AIR EMISSION RISK ASESSMENT SCREENING

SIMPLE BESPOKE ENVIRONMENTAL PERMIT APPLICATION
HEM HEATH SITE

PREPARED FOR: INFINIS ENERGY SERVICES LIMITED

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1.0 INTRODUCTION

SLR Consulting Ltd has been commissioned by Infinis Energy Services Limited (Infinis) to undertake an Air Emissions Risk Assessment (AERA) to support their 'simple bespoke' Environmental Permit (EP) application for their Specified Generator (SG) plant at their Hem Heath Site, Stoke–on-Trent (the 'Site').

1.1 Background

The Site comprises of Gas-Engine Generating-Sets (generators) fired on natural gas to provide grid balancing purposes located within a purpose built building. Full details of the application are contained within the NTS and accompanying Permit application, the following details are of direct relevance to the assessment:

- the generators are fired on natural gas, each generator has a 4.84MWth capacity (combined 9.68MWth);
- combustion emissions are discharged via individual flues located within a single windshield terminating 15.2m above ground level;
- the generators will comply with a nitrogen oxide (NOx) exhaust emission limit value (ELV) of <190mg/Nm³ (dry, STP, 15% O_2).

1.2 Scope and Objective

The scope of the assessment is limited to the point source combustion emissions to air at the installation. Consistent with EA guidance, for a gas engine fired on natural gas, the principal release of oxides of nitrogen (NOx) have been assessed.

The objective of the study is to assess the impact of NOx emissions against the relevant Air Quality Standards for nitrogen dioxide (NO_2) for the protection of human health and for the protection of designated ecological receptors.

This report presents the approach, detailed methodology and findings of the AERA.

2.0 LEGISLATION AND RELEVANT GUIDANCE

2.1 Environmental Permitting Regulations

The Environmental Permitting (England and Wales) Amendment Regulations 2018 implements European Union Directive 2015/2193/EU (the Medium Combustion Plant Directive, MCPD) in Schedule 25A, alongside additional controls introduced by Defra relating to SG's through the SG Regulations (the SGR) in Schedule 25B.

Whilst the generators are classified as 'existing' MCP (and not require an EP until 2024/2029), as they generate electricity they are also categorised as SG's. The generators are classified as 'Tranche B' SG's as they export electricity under a post 2015 capacity market agreement; therefore they are required to comply with the SGR requirements from 1st January 2019.

As a result of the size, operational hours and location of the Site, it does not comply with the requirements of any 'Standard Rules' permit. Therefore the Site requires a screening assessment of emissions to air to identify if it complies with the requirements for a 'simple bespoke' or 'complex bespoke' (where detailed atmospheric dispersion modelling is required) Environmental Permit (EP).

2.1.1 Permitting Guidance

Guidance Notes produced by Defra provide a framework for regulation of installations and additional technical guidance produced by the EA are used to provide the basis for permit conditions.

The Environment Agency provide guidance to assist operators for all types of permitted facilities to assess risks to the environment and human health when applying for a permit under the EP Regulations. In relation to impact on Air Quality, the '*Air emissions risk assessment for your environmental permit*'[1] (the AERA guidance) details the EA's requirements.

In relation to SG, the EA have produced specific guidance for the detailed assessment of emissions to air from SG[2] and a specific 'Specified Generator Tranche B Screening Tool' to assist with identifying whether detailed modelling is required and whether the permit application is classified as '*simple bespoke'* or '*complex bespoke'*.

The AERA guidance provides generic 'dispersion factors' for all point sources as well as supplementary 'dispersion factors' specifically for landfill gas engines The application of these 'dispersion factors' is considered to be appropriate as the actual engines and dispersion characteristics are comparable and no heat recovery is applied. The application of the EA's AERA LFG engine 'dispersion factors' has been agreed with the EA as a suitable alternative methodology for identifying whether detailed atmospheric dispersion modelling is required and consequently whether the permit application is classified as '*simple bespoke'* or '*complex bespoke'.*

2.2 National Air Quality Legislation and Guidance

2.2.1 Air Quality Standards

The Air Quality Standards Regulations 2010 (the AQSR) transpose the Air Quality Directive (2008/50/EC) and Fourth Daughter Directive (2004/107/EC) into UK legislation. The regulations include Limit Values, Target Values, Objectives, Critical Levels and Exposure Reduction Targets for the protection of human health and the environment.

