[8] Available at https://gov.wales/topics/planning/policy/ppw/?lang=en

And Paragraph 2.32 states that:

"Good design can help to ensure high environmental quality. Landscape and green infrastructure considerations are an integral part of the design process and integrating green infrastructure and addressing environmental risks can make a positive contribution to environmental protection and improvement, for example to land contamination, biodiversity, climate protection, air quality and the protection of water resources."

With specific regards to air quality, within Chapter 5 of the PPW, Distinctive and Natural Places, is a section on 'Recognising the Environmental Qualities of Places' and more specifically 'Air Quality and Soundscape'. The opening paragraph states that:

"Clean air and an appropriate soundscape15, contribute to a positive experience of place as well as being necessary for public health, amenity and well-being. They are indicators of local environmental quality and integral qualities of place which should be protected through preventative or proactive action through the planning system."

5.4.3 Technical Advice Notes (TANs)

Technical Advice Notes [9](TANs) take forward the policies and objectives of PPW and provides local authorities with guidance on the relevant factors with which to prepare their local plans and base their planning decisions.

TAN12 (Design) 2016 provides guidance on how good design should be achieved. The objectives of good design as shown in Figure 1 of TAN12, relate to access, character, community safety, environmental sustainability and movement. An overview of the journey to siting and the design of this proposal are set out in a Design and Access Statement that accompanies the application.

TAN5 (Nature Conservation and Planning) 2009 provides guidance on how proposals should contribute to protecting and enhancing biodiversity.

TAN6 (Planning for Sustainable Rural Communities) provides guidance on how planning decisions can help support sustainable rural communities. The proposal the subject of this application provides a back-up generation of power to the local community and therefore is an important opportunity to secure energy security for the local area.

5.5 Air Quality Standards and Guidelines for Ecology

In addition to undertaking an assessment of the potential effects of emissions from the FPP on human health, assessment of air quality impacts on protected ecological receptors has also been undertaken. These impacts are of interest only for the operational phase, as short term impacts during construction are considered to be negligible. Effects on sensitive ecological receptors primarily arise as a result of pollutant emissions by the following mechanisms:

- Direct effects on flora due to increased concentrations of airborne pollutants;
- Secondary effects on flora due to changes in soil chemistry brought about by deposition of pollutants to soil; and
- Secondary effects on fauna due to changes in flora.

[9]Available at https://gov.wales/topics/planning/policy/tans/?lang=en

The European Habitats Directive[10] sets out the legal framework requiring EU member states to protect habitat sites supporting vulnerable and protected species, as listed within the Directive. This Directive was incorporated into UK domestic legislation by means of the Conservation of Habitats and Species Regulations 2010[11]. This Directive requires the protection of certain sites including Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and RAMSAR sites. In addition, impacts on air quality are predicted at nationally important ecology sites in the form of Sites of Special Scientific Interest (SSSIs) and any relevant locally designated habitat sites.

The relevant standards and guidelines that provide a framework for assessing impacts on sensitive ecological receptors are derived from a number of sources:

- Air quality standards (AQS) for NO_x (annual mean) for the protection of habitats are derived from European Union Air Quality Directives;
- Air quality guidelines for NO_x (24 hour mean) have been derived by the Centre for Ecology and Hydrology (CEH) and are set out in EA Guidance[12]; and,
- Guidelines for the assessment of acid and nutrient nitrogen deposition as set out in the UK Air Pollution Information Service (APIS) website[13].

On the basis of the above legislative framework and guidance, relevant critical levels (that relate to airborne pollutants) and site specific critical loads (that relate to deposition of materials to soils) have been established. These values represent the environmental criteria used in this assessment.

[10]Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora

[11] Statutory Instrument 2010 No. 490 The Conservation of Habitats and Species Regulations 2010

[12]Environment Agency (2016) Air emissions risk assessment for your environmental permit

https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit#page-navigation

[13] Centre for Ecology and Hydrology (2010) UK Air Pollution Information Service http://www.apis.ac.uk/

6 Methodology

6.1 Overview

This section details the basis of the methodology used for the assessment further to consultation undertaken with the relevant statutory bodies.

6.2 Applicable Air Quality Limits

Based on the emissions data from the FPP, the below air quality limits have been identified. Limits for human receptors are shown in Table 6.1 below.

Table 6.1 Limits for Protection of Human Health

Pollutant	Averaging Period	EAL/AQS ($\mu g/m^3$)	Comments
Nitrogen Dioxide (NO_2)	Annual Mean	40	UK AQO
Nitrogen Dioxide (NO_2)	1-hour Mean	200	UK AQO, not to be exceeded more than 18 times per annum

For the purposes of LAQM, regulations state that exceedances of the objectives should be assessed in relation to '*the quality of the air at locations which are situated outside of buildings or other natural or man-made structures, above or below ground, and where members of the public are regularly present*'.

Examples of where the objectives should, and should not apply, are summarised in DEFRA Guidance LAQM TG(16). This guidance should be considered in the context of the conclusions of various review documents such as The AQC report *Relationship between the UK Air Quality Objectives and Occupational Air Quality Standards (November 2016)*. In particular it is important that, when setting the objective, DEFRA took account of EPAQs' recommendations. It was also influenced by the limit value set in European Commission's First Air Quality Daughter Directive which made it clear that it only applied to '*outdoor air in the troposphere, excluding work places*'. The Ambient air quality Directive is consistent with this, stating that '*Compliance with the limit values directed at the protection of human health shall not be assessed… on factory premises or at industrial installations to which all relevant provisions concerning health and safety at work apply*'.

As such, commercial/industrial occupiers of industrial units such as those in the nearby Industrial Estates, would therefore be outside the requirements of the AQOs. Occupiers of industrial units where members of the public would 'regularly be present' are however within the requirements.

The criteria for assessment of impacts at sensitive ecological receptors are derived from three sources:

- UK AQS;
- Critical loads set out on the Air Pollution Information System (APIS) website; and
- EAs Environmental risk assessment.

