APPENDIX I – UPDATED AIR DISPERSION MODELLING STUDY

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TEES RENEWABLE ENERGY PLANT

UPDATED AIR DISPERSION MODELLING STUDY

Revision History

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Prepared By	Reviewed By	Approved By
Ross Taylor	Emily Agus	Emily Agus
Development and Environmental Engineer	Senior Development and Environmental Engineer	Senior Development and Environmental Engineer

Ramboll Energy
Rotterdam House
116 Quayside
Newcastle upon Tyne
NE1 3DY
United Kingdom

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1 UPDATED AIR DISPERSION MODELLING STUDY

1.1 Introduction

1.1.1 Redcar and Cleveland Borough Council (RCBC) has declared no Air Quality Management Areas (AQMA) for any prescribed pollutant.

1.1.2 Air quality is monitored, in the region, by a continuous monitoring station at Dormanstown and a network of 3 non-automatic monitors (for heavy metals)[1]. RCBC has not, historically, utilised diffusion tubes (for the monitoring of oxides of nitrogen), "in view of the relatively low traffic densities in areas of relevant public exposure."

1.1.3 The available date indicates generally good air quality throughout the study area, though it is noted that The Department of Environment, Food and Rural Affairs (DEFRA) identified, through modelling, that the Teesside agglomeration did not comply with the hourly limit value for nitrogen dioxide. In 2014 Redcar & Cleveland Council in partnership with Sustrans Get Moving Redcar & Cleveland, will be conducting a year-long survey of nitrogen dioxide levels across the Council area using diffusion tubes. The aim of this network is to highlight any areas in the district that could have an issue with air quality from vehicle or industrial emissions.

1.1.4 A dispersion modelling study has been undertaken to predict the impacts of the operation of the Development quantifying the contributions that the flue gases from the Development could make to the existing background ground level concentrations of relevant pollutants in order to determine the overall effect on local ambient air quality. The assessment of the impact on air quality due to emissions from the Development is based on the predicted changes of the ground level concentrations of pollutants in accordance with the UK Air Quality Standard Regulations 2010 (AQS) and a comparison with the potential emissions (and their impacts) determined by previous modelling studies regarding the Development.

1.1.5 The predicted process contributions are considered to represent a worst case. Modelling has assumed that the Development will operate at full load for 8760 hours per year (i.e. the maximum possible operation). All emissions from the combustion of the biomass fuel gases will be discharged from the 95 m stack as permitted by the Consent. In reality, the Development may actually run at various different loading regimes. The effect of this on predicted concentrations of the various pollutant gases will be to reduce the long term average, as the plant is operating less, and also to potentially lower the maximum predicted short term averages, as the plant may not operate during the meteorological conditions that lead to peak concentrations.

[1] '2014 Air Quality Progress Report for Redcar and Cleveland' (July 2014)

1.2 Site Location

1.2.1 The Development will be located at Teesdock, Grangetown, Middlesborough, TS6 6UD. The Development is to be located on 14 ha of land within the Teesport landholding approximately 5 km east of Middlesbrough and 6 km west of Redcar. The site falls within the jurisdiction of Redcar and Cleveland Borough Council in the county of Tees Valley..

1.2.2 The Teesport Estate, in which the Project site is situated, is an industrial area, and is one of the few natural deep water tidal facilities in the UK, and is the second largest port in the UK, in terms of tonnage. The port handles over 50 million tonnes of cargo a year. The area surrounding the site of the proposed development is a busy industrial area with associated heavy 24 hour traffic flows on the A66, A1053, A1085 and A174.

1.2.3 A site location is shown in Appendix B of the Variation Application.

1.2.4 The study area for this study has been defined in accordance with the provisions of the Environment Agency (EA) “Horizontal Guidance Note H1 – Annex (f)” (April 2010) (the H1 Guidance).

1.3 Legislative and Regulatory Framework

Ambient Air Quality Directive

1.3.1 Council Directive 96/62/EC on ambient air quality assessment and management (the Air Quality Framework Directive) described the basic principles as to how air quality should be assessed and managed in the Member States. Subsequent Daughter Directives introduced numerical limits, thresholds and monitoring requirements for a variety of pollutants including oxides of nitrogen and sulphur dioxide to guarantee that there are no adverse effects with regard to human health.

1.3.2 Directive 2008/50/EC of 21 May 2008 on ambient air quality and cleaner air for Europe (the Ambient Air Quality Directive) merges the Air Quality Framework Directive with the First, Second and Third Daughter Directives. The Ambient Air Quality Directive identifies desired maximum ground level concentrations and the date by which the objectives should be met and introduces new objectives for fine particles.

1.3.3 The Air Quality Standards Regulations 2010 (the AQS Regulations) give effect, in England, to the Ambient Air Quality Directive.