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[1] https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit

[2] Emissions from specified generators. Guidance on dispersion modelling for oxides of nitrogen assessment from specified generator. Version 1, environment agency, UNCLASSIFED.

2.2.2 Air Quality Strategy

The United Kingdom Air Quality Strategy (AQS) 2007 for England, Scotland, Wales and Northern Ireland[3] sets out a comprehensive strategic framework within which air quality policy will be taken forward in the short to medium term, and the roles that Government, industry, the Environment Agency, local government, business, individuals and transport have in protecting and improving air quality. The AQS contains air quality objectives based on the protection of both human health and vegetation (ecosystems).

The Environment Agency's role in relation to Local Air Quality Management (LAQM) is as follows[4]:

> *"The Environment Agency is committed to ensuring that any industrial installation or waste operation we regulate will not contribute significantly to breaches of an AQS objective.*
>
> *It is a mandatory requirement of EPR legislation that we ensure that no single industrial installation or waste operation we regulate will be the sole cause of a breach of an EU air quality limit value. Additionally we have committed that no installation or waste operation will contribute significantly to a breach of an EU air quality limit value."*

2.2.3 Local Air Quality Management

Section 82 of the Environment Act 1995 (Part IV) 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 AQALs prescribed in regulations are being achieved or are likely to be achieved in the future.

Where any of the prescribed AQALs are not likely to be achieved the authority concerned must designate 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 AQAL. As such, Local Authorities (LAs, have formal powers to control air quality through a combination of LAQM and by use of their wider planning policies.

Defra has published technical guidance for use by local authorities in their LAQM work[5]. This guidance, referred to in this report as LAQM.TG(16), has been used where appropriate in the assessment presented here.

2.3 Standards for Air Quality

The standards applied in this assessment for protection of human health are provided in Table 2-1.

Table 2-1
Applied Air Quality Standards ($\mu g/m^3$)

Pollutant		Annual Standard	Short Term Standard
Nitrogen dioxide	NO_2	40	200 (1-hour) not to be exceeded more than 18 times per year

Defra has published technical guidance for use in Local Air Quality Management[6]. According to LAQM.TG(16) air quality standards should only apply to locations where *'members of the public are likely to be regularly present and are likely to be exposed for a period of time appropriate to the averaging period of the objective.*

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[3] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, DEFRA. July 2007.
[4] Regulating to Improve Air Quality. AQPG3, version 1, Environment Agency, 14 July 2008.
[5] Department for Environment, Food and Rural Affairs (DEFRA): Local Air Quality Management Review and Assessment Technical Guidance LAQM.TG(16), 2016.
[6] Department for Environment, Food and Rural Affairs (DEFRA): Local Air Quality Management Review and Assessment Technical Guidance LAQM.TG(16), 2016

Authorities should not consider exceedences of the objectives at any location where relevant public exposure would not be realistic' (examples are provided in Table 2-2*)*. This is emphasised in the EA SG modelling guidance that states the 1-hour mean should apply (but may not be limited to) '*residential properties, schools, hospitals, care homes, hotels, gardens, busy shopping streets, bus stations and railway stations that are not fully enclosed, and car parks where the public are reasonably expected to spend an hour or more'*.

Longer term standards such as annual means, should apply at houses or other locations which the public can be expected to occupy on a continuous basis. These standards do not apply to exposure at the workplace.