For ecological impacts, two metrics are assessed: critical levels (which are expressed as the concentration of a pollutant in air) and critical loads (which are expressed as the deposition of a pollutant to the surface). Critical levels are not habitat or species specific and are the same for all sites. These are set out in Table 6.2.

Impacts relating to acid and nutrient nitrogen deposition are habitat and species specific; the site specific critical loads are set out in Tables 6.9 for the sensitive ecological receptors applicable to this FPP.

Table 6.2 Limits for Protection of Ecological Receptors (applicable to flora)

Pollutant	Averaging Period	Concentration (μg/m³)
Oxides of Nitrogen (NO_x)	Annual Mean	30
Oxides of Nitrogen (NO_x)	Daily Mean	75

6.3 Study Area

The assessment will take into account the sensitivity and potential impacts of the FPP on ecological and human receptors within 5km from the Site ('Study Area').

The Study Area for the assessment has been identified based on the size, location and operational regime of the FPP. The following sections detail the adopted Study Area(s).

6.3.1 Sensitive Human Health Receptors

The term 'sensitive receptors' includes any persons, locations or systems that may be susceptible to changes as a consequence of the FPP.

Impacts have been modelled against specific discrete receptor locations in addition to a receptor grid and impact pollution contours presented within this report. The list of discrete receptors included within the model are shown in Table 6.3 below and Figure 2.

Table 6.3 Discrete receptor Locations

ID	Receptor	OS GR X (m)	OS GR Y (m)
HR1	Meadow View Court	315046.2	168488.1
HR2	Beechwood College	314890.4	168160.1
HR3	Cardiff Road	313974.7	168879.3

These ground level concentrations may therefore be compared with relevant air quality standards and guidelines for the protection of health at any location.

As described above, Directive 2008/50/EC makes it clear that the ambient air quality standards shall not be enforced where there is no regular public access and fixed habitation:

> *'2. Compliance with the limit values directed at the protection of human health shall not be assessed at the following locations:*
>
> *a) (Any locations situated within areas where members of the public do not have access and there is no fixed habitation;*
>
> *b) In accordance with Article 2(1), on factory premises or at industrial installations to which all relevant provisions concerning health and safety at work apply;*
>
> *c) On the carriageway of roads; and on the central reservations of roads except where there is normally pedestrian access to the central reservation.'*

The long term objective would not apply at workplaces within or adjacent to the FPP, DEFRA LAQM TG (16) states the following in relation to application of the objectives, particularly the short term objectives:

> *1.38 For the purposes of LAQM, regulations state that exceedances of the objectives should be assessed in relation to "the quality of the air at locations which are situated outside of buildings or other natural or man-made structures, above or below ground, and where members of the public are regularly present".*

Annual and hourly average impacts have been modelled on a receptor grid and pollution contours have been presented in order to visualise the predicted impacts. These predicted concentrations have then been compared with relevant long- and short-term air quality standards and guidelines for the protection of human health.

6.3.2 Sensitive Ecological Receptors and Designated Habitats

The following sites protected on account of their habitats or species have been assessed:

- Special Areas of Conservation (SACs) and candidate SACs (cSACs) designated under the EC Habitats Directive[14];
- Special Protection Areas (SPAs) and potential SPAs designated under the EC Birds Directive[15];
- Ramsar Sites designated under the Convention on Wetlands of International Importance[16];
- Sites of Special Scientific Interest (SSSI);
- National Nature Reserves (NNR);
- Local Sites; and,
- Ancient woodland.

Where sensitive ecological receptors are present, maximum predicted ground level concentrations of NO_x are compared with relevant critical levels, thresholds of airborne pollutant concentrations above which damage may be sustained to sensitive flora and species. The FPP is not a significant source of SO_2 or HCl/HF arising from the combustion of natural gas and these pollutants are not considered further.

Points within the relevant sites of European/national interest have been modelled as the following discrete receptor locations, located at the nearest/worst case point with regards to the Proposed Development and are shown in Table 6.4.

Table 6.4 Ecological Receptor Locations

ID	Receptor	Designation	OS GR X (m)	OS GR Y (m)
ER1	Cog Moors	SSSI	315625	169199
ER2	Cosmeston Lakes	SSSI	317154	169133
ER3	Penarth Coast	SSSI	317350	167630
ER4	Hayes Point	SSSI	314482	167720
ER5	Fferm Walters	SSSI	310254	168990
ER6	Barry Island	SSSI	312065	166582
ER7	Barry Woodlands	SSSI	312885	170250
ER8	Sully Island	SSSI, ,	316444	167050
ER9	Severn Estuary	SPA, SSSI, SAC, RAMSAR	318629	168605

[14] Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.

[15] Council Directive 79/409/EEC on the conservation of wild birds.

[16] The Convention of Wetlands of International Importance especially as Waterfowl Habitat 1971 (The Ramsar Convention).

6.4 Scope and Extent of the Assessment

6.4.1 Operational Emissions to Atmosphere

The only vehicle movements associated with the FPP will be service and maintenance visits (estimated at roughly six two-way movements per month). Therefore, dispersion modelling of traffic impacts during the operational phase of the FPP is not included within the assessment.

The scope of the impact assessment for stack emissions from the FPP has been determined in the following way:

- Review of air quality data for the area surrounding the Site, including data from the Defra Air Quality Information Resource (UK-AIR) and the APIS;
- Desk study to confirm the location of nearby areas that may be sensitive to changes in local air quality; and,
- Review of emission parameters for the FPP and dispersion modelling using the Breeze AERMOD 8 dispersion model (version 16216r) to predict ground-level concentrations of pollutants at sensitive human and habitat receptor locations.

6.5 Modelling Inputs

6.5.1 Design Basis for the Assessment

One model scenario has been assessed which represents the FPP layout. All emissions to air will be via eight 12m stacks, over 3m above the roofline of the plant and adjacent buildings. Manufacturer emission limits have been assumed for the purposes of the modelling assessment and the Proposed Development is assumed to be operating at full load:

- For the entire year (8760 hours), with regards to short term impacts, as these rely on a maximum value rather than average over the period; and,
- For 2500 hours of the year for annual average impacts.