Air Quality Standards Regulations 2010

1.3.4 The AQS Regulations specify a series of standards and objectives for air quality in the UK. The AQS Regulations have also been implemented through the Air Quality Strategy for England, Wales, Scotland and Northern Ireland (2007).

1.3.5 The objectives, as relevant to this assessment, are summarised in Table 1.

TABLE 1: UK AQS OBJECTIVES FOR AMBIENT AIR QUALITY

Pollutant	Averaging Period	Objective (Ground Level Concentration) ($\mu g/m^3$)	Number of permitted Exceedances
Nitrogen Dioxide (NO_2)	1 Hour	200	18
	Annual	40	-
Sulphur Dioxide (SO_2)	15-minute	266	35
	1 Hour	350	24
	24 Hour	125	3
Particles (PM_{10})	24 Hour	50	35
	Annual	40	-
Carbon Monoxide	8-hour rolling	10 000	-
Oxides of Nitrogen (NO_x) *	Annual	30	-

** For the protection of vegetation and ecosystems*

Local Air Quality Management

1.3.6 The Environment Act 1995 requires local authorities to review air quality within their district or borough in order to determine where pollutant levels identified in the Air Quality Framework Directive may be in excess of the standards.

1.3.7 If pollutant levels in an area are likely to exceed statutory objectives, then local authorities must declare an Air Quality Management Area (AQMA) and draft an Action Plan to achieve the statutory objectives. DEFRA has issued technical guidance[2] to local authorities to assist in undertaking this task.

[2] Local Air Quality Management Policy Guidance (PG09), February 2009

1.3.8 This gives the local authority a clear picture of the sources which can be controlled or influenced, and aid the local authority to target more effectively the relative contributions of industry, transport and other sectors and ensure that the solutions are cost effective and proportionate when producing their Action Plan.

1.3.9 As part of the on-going review and assessment process of AQMAs, a phased approach has been adopted to ensure that the level of local authority assessment is commensurate with the risk of an air quality objective being exceeded. Therefore, each local authority is required to undertake an Updating and Screening Assessment (USA) of the AQMAs within their administrative area in order to identify changes which have occurred since the previous review and assessment that could potentially lead to a risk of an air quality objective being exceeded. Where a risk has been identified the local authority is required to undertake a more detailed assessment to determine the likelihood of an exceedance and revise the AQMA as appropriate.

Industrial Emissions Directive

1.3.10 Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control) (IED) recast seven directives related to industrial emissions, in particular Directive 2008/1/EC of 15 January 2008 concerning integrated pollution prevention and control (the Integrated Pollution Prevention and Control (IPPC) Directive) and Directive 2001/80/EC of 23 October 2001 on the limitation of emissions of certain pollutants into the air from large combustion plants (the Large Combustion Plant Directive (LCPD)), into a single legislative instrument to improve the permitting, compliance and enforcement regimes adopted by Member States.

1.3.11 The IPPC Directive laid down measures to prevent or, where that is not practicable, to reduce emissions in the air, water and land introducing emissions limit values (ELV) and best available techniques (BAT). The LCPD prescribed ELVs for nitrogen oxides, sulphur dioxide and particulates. These are the pollutants relevant to the Environmental Impact Assessment (EIA) of the Development.

1.3.12 The IED makes provisions for the continuation of the requirements and principles of the IPPC Directive and the LCPD and introduces new, more stringent, ELVs with full compliance required by 1 January 2016.

1.3.13 The LCPD and IPPC Directive are implemented in the UK by the Environmental Permitting (England and Wales) Regulations 2010 (the EP Regulations).

Environmental Permitting (England and Wales) Regulations 2010

1.3.14 The Environmental Permitting (England and Wales) Regulations 2007 sought to introduce a single streamlined environmental permitting and compliance regime to apply in England and Wales. They do this by integrating the previous regimes covering waste management licensing and Pollution Prevention and Control.

1.3.15 The EP Regulations increase the scope of the 2007 Regulations.

1.3.16 In February 2013, the EP Regulations were amended, primarily, to transpose the IED into the legislative framework of England and Wales; the EP Regulations were most recently amended in 2015.

1.4 Baseline Conditions

1.4.1 Baseline conditions can be determined by examining Local Authority ambient air quality data. Local Authorities have duties under Part IV of the Environment Act 1995 to assess air quality within their administrative areas. The last USA, undertaken by RCBC, was published in July 2012[3]. The most recent relevant report was the 2014 Progress Report[1].

1.4.2 No AQMAs have been declared by RCBC.

1.4.3 There is one automatic air quality monitoring stations in the vicinity of the Development, at Dormanstown (National Grid Reference: NZ 58381 23486).

1.4.4 This monitoring station has been in operation since January 2012 (having been relocated) and has been recording data since then, which will include contributions from existing industrial facilities within the study area.