Table 2-2
Relevant Public Exposure

Averaging Period	Relevant Locations	AQO's should apply at:	AQO's don't apply at:
Annual mean	Where individuals are exposed for a cumulative period of 6 months in a year	Building facades of residential properties, schools, hospitals etc.	Facades of offices Hotels Gardens of residences Kerbside sites
1-hour mean	Where individuals might reasonably expected to spend one hour or longer	As above together with locations of regular access, car parks, bus stations etc.	Locations not publicly accessible or where occupation is not regular

2.4 Protection of Ecological Receptors

Sites of nature conservation importance are provided environmental protection with respect to air quality through the application of standards known as Critical Levels (C_{Le}) for airborne concentrations and Critical Loads (C_{Lo}) for deposition to land from air.

The EA's SG guidance requires that designated ecological sites of should be screened against relevant standards if they are located within the following set distances from the SG Site:

- Special Protection Areas (SPAs), Special Areas of Conservation (SACs) or Ramsar sites within 10km of the installation; and
- Sites of Special Scientific Interest (SSSIs) within 2km of the installation.

2.4.1 Critical Levels (C_{Le})

C_{Le} are a quantitative estimate of exposure to one or more airborne pollutants in gaseous form, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge. The relevant C_{Le}'s for the protection of vegetation and ecosystems are specified within the Air Quality Standards Regulations and AERA guidance (see Table 2-3).

Table 2-3
Relevant C_{Le} for the Protection of Vegetation and Ecosystems

Pollutant	C_{Le} (µg/m^3)	Habitat and Averaging Period
Nitrogen oxides (NO_x)	30	Annual mean (all ecosystems)
	75	Daily mean (all ecosystems)

2.4.2 Critical Loads (CLo)

C_{Lo}'s are a quantitative estimate of exposure to deposition of one or more pollutants, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge.

Critical loads are set for the deposition of various substances to sensitive ecosystems. In relation to combustion emissions critical loads for eutrophication and acidification are relevant which can occur via both wet and dry deposition; however on a local scale only dry (direct deposition) is considered significant.

Empirical C_{Lo} for eutrophication (derived from a range of experimental studies) are assigned based for different habitats, including grassland ecosystems, mire, bog and fen habitats, freshwaters, heathland ecosystems, coastal and marine habitats, and forest habitats and can be obtained from the UK Air Pollution Information System (APIS) website (www.apis.ac.uk/).

C_{Lo} for acidification have been set in the UK using an empirical approach for non-woodland habitats on a 1km grid square based upon the mineralogy and chemistry of the dominant soil series present in the grid square, and the simple mass balance (SMB) equation for both managed and unmanaged woodland habitats.

3.0 ASSESSMENT METHODOLOGY

An AERA screening assessment has been undertaken with due consideration to appropriate EA guidance and is based upon the following stages:

- review of generator specification and operational envelope to define emission sources, pollutant emission rates and characteristics;
- identification of sensitive receptors;
- compilation of the existing air quality baseline and review of Local Air Quality Management (LAQM) status; and
- application of appropriate 'dispersion factors' to determine potential process contribution (PC) and predicted environmental concentration (PEC)
- evaluation of PC and PEC against relevant environmental standards for both human and ecological receptors to determine the requirement for detailed atmospheric dispersion modelling.

3.1 Quantification of Emissions

The emission parameters applied in the modelling are provided in Table 3-1 below. The generator emission parameters have been input on the basis of manufacturer's design specifications.

Table 3-1
Emission Parameters

Parameter / Source	Engine 1	Engine 2
Fuel	Natural gas	Natural gas
Thermal Capacity (MWth)	4.84	4.84
Stack Location (NGR x,y)	372326, 194403	
Stack Height (m)	15.2	
Emission temperature (K)	450	450
Flue diameter (m)	0.45	0.45
Velocity (m/s)	27.4	27.4
Flow (Nm^3/s)	3.54	3.54
NOx Concentration (mg/Nm^3)	190	190
NOx emission g/s	0.67	0.67

Table Note:
a) Normalised to 273K, dry, 101.3kPa, 15% O_2 assuming stack oxygen concentration of 5.9% (dry) and moisture content 14.7%.