This is consistent with Environment Agency guidance[17], which has been used in relation to the input data for the prediction of annual average impacts from an intermittent process.

As typical STOR or FPP facilities are not expected to be operational for the above durations, the modelled scenario is considered to represent a typical operating scenario.

6.5.2 Engine Parameters

The FPP will use gas-fuelled spark ignition engines for the generation of electricity. The relevant details are shown in Table 6.5

Table 6.5 Release Parameters

Parameter	Engine Type
Model	TCG 2020V20
Number of Units	8
Actual Flow Rate per engine (Am^3/s)	5.91
Normalised Flow Rate per engine (Nm^3/s)	2.35

[17] AQMAU, Conversion Rates for NO_x and NO_2

Parameter	Engine Type
NO_x Emission Concentration (mg/Nm^3)	500

The emission parameters for the combined stack for modelling purposes are as follows:

- Stack Height: 12m;
- Stack Diameter: 0.45m;
- Temperature of Release: 686K; and
- Emission Velocity at Stack Exit: 37.17 m/s.

The mass emissions per engine type are shown in Table 6.6 below.

Table 6.6 Emissions per Engine

Pollutant	Modelled Emission (g/s)
NO_x	0.80

The location of each stack is presented in Table 6.7.

Table 6.7 Stack Location

Stack	OS GR X (m)	OS GR Y (m)
Engine 1	314584.7	168695.1
Engine 2	314583.5	168700.6
Engine 3	314582.3	168706.3
Engine 4	314581.2	168711.8
Engine 5	314580.1	168717.4
Engine 6	314578.9	168723.0
Engine 7	314577.8	168728.5
Engine 8	314576.6	168734.1

6.6 Local Meteorological Data

The dispersion modelling has been based on five years (2013-2017) of hourly sequential meteorological data in order to take account of inter-annual variability and reduce the effect of any atypical conditions. Data from the meteorological station at Rhoose meteorological station has been used for the assessment, which is the most representative data currently available for the Study Area.

A wind rose for all years of meteorological data is presented in Figure 3.

6.6.1 Building Downwash/Entrainment

The topography near the FPP site is relatively flat, with the development at approximately 6.3m AoD. Topography data has been included within the dispersion model within a DEM files covering the Study Area.

The presence of buildings close to emission sources can significantly affect the dispersion of pollutants by leading to downwash. This occurs when a building distorts the wind flow, creating zones of increased turbulence. Increased turbulence causes the plume to come to ground earlier than otherwise would be the case and result in higher ground level concentrations closer to the stack.

Downwash effects are only significant where building heights are greater than 40% of the emission release height. The downwash structures also need to be sufficiently close for their influence to be significant.

The building that houses the engines is only included with the dispersion model and the details are shown in Table 6.8 below.

Table 6.8 Details of buildings entered into the dispersion model

No	Building	Approximate Centre Point (X,Y)	Max Height (m)	Length/Width (m)	Elevation (m)	Angle
B1	FPP Building	314582.1, 168739.2	8.0	19.3/48.6	4	168.2

6.6.2 Nitric Oxide to NO_2 Conversion

Oxides of nitrogen (NO_x) emitted to atmosphere as a result of combustion will consist largely of nitric oxide (NO), a relatively innocuous substance. Once released into the atmosphere, NO is oxidised to NO_2. The proportion of NO converted to NO_2 depends on a number of factors including wind speed, distance from the source, solar irradiation and the availability of oxidants, such as ozone (O_3).

A conversion ratio of 70% NO_x: NO_2 has been assumed for comparison of predicted concentrations with the long-term objectives for NO_2. A conversion ratio of 35% has been utilised for the assessment of short-term impacts, as recommended by Environment Agency guidance[18].

6.7 Assessment Criteria

In relation to ambient pollutant concentrations, the criteria used for the assessment of operational impacts are the AQOs and limit values set out in Table 5.1.

For deposition, no comparable regulated standards exist and the impacts are assessed against critical loads.

A critical load is defined as *"a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge".* Critical loads are set for effects due to eutrophication (nitrogen deposition) and acidification (combined action of sulphur and nitrogen deposition).

Critical loads are assigned to habitat classes of the European Nature Information System (EUNIS) to enable consistency of habitat terminology and understanding across Europe. They are presented as ranges (eg 10-20kgN/ha/yr) which reflect variations in ecosystem response across Europe. In this assessment, a conservative approach has been adopted and impacts are compared to the lower limit of the specified range.

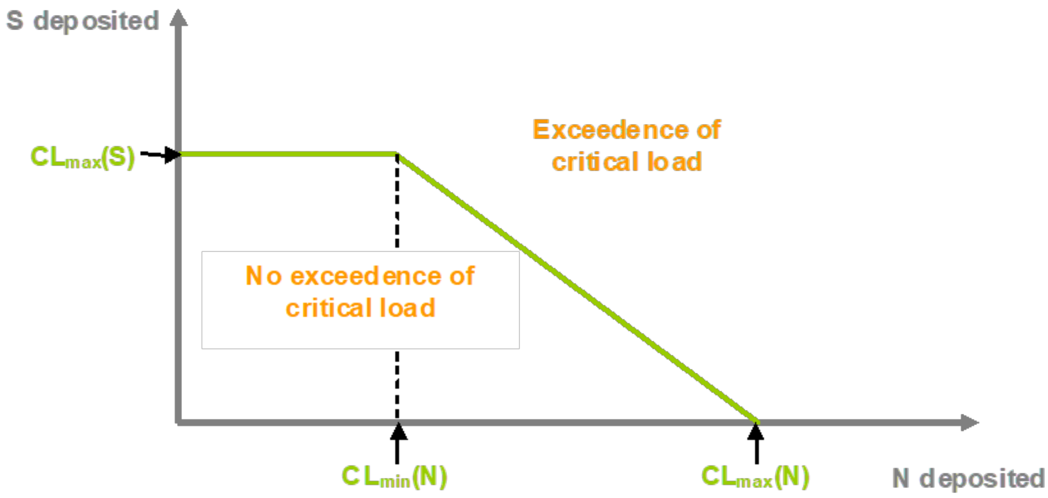
For acidification, the critical loads are specified through the definition of a critical load function (CLF) which identifies the combinations of sulphur and nitrogen deposition that will not cause harmful effects. In the CLF, sulphur deposition is plotted against nitrogen deposition (shown below), and the risk of acidification impacts is characterised by the three following quantities:

- CLmax(S) – Maximum critical load for sulphur
- CLmin(N) – Minimum critical load for nitrogen
- CLmax(N) – Maximum critical load for nitrogen

This is shown in Insert 1.