3.2 AERA Screening Method

The principal of the AERA screening technique is based on dispersion factors (DFs) for differing stack heights derived from atmospheric dispersion modelling with the LFG engine specific DFs accounting for the typical exit velocity and temperature from gas-fired generators.

The method requires details of the pollutant emissions rate and effective release height. The predicted ground level concentration is then compared to environmental standards to determine if emissions are insignificant or whether detailed modelling is required.

In accordance with AERA guidance, emissions to air can be considered to be insignificant and not require further assessment if:

- the long term process contribution is <1% of the long term environmental standard; and
- the short term process contribution is <10% of the short term environmental standard

For process contributions that cannot be considered insignificant the need for detailed modelling is determined against the following threshold criteria:

- [Maximum Process Contribution (long term) + background concentration] > 70% of the Environmental Assessment Level; or
- Maximum Process Contribution (short term) > 20% of the difference between the short term environmental benchmark minus twice the long term background concentration.

3.2.1 Assessment of Impacts

The assessment of impacts against the standards as defined in Section 2.3 has been undertaken as described in Table 3-2 below.

With respect to NOx emissions, it is considered given the nature of the spark ignition generators and fuel that the primary NO_2 to NOx ratio will be <10%[7]; therefore as per the AERA guidance EA's Air Quality Modelling and Assessment Unit (AQMAU) guidance[8] on conversion ratio for NO_x and NO_2 it has been assumed that 100% of NO_x is present as NO_2 in relation to long term impacts and 50% of NOx is present as NO_2 in relation to short-term impacts.

Table 3-2
Model Outputs

Averaging Period	Process Contribution (PC)	Predicted Environmental Concentration (PEC)
15 minute mean.	1 hour mean multiplied by 1.34	PC + 2 x annual mean background
1 hour mean.	1 hour mean	PC + 2 x annual mean background
24 hour mean.	1 hour mean multiplied by 0.59	PC + 2 x annual mean background
Annual mean	Annual mean	PC + annual mean background

[7] https://www3.epa.gov/scram001/no2_isr_database.htm
[8] Environment Agency, Air Quality Modelling and Assessment Unit, 'Conversion Ratios for NOx and NO_2' (no date)

4.0 BASELINE ENVIRONMENT

4.1 Site Setting and Sensitive Receptors

The Site is located within an industrial area in the south of Hem Heath and falls within the administrative area of Stoke on Trent City Council (SoTCC). The locale of the Site can be characterised by the following:

- Industrial and commercial land use to the north and east for over 500m;
- Industrial and commercial land use to the west, beyond which lies agricultural land and residential dwellings within 400mto the southwest; and.
- To the south, residential development has been consented (and is being built out) to within 35m of the Site.

The Site is within Stoke on Trent AQMA. The AQMA was declared due to exceedences of the annual and hourly AQO for NO_2 and can be described as "an area encompassing the whole city of Stoke-on-Trent". The main source of pollution has been deemed as road traffic.

There are no other known specified generator arrays operating more than 50 hours per year within 1km of the Site.

There are no Sites of Special Scientific Interest (SSSI) within 2km of the Site or any Special Protection Areas (SPA), Special Areas of Conservation (SAC) or Ramsar sites within 10km of the Site.

4.2 Ambient Air Quality

4.2.1 Local Air Quality Management

The SoTCC 2016 LAQM report[9] indicates that pollutant concentrations meet the relevant AQOs with the exception of NO_2 at multiple monitoring locations in proximity to the city centre and busy roads. The Site is not in proximity to any such areas with the A50 over 1km to the north and therefore baseline NO_2 concentrations are anticipated to be close to 'background' concentrations.

4.2.2 Local Air Quality Monitoring Data

The Stoke on Trent LAQM report and UK Automatic Urban and Rural Network (AURN) have been reviewed for relevant local monitoring data for use in the assessment.