[18] AQMAU, Conversion Rates for NOx and NO_2.

Insert 1 - Schematic of Critical Load Function for acidification



The critical loads used in the assessment for SSSI, SAC and Ramsar sites were taken from APIS website, using the facility to extract site-specific relevant critical loads. The critical loads are shown in Table 6.9

Table 6.9 Critical Loads for Ecological Receptors in Model Domain

Designated Site	Most Sensitive Habitat	Nitrogen Deposition kgN/ha/yr		Acidification k_{eq}/ha/yr					
				CLmin(N)		CLmax(N)		CLmax(S)	
		Min	Max	Min	Max	Min	Max	Min	Max
Cog Moors	Neutral Grasslands – Mountain Hay Meadows	10	20	0.30	0.44	2.28	4.39	1.59	4.90
Cosmeston Lakes	Coniferous Woodlands	5	15	0.38	0.38	2.88	2.89	2.53	2.53
Penarth Coast	Neutral Grasslands – Mountain Hay Meadows	10	20	0.44	1.71	2.28	5.71	1.59	4.00
Hayes Point	Not sensitive to Nitrogen or Acidity								
Fferm Walters	Neutral Grasslands – Mountain Hay Meadows	10	20	1.00	1.00	5.00	5.00	4.00	4.00
Barry Island	Not Sensitive to Nitrogen or Acidity								
Barry Woodlands	Coniferous Woodlands	5	15	0.14	0.36	2.88	11.16	1.94	2.53
Sully Island	Purple Moor Grass and Rush Pastures - (Swamp)	15	25	0.22	0.22	4.31	4.31	4.09	4.09
Severn Estuary	Pioneer, Low-Mid, Mid-Upper Saltmarshes	20	30	0.22	0.44	1.06	4.57	0.84	4.13

6.8 Significance of Impact

The EA online guidance states that in order to determine the potential significance of the predicted impacts, two parameters need to be presented:

- The Process Contribution (PC) which is the pollutant concentration resulting from the contribution of the FPP alone; and
- The Predicted Environmental Concentration (PEC) which is the background concentration plus the process contribution.

Both metrics are considered as absolute pollutant concentrations and as a percentage of the relevant assessment standard. Based upon the EA online guidance the significance criteria for assessing impacts in the assessment are set out below. The PC can be considered insignificant if:

- The long term process contribution is <1 % of the long term air quality standards or guidelines;
- The short term process contribution is <10 % of the short term air quality standards or guidelines.

In the event that the PC exceed the above criteria, impacts can be considered insignificant when the PEC does not exceed 70% of the long term standard, or 20% of the headroom between short term standard and short term background concentrations. This approach is used to give clear definition to those impacts that can be disregarded as insignificant, including impacts on statutory designated sites, and which need to be considered in more detail or may require specific further mitigation.

In relation to impacts on sensitive designated sites, the specific sensitivity criteria taken from EA online guidance state that impacts of stack emissions are considered to have insignificant impact (ie no further mitigation or assessment required) if:

- PC is <100% of the Long Term Critical Load or Critical Level
- PEC is <100% of the Critical Load or Critical Level.

7 Baseline Conditions

7.1 Review and Assessment of Air Quality for Human Health Receptors

The site lies within the administrative area of the Vale of Glamorgan Council (VGC).

VGC carries out frequent reviews and assessments of air quality within the area and produces LAQM reports in accordance with the requirements of DEFRA. There is currently one Air Quality Management Area (AQMA) within the borough, located approximately 4.7km away in the town of Penarth, declared in 2013 for exceedances of the annual mean NO_2 NAQO.

The executive summary of the latest Air Quality Annual Status Report (ASR) 2017 states that:

"This Annual Progress Report confirms that air quality within the Vale of Glamorgan continues to meet the relevant air quality objectives, including within the existing Air Quality Management Area (AQMA) on Windsor Road, Penarth."

7.2 Local Monitoring Data

VGC undertook continuous automatic monitoring of air quality at one location during 2016, NO_x and PM_{10}. The automatic monitor is situated within the Penarth AQMA approximately 4.7km from the Proposed Development site and is a roadside monitor. This site would not be representative of the FPP site and as such data has not been presented within this report.

VGC undertook passive sampling of NO_2 at 44 locations during 2016. The nearest monitoring location with respect to the FPP site were located within Barry and one site within Sully. Annual mean concentrations at sites within 2km have been produced in Table 7.1.

Table 7.1 VGC Passive Diffusion Tube Monitoring Data 2012 - 2016

ID	Location	Type	2012	2013	2014	2015	2016
41	Dispenser Rd, Sully	Urban Background	16.1	15.0	13.1	13.1	14.5
66	17 Churchill Terrace, Barry	Roadside	37.5	33.0	30.2	30.9	27.7
83	24 Cardiff Rd, Barry	Roadside	29.5	27.0	23.2	23.2	24.9
84	Bendricks Rd, Barry	Urban Background	13.8	15.0	12.9	12.5	13.7
87	110 Dock View Rd, Barry	Roadside	18.9	17.0	16.6	14.8	15.0

The data shows that no site has exceeded the annual mean NO_2 AQO in any year. The data also shows a general downward trend in emissions between 2012 and 2016.

7.3 DEFRA Background Maps

Additional information on background concentrations in the vicinity of the Application Site has been obtained from the 2015 DEFRA background pollutant maps and extrapolated to 2018. Background concentrations from grid square 314500, 168500 which represents the Application Site, are provided in Table 7.2.