There is no AURN monitors within the locale of the Site with the closest being Stoke on Trent A50 approximately 3.8km north east of the Site. Based upon the distance between the monitoring location and the Site, monitored concentrations at Stoke on Trent A50 are not considered representative of concentration in the vicinity of the Site.

Stoke on Trent City Council undertake diffusion tube monitoring across their administrative area. DT18 'roadside' monitor is the closest monitoring location to the Site, approximately 3km north-west of the Site at a roadside location and therefore not considered representative of concentrations in the vicinity of the Site.

4.2.3 Modelled Background Pollutant Concentrations

Background pollutant concentration data on a 1km x 1km spatial resolution is provided by Defra through the UK AIR website and is routinely used to support LAQM and Air Quality Assessments. Background pollutant

[9] Stoke on Trent City Council: 2018 Air Quality Annual Status Report. June 2018.

concentrations for NO_2 are based upon a 2015 base year, and projected to future years[10] (2018 is presented below). The background concentrations for the grid squares containing the Site and nearby receptors are shown in Table 4-1.

Table 4-1
Annual Mean Background Concentrations

X,Y (NGR)	NO_2 (µg/m^3)
388500, 341500	12.6
388500, 340500	14.0

[10] Background mapping data for local authorities – http://uk-air.defra.gov.uk/data/laqm-background-home.

5.0 AERA SCREENING RESULTS

5.1 Dispersion factors

For the AERA screening assessment, the stack height of 15.2m and distance to closest relevant receptor of 30m (for proposed residential) has been used to identify the following appropriate LFG engine AERA DFs based on a '15m gas engine stack' and distance from stack to nearest relevant receptor of '<50 metres' as follows:

- Long-term (LT) dispersion factor: 3.5 (µg/m^3 per g/s emitted); and
- Short-term (ST) dispersion factor: 3595 (µg/m^3 per g/s emitted).

5.1.1 Operational envelope

As a worst case scenario it has been assumed that the SG operates at maximum output for 8,760 hours per year.

5.2 Impacts on Air Quality

The inputs and results of the AERA LFG engine screening for the Site are provided in Table 5-1.

Table 5-1
AERA Air Quality Screening Results

	Oxides of Nitrogen (as NO_2)	
	1-hour	Annual
Environmental Benchmark [*EAL*] (µg/m^3)	200	40
Total Emission Rate (g/s)	0.67	1.34
Dispersion Factor [DF] (µg/m^3 per g/s emitted)	35.0	3.5
Process Contribution [*PC*] (µg/m^3)	23.5	4.7
PC as % EAL	11.8%	11.8%
PC insignificant?	**No**	**No**
Background [BG] (µg/m^3)	28.0	14.0
Predicted Environmental Concentration [*PEC*] (µg/m^3)	51.5	18.7
LT PEC as % of EAL	N/A	46.8%
Headroom (EAL-2*LTBG)	172.0	N/A
% of Headroom	13.7%	N/A
Is detailed modelling required?	**No**	**No**

6.0 SUMMARY AND CONCLUSIONS

This AERA assessment has quantified and assessed the potential air quality impacts associated with combustion emissions from the Site using EA approved techniques appropriate for SG's and against published standards for the protection of human health.

The findings of the AERA screening assessment are as follows:

- potential impacts of NO_2 emissions are >1% of the annual NO_2 EAL and therefore consideration of the background concentration is required;
- as the overall PEC is significantly <70% of the EAL, long-term NO_2 impacts does not affect the Stoke-on-Trent AQMA or contribute to any potential non-compliance with the annual average AQO for NO_2 and therefore does not require further consideration or detailed modelling; and
- Potential impacts of NO_2 emissions are >10% of the 1-hour NO_2 EAL and therefore consideration of the background concentration is required. As the overall PEC is <20% of the 'headroom', short-term NO_2 impacts do not require further consideration or detailed modelling.

The Hem Heath SG is therefore considered to comply with the requirement of the AERA screening assessment and as such is eligible to apply for a 'simple bespoke' environmental permit.

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