Table 7.2 Estimated 2018 Background Concentrations from DEFRA Maps

Pollutant	2018 Concentration (µg/m^3)
NO_x	18.1
NO_2	13.1

The data presented in Table 5.2 shows that the estimated background concentration of NO_2 is 'well below' the annual mean objective of 40 µg/m^3, and NO_x concentrations are well below the annual mean objective for the protection of vegetation of 30 µg/m^3. For calculation of an hourly NO_2 background, the annual mean has been doubled in line with EA guidance and LAQM. (TG16).

7.4 Background Data used in the Assessment

Data from the Dispenser Road urban background site will be used for the human and grid receptors as it is representative of the area type and location. It is proposed that background NO_2 concentrations from the nearest 1km grid square from the Defra maps will be applied at ecological receptors, as these are typically in a rural setting and at a greater distance from the FPP site. NO_x background concentrations for each ecological receptor have been obtained from the APIS website and represent a three year average 2015 - 2017:

- ER1 Cog Moors – 15.82µg/m^3;
- ER2 Cosmeston Lakes – 11.77µg/m^3;
- ER3 Penarth Coast – 10.61µg/m^3;
- ER5 Fferm Walters – 15.98µg/m^3;
- ER7 Barry Woodlands – 15.95µg/m^3;
- ER8 Sully Island – 11.54 µg/m^3; and
- ER9 Severn Estuary – 12.26 µg/m^3.

7.5 Background Pollutant Deposition

Background levels of nitrogen and sulphur deposition within the study areas have been taken from the APIS website and are presented in Table 7.4.

For all sites, nitrogen deposition levels exceed the estimated minimum of the critical load range. Furthermore, at Cosmeston Lakes, Fferm Walters and Barry Woodland, the level of nitrogen deposition also exceeds the upper estimate of the critical load.

For acidification, the baseline nitrogen and sulphur deposition results in no exceedances of the lower estimate of the critical load function for all receptors. In summary, levels of nitrogen deposition are high and, taking into account uncertainty in the setting of critical loads, are likely to exceed the critical loads for all habitats in the designated sites in the study area.

Table 7.4 Background Deposition for Ecological Receptors in Model Domain

Designated Site	Most Sensitive Habitat	Nitrogen Deposition kgN/ha/yr		Acidification k_{eq}/ha/yr			
				Nitrogen		Sulphur	
		Critical Load	Max	Critical Load	Max	Critical Load	Max
Cog Moors	Neutral Grasslands – Mountain Hay Meadows	10	10.22	2.28	0.73	1.59	0.21
Cosmeston Lakes	Coniferous Woodlands	5	16.38	2.88	1.17	2.53	0.24

Designated Site	Most Sensitive Habitat	Nitrogen Deposition kgN/ha/yr		Acidification k_{eq}/ha/yr			
				Nitrogen		Sulphur	
		Critical Load	Max	Critical Load	Max	Critical Load	Max
Penarth Coast	Neutral Grasslands – Mountain Hay Meadows	10	12.88	2.28	0.92	1.59	0.27
Fferm Walters	Neutral Grasslands – Mountain Hay Meadows	10	26.04	5.00	1.86	4.00	0.50
Barry Woodlands	Coniferous Woodlands	5	23.66	2.88	1.69	1.94	0.28
Sully Island	Purple Moor Grass and Rush Pastures - (Swamp)	15	9.7	4.31	0.69	4.09	0.30
Severn Estuary	Pioneer, Low-Mid, Mid-Upper Saltmarshes	20	9.66	1.06	1.70	0.84	0.45

The range of critical loads for the most sensitive habitat(s) in each site are also shown; for acidification, the critical loads are taken to be the CLmax(N) and CLmax(S). All data taken from the APIS website. Deposition values represent the value for the site taken from the 5km x 5km resolution mapped data.

8 Assessment of Impacts

The assessment results are presented in the tables below. These relate to the operation phase of the FPP including the detailed dispersion modelling assessment results for emissions from the stacks.

8.1 Human Health Effects during the Operational Phase at Sensitive Receptor Locations

The results at the receptor locations (relevant to human impacts) are shown in Table 8.1 below. Annual concentration impacts have been adjusted for the approximate operating hours for the FPP (2500 hrs). The highest predicted long term NO_2 impacts are predicted at receptor HR1, an increase of 1.61µg/m³ (4.03% PC). As such the long term PC exceeds the 1% criteria, however the long term PEC is well below 70% of the long term standard and as such the impact can be considered as **'insignificant'**.

Table 8.1 Comparison of Annual Mean NO_2 Predictions with Baseline Concentrations (µg/m³)

Receptor Ref	PC Annual NO_2 (µg/m³)	% PC of the AQO	PEC Annual NO_2 (µg/m³)	% PEC of the AQO
HR1	1.61	4.0	16.11	40.3
HR2	0.32	0.80	14.82	37.1
HR3	0.46	1.2	14.96	37.4
AQO	**40 µg/m³**			

Short term (1 hr 99.79th percentile) NO_2 concentrations at each receptor, presented in Table 8.2, exceed 10% of the short term standard and the PEC exceeds 20% of the head room between the short term standard and the short term background, constituting a potential significant impact. However the PEC concentrations fall well below the short term standard (below 50% at each receptor) and the operating regime included within the model (8760 hrs) for five years far exceeds the approximate number of hours the FPP could run for (2500 hrs), and as such presents the worst-case impact.

Table 8.2 Comparison of 99.79th Percentile 1-hr NO_2 Predictions with Baseline Concentrations (µg/m³)

Receptor Ref	PC (99.79th Percentile) 1-hr NO_2	% PC of the AQO	PEC (99.79th Percentile) 1-hr NO_2	% PEC of the AQO
HR1	36.98	18.5	65.98	33.0
HR2	23.09	11.5	52.09	26.0
HR3	25.32	12.7	54.32	27.2
AQO	**200 µg/m³**			

Short term (1 hr 100th percentile) NO_2 concentrations do not exceed 200µg/m³ at any receptor. Furthermore the operating regime included within the model (8760 hrs) for five years far exceeds the approximate number of hours the FPP could run for (2500 hrs), as such hourly NO_2 concentrations will likely be far lower.

Table 8.3 Comparison of 100th Percentile 1-hr NO_2 Predictions with Baseline Concentrations (µg/m³)

Receptor Ref	PC (100th Percentile) 1-hr NO_2	% PC of the AQO	PEC (100th Percentile) 1-hr NO_2	% PEC of the AQO
HR1	110.82	55.4	139.82	69.9
HR2	31.35	15.7	60.35	30.2
HR3	83.64	41.8	112.64	56.3

8.2 Sensitive Habitats Impact during the Operational Phase

Standalone operation NO_x impacts at ecological receptors are presented in Table 8.4 below. Annual NO_x PCs are below 1% of the critical level except at ER. However, all PECs are well below 70% of the AQO. As such, the impact at sensitive habitats can be considered '**insignificant**'.

Table 8.4 Comparison of Predicted Annual NO_x and Background Concentrations (μg/m³) with Critical Levels

Receptor Ref	PC Annual NO_x (μg/m³)	% PC of the AQO	PEC Annual NO_x (μg/m³)	% PEC of the AQO
ER1	0.44	1.5	16.26	54.2
ER2	0.17	0.6	11.94	39.8
ER3	0.19	0.6	10.80	36.0
ER5	0.03	0.1	16.01	53.4
ER7	0.09	0.3	16.04	53.5
ER8	0.19	0.6	11.73	39.1
ER9	0.11	0.4	12.37	41.2
AQO	**30 μg/m³**			

Short term (24 hr) NO_x concentrations exceed the EA screening criteria at receptors ER1 and ER7. The short term assessment has been run for 8760 hours, far exceeding the maximum number of hours the plant is expected to run for (2500 hrs) and PEC concentrations fall below the applicable critical level, as such the impacts are considered to be '**insignificant**'.

Table 8.5 Comparison of Predicted 24 hr NO_x and Background Concentrations (μg/m³) with Critical Levels

Receptor Ref	PC Annual NO_x (μg/m³)	% PC of the AQO	PEC Annual NO_x (μg/m³)	% PEC of the AQO
ER1	17.48	23.3	49.12	65.5
ER2	4.69	6.2	28.23	37.6
ER3	5.09	6.8	26.31	35.1
ER5	3.06	4.1	35.02	46.7
ER7	7.60	10.1	39.50	52.7
ER8	8.32	11.1	31.40	41.9
ER9	3.38	4.5	27.90	37.2
AQO	**75 μg/m³**			

Table 8.6 shows the maximum process contribution to nitrogen and acid deposition resulting from the FPPs emissions for the designated sites respectively. As shown in Table 7.4, existing deposition levels exceed the lower estimates of the critical loads for the most sensitive habitat for nitrogen deposition but not for acid deposition.

For all sites, the contribution of the FPP to total nitrogen or acid deposition is less than 0.7% of the relevant critical load. The data presented in Table 8.6 reflect the maximum deposition levels over the designated sites and mean impacts over the sites, taking into account due to both inter-annual and spatial variability, are significantly lower. Based on EA guidance this level of impact on nitrogen deposition is **'insignificant'**.

For acid deposition, the deposition of nitrogen has been assessed against the CLmax(N) parameter within the critical load function. The maximum impacts are less than 1% of this critical load. With impacts of the order of 0.1% or less of the relevant critical loads, the difference between deposition levels with and without the Project is indistinguishable. That is to say, the risk of exceedance of critical loads or the level of exceedance of the critical load, is wholly dependent on the existing deposition levels. Based on EA guidance this level of impact on acid deposition is **'insignificant'**.

Table 8.6 Predicted Nitrogen Deposition and Acidification at Ecological Receptors in Model Domain

Designated Site	Most Sensitive Habitat	Nitrogen Deposition kgN/ha/yr			Acidification k_{eq}/ha/yr		
		Critical Load	PC	% of Critical Load	Critical Load	PC	% of Critical Load
Cog Moors	Neutral Grasslands – Mountain Hay Meadows	10	0.04	0.4	2.28	0.003	0.1
Cosmeston Lakes	Coniferous Woodlands	5	0.03	0.7	2.88	0.002	0.1
Penarth Coast	Neutral Grasslands – Mountain Hay Meadows	10	0.02	0.2	2.28	0.001	0.060
Fferm Walters	Neutral Grasslands – Mountain Hay Meadows	10	0.003	0.03	5.00	0.0002	0.005
Barry Woodlands	Coniferous Woodlands	5	0.02	0.3	2.88	0.001	0.04
Sully Island	Purple Moor Grass and Rush Pastures - (Swamp)	15	0.04	0.26	4.31	0.003	0.07
Severn Estuary	Pioneer, Low-Mid, Mid-Upper Saltmarshes	20	0.01	0.1	1.06	0.001	0.07

9 Cumulative Impacts Assessment

9.1 Introduction

Impacts from multiple FPPs should be considered where the sites are within close proximity, within 1km, of each other and operation of each site is greater than 50 hours per year, as per the SG guidance. The PGP FPP lies approximately 20m south of the Cadoxton FPP and is assumed to operate for greater than 50 hours per year. As such the cumulative (or in combination) impacts have been assessed at local sensitive receptors.

It is understood that the PGP FPP is comprised of ten diesel generator units with a power output of $24MW_e$. At the time of writing, many details regarding the FPP, such as make and models of generators, operating hours, stack height etc are unknown and as such assumptions have been made in order to quantify the potential cumulative impacts of the generators. These are provided in the sections below.

9.2 Methodology

9.2.1 Engine Parameters and Emissions Data

Calculations for the input parameters have been calculated from a typical diesel generator and are presented in Table 9.1 below. All inputs are regarded as assumptions.

Emissions inputs for the Cadoxton FPP are as in Section 6.

Table 9.1 Model Input Data

Parameter	Modelled Value
Number of Units	10
Number of Stacks	10
Stack Height (m)	8.0 (3m above assumed generator height)
Stack Diameter (m)	0.5
Temperature of Release (K)	746
Actual Flow Release (Am^3/s)	6.87
Emission Velocity at Stack Exit (m/s)	35.0
Normalise Flow Rate (Nm^3/s)	1.72
NO_x Emission Concentration (mg/Nm^3)	500
NO_x Modelled Emissions (g/s)	0.86

Stack locations have been identified using Google satellite imagery and are available in Table 9.2.

Table 9.2 PGP Stack Locations

Stack	OS GR X (m)	OS GR Y (m)
Engine 1	314574.7	168661.1
Engine 2	314579.1	168662.1
Engine 3	314583.3	168663.0
Engine 4	314593.3	168665.1

Stack	OS GR X (m)	OS GR Y (m)
Engine 5	314597.6	168666.0
Engine 6	314579.3	168638.6
Engine 7	314583.8	168639.1
Engine 8	314588.0	168640.0
Engine 9	314598.1	168642.1
Engine 10	314602.3	168643.0

9.2.2 Operating Scenarios

For the purposes of the cumulative modelling assessment each FPP is assumed to be operating at full load:

- For the entire year (8760 hours), with regards to short term impacts, as these rely on a maximum value rather than average over the period; and,
- For 2,500 hours of the year for Cadoxton annual average impacts; and
- For 500 hours of the year for PGP annual average impacts.

This is consistent with Environment Agency guidance, which has been used in relation to the input data for the prediction of annual average impacts from an intermittent process.

As typical FPP facilities are not expected to be operational for the above durations, the modelled scenario is considered to represent a typical case for Cadoxton FPP and a 'worst-case' PGP FPP scenario.

9.2.3 Sensitive Receptors

Due to the close proximity of each FPP, the discrete sensitive 'human' and 'ecological' receptors are as detailed in Section 6.

9.2.4 Building Downwash/Entrainment

Topography data has been included within the dispersion model within a .DEM files covering the Study Area.

The Cadoxton FPP building as described in Section is included within the model. The PGP FPP is a series of ten individual generators and associated equipment enclosed by a fence, this has been represented by a single rectangular building within the model and is presented in Table 9.3.

Table 9.3 Details of buildings entered into the dispersion model

No	Building	Approximate Centre Point (X,Y)	Max Height (m)	Length/Width (m)	Elevation (m)	Angle
B1	Cadoxton FPP Building	314582.1, 168739.2	8.0	19.3/48.6	4	168.2
B2	PGP FPP Enclosure	314569.9, 168663.5	5.0	37.5/37.5	4	75.8

9.2.5 Background Concentrations

As per used in the above assessment at each receptor.

9.2.6 Nitric Oxide to NO_2 Conversion

Oxides of nitrogen (NO_x) emitted to atmosphere as a result of combustion will consist largely of nitric oxide (NO), a relatively innocuous substance. Once released into the atmosphere, NO is oxidised to NO_2. The proportion of NO converted to NO_2 depends on a number of factors including wind speed, distance from the source, solar irradiation and the availability of oxidants, such as ozone (O_3).

A conversion ratio of 70% NO_x: NO_2 has been assumed for comparison of predicted concentrations with the long-term objectives for NO_2. A conversion ratio of 35% has been utilised for the assessment of short-term impacts, as recommended by Environment Agency guidance[19].

9.2.7 Significance Criteria

As detailed in Section 6 of this assessment.

9.3 Cumulative Assessment Results

The cumulative assessment results are presented in the tables below. These relate to the operation phase of the FPP including the detailed dispersion modelling assessment results for emissions from the stacks.

9.3.1 Human Health Effects during the Operational Phase at Sensitive Receptor Locations

The results at the receptor locations (relevant to human impacts) are shown in Table 9.4 below. Annual concentration impacts have been adjusted for the approximate operating hours for the Cadoxton FPP (2500 hrs) and the PGP FPP (500 hrs, maximum for a diesel plant. The highest predicted long term NO_2 impacts are predicted at receptor HR1, an increase of 2.0μg/m^3 (5.1% PC). As such the long term PC exceeds the 1% criteria, however the long term PEC is well below 70% of the long term standard and as such the impact can be considered as **'insignificant'**.

Table 9.4 Comparison of Annual Mean NO_2 Predictions with Baseline Concentrations (μg/m^3)

Receptor Ref	PC Annual NO_2 (μg/m^3)	% PC of the AQO	PEC Annual NO_2 (μg/m^3)	% PEC of the AQO
HR1	2.03	5.1	16.53	41.3
HR2	0.42	1.0	14.92	37.3
HR3	0.56	1.4	15.06	37.7
AQO	**40 μg/m^3**			

Short term (1 hr 99.79th percentile) NO2 concentrations at each receptor, presented in Table 9.5, exceed 10% of the short term standard and the PEC exceeds 20% of the head room between the short term standard and the short term background, constituting a potential significant impact. However the PEC concentrations fall well below the short term standard (below 55% at each receptor) and the operating regime included within the model (8760 hrs) far exceeds the approximate number of hours the FPP could run for (2500 hrs & 500 hrs), and as such presents the worst-case impact.

[19] AQMAU, Conversion Rates for NOx and NO_2.

Table 9.5 Comparison of 99.79th Percentile 1-hr NO_2 Predictions with Baseline Concentrations (µg/m^3)

Receptor Ref	PC (99.79th Percentile) 1-hr NO_2	% PC of the AQO	PEC (99.79th Percentile) 1-hr NO_2	% PEC of the AQO
HR1	76.80	38.4	105.80	52.9
HR2	56.15	28.1	85.15	42.6
HR3	52.87	26.4	81.87	40.9
AQO	**200 µg/m^3**			

Short term (1 hr 100th percentile) NO_2 concentrations do not exceed 200µg/m^3 at any receptor. Furthermore the operating regime included within the model (8760 hrs) for five years far exceeds the approximate number of hours the FPPs could run for (2500 hrs & 500 hrs), as such hourly NO_2 concentrations will likely be far lower.

Table 9.6 Comparison of 100th Percentile 1-hr NO_2 Predictions with Baseline Concentrations (µg/m^3)

Receptor Ref	PC (100th Percentile) 1-hr NO_2	% PC of the AQO	PEC (100th Percentile) 1-hr NO_2	% PEC of the AQO
HR1	111.49	55.7	140.49	70.2
HR2	67.18	33.6	96.18	48.1
HR3	83.94	42.0	112.94	56.5

9.3.2 Sensitive Habitats Impact during the Operational Phase

Cumulative operation NO_x impacts at ecological receptors are presented in Table 9.7 below. Annual NO_x PCs are below 1% of the critical level except at receptor ER1, however the PEC concentrations is below 70% of the AQO and as such can be considered '**insignificant**'.

Table 9.7 Comparison of Predicted Annual NO_x and Background Concentrations (µg/m^3) with Critical Levels

Receptor Ref	PC Annual NO_x (µg/m^3)	% PC of the AQO	PEC Annual NO_x (µg/m^3)	% PEC of the AQO
ER1	0.55	1.8	16.37	54.6
ER2	0.21	0.7	11.98	39.9
ER3	0.24	0.8	10.85	36.2
ER5	0.04	0.1	16.02	53.4
ER7	0.11	0.4	16.06	53.5
ER8	0.25	0.8	11.79	39.3
ER9	0.13	0.4	12.39	41.3
AQO	**30 µg/m^3**			

Short term (24 hr) NO_x concentrations exceed the EA screening criteria at all receptors except ER5 (Table 9.8). The short term assessment has been run for 8760 hours, far exceeding the maximum number of hours the FPPs are expected to run for (2500 & 500 hrs) and PEC concentrations fall below the applicable critical level, as such the impacts are still considered to be '**insignificant**'. Furthermore the assessment assumes both plants would be operational at the same time.

Table 9.8 Comparison of Predicted 24 hr NO_x and Background Concentrations (μg/m³) with Critical Levels

Receptor Ref	PC Annual NO_x (μg/m³)	% PC of the AQO	PEC Annual NO_x (μg/m³)	% PEC of the AQO
ER1	38.16	50.9	69.80	93.1
ER2	10.31	13.8	33.85	45.1
ER3	12.07	16.1	33.29	44.4
ER5	32.71	43.6	64.67	86.2
ER7	11.91	15.9	43.81	58.4
ER8	15.77	21.0	38.85	51.8
ER9	13.53	18.0	38.05	50.7
AQO	**75 μg/m³**			

Table 9.9 shows the maximum process contribution to nitrogen and acid deposition resulting from the FPPs emissions for the designated sites respectively. As shown in Table 7.4, existing deposition levels exceed the lower estimates of the critical loads for the most sensitive habitat for nitrogen deposition but not for acid deposition.

For all sites, the contribution of the FPPs to total nitrogen or acid deposition is less than 1% of the relevant critical load. The data presented in Table 9.9 reflect the maximum deposition levels over the designated sites and mean impacts over the sites, taking into account due to both inter-annual and spatial variability, are significantly lower. Based on EA guidance this level of impact on nitrogen deposition is **'insignificant'**.

For acid deposition, the deposition of nitrogen has been assessed against the CLmax(N) parameter within the critical load function. The maximum impacts are less than 1% of this critical load. With impacts of the order of 0.2% or less of the relevant critical loads, the difference between deposition levels with and without the Project is indistinguishable. That is to say, the risk of exceedance of critical loads or the level of exceedance of the critical load, is wholly dependent on the existing deposition levels. Based on EA guidance this level of impact on acid deposition is **'insignificant'**.

Table 9.9 Predicted Nitrogen Deposition and Acidification at Ecological Receptors in Model Domain

Designated Site	Most Sensitive Habitat	Nitrogen Deposition kgN/ha/yr			Acidification k_{eq}/ha/yr		
		Critical Load	PC	% of Critical Load	Critical Load	PC	% of Critical Load
Cog Moors	Neutral Grasslands – Mountain Hay Meadows	10	0.06	0.6	2.28	0.004	2.28
Cosmeston Lakes	Coniferous Woodlands	5	0.04	0.9	2.88	0.003	2.88
Penarth Coast	Neutral Grasslands – Mountain Hay Meadows	10	0.02	0.2	2.28	0.002	2.28
Fferm Walters	Neutral Grasslands – Mountain Hay Meadows	10	0.004	0.04	5.00	0.0003	5
Barry Woodlands	Coniferous Woodlands	5	0.02	0.4	2.88	0.002	2.88

Sully Island	Purple Moor Grass and Rush Pastures - (Swamp)	15	0.05	0.33	4.31	0.004	4.31
Severn Estuary	Pioneer, Low-Mid, Mid-Upper Saltmarshes	20	0.01	0.1	1.06	0.001	1.06

10 Mitigation

The stack height has been selected through iterative dispersion modelling to ensure that the impact is acceptable at relevant receptor locations even with the FPP operating for a significantly longer period than would be expected.

Maintenance of the engines in accordance with an approved service schedule will ensure that emissions remain within manufacturers stated limits.

11 Summary and Conclusions

An assessment has been carried out to determine the local air quality impacts associated with the operation of the FPP.

Operational traffic flows are expected to be insignificant compared with baseline flows and have been screened out of the assessment.

Detailed air quality modelling using the AERMOD dispersion model has been undertaken to predict the impacts associated with stack emissions from the FPP. One model scenario has been assessed which represents the proposed layout. All emissions to air will be via 8 No individual stacks of 12m. Manufacturer emission limits have been assumed for the purposes of the modelling assessment and the plant is assumed to be operating at full load for 2500 hours per year for long-term impacts and all hours of the year for short-term impacts.

All long-term impacts at human receptors are either predicted to be below limit values at locations where the Air Quality Directive states that they must be applied, or are not significant (ie below 1% and 10% of their relevant objectives). The maximum short-term NO_2 impact is not at a location where members of the public would reasonably be expected to spend an hour or more. The impact of the FPP at sensitive habitats within the Study Area is predicted to be negligible.

A cumulative impact assessment of the neighbouring PeakGen Diesel FPP has been undertaken using assumed emissions data and maximum operation of 500 hours per year. Impacts are predicted to be '**insignificant**'.

In summary, the air quality impact of the FPP is considered to be below limits at relevant human or ecological receptor locations.

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