1.4.5 A summary of measured data from the Dormanstown monitoring site is shown in Table 1.

TABLE 1: DATA FROM DORMANSTOWN AUTOMATIC MONITORING STATION

Pollutant	Averaging Period	Objective (Ground Level Concentration) (µg/m^3)	Maximum Value (2014)
Nitrogen Dioxide (NO_2)	1 Hour	200	55.5
	Annual	40	9.0
Sulphur Dioxide (SO_2)	15-minute	266	-
	1 Hour	350	55.9
	24 Hour	125	16.3
Particles (PM_{10})	24 Hour	50	65.6 (1 *)
	Annual	40	16.7
Carbon Monoxide	8-hour rolling	10 000	-

* (xx) = number of recorded exceedances; permitted exceedances = 35

1.4.6 In addition, Defra produces background maps in order to assist local authorities in performing their duties in accordance with the Environment Act 1995.

1.4.7 Table 2 gives detail of the annual ground level concentrations estimated for North Lincolnshire Council, by Defra, including NO_2 and PM_{10} projections for the years 2020 and 2025.

TABLE 2: ANNUAL POLLUTANT LEVELS ESTIMATED FOR RCBC («g/m^3)

Year	NO_2		PM_{10}	
	Maximum	Average	Maximum	Average
2014	30.2	10.6	19.1	13.6
2020	27.0	8.5	19.7	13.0
2025	26.7	8.0	19.6	12.9

1.4.8 Table 2 demonstrates that pollutant levels in RCBC are generally not close to exceeding either the long-term or short-term objectives of the AQS Regulations and are, as per Table 2, expected to generally improve over the next decade.

[3] '2012 Air Quality Updating and Screening Assessment for Redcar and Cleveland' (July 2012)

1.5 Dispersion Modelling Software

1.5.1 To gauge the impact of Project, a dispersion modelling exercise has been undertaken. The dispersion models available and accepted by the UK Environment Agency for point sources are AERMOD and ADMS. Both are second generation models developed in the US and the UK respectively.

1.5.2 ADMS is developed by Cambridge Environmental Research Centre Ltd (CERC).

1.5.3 ADMS was preferred for the modelling of the Development for consistency between this Application and previous assessments.

1.5.4 The latest version of this software (ADMS 5.1) has been used in undertaking the air dispersion modelling for this study.

1.5.5 It is considered given previous acceptance of the use of the above modelling software by the EA, is, as per 'Horizontal Guidance Note H1 – Annex (f)', "... fit for purpose, based on established science, and [ ] validated and independently reviewed."

1.5.6 It is noted that previous studies have used older versions of ADMS, these models have therefore been recreated in order to allow a direct comparison between the proposals for the Development considered in each of the July 2008 ES, the January 2010 ES Addendum and the June 2015 ES Addendum; slight changes to the results presented in this document and the reporting of previous studies are considered to relate to use of the updated software (together with some uncertainties when recreating the models[4]).

[4] The original model files were not available for this study; the models have been recreated based on previous reports and information provided by MGT.

1.6 Emissions Parameters

1.6.1 The Development will comprise one major point source of emissions to air, being the 95 m stack permitted by the Consent.

1.6.2 The emissions parameters have been determined based on manufacturer-supplied data and the application of the relevant emissions limit values (ELV) for the prescribed pollutants that will be present in the flue gases of the Development and controlled by the Environmental Permit. The ELVs have been taken from the application to vary the current Environmental Permit (a copy of which is provided at Appendix G to the variation application).

1.6.3 Details of the modelling input parameters for the Development can be found in Table 3.

TABLE 3: DISPERSION MODEL INPUTS – STACK

Parameter	Units	July 2008 ES	January 2010 ES Addendum	June 2015 ES Addendum
Actual flue gas volume	m^3/s	530	561.4	385.8
Flue gas velocity	m/s	25.2	22.0	23.5
Stack diameter	m	5.2	5.7	4.6
Stack height	m		95	
Flue gas temperature	°C	95	140	154
Oxygen content	% v/v	6	-	2.6
Moisture content	% v/v	-	-	15.5
Normalised flue gas volume *	Nm^3/s	323	323.3 **	249.5
NO_x emission level	mg/Nm^3	150	150	150
NO_x flow rate	g/s	48.5	48.5	37.4
SO_2 emission level	mg/Nm^3	106	53 / 106	106
SO_2 flow rate	g/s	34.4	17.2 / 34.4	26.4
PM_{10} emission level	mg/Nm^3	20	20	15
PM_{10} flow rate	g/s	6.4	6.4	3.7
CO emission level	mg/Nm^3	100	100	100
CO flow rate	g/s	32.3	32.3	25.0
HCl emission level	mg/Nm^3	1	20	20
HCl flow rate	g/s	0.3	6.4	6.5

* Corrected to 15% v/v O2, dry, 1 atm, 0°C

** Calculated based on information presented in January 2010 ES Addendum

1.7 Modelled Domain / Receptors

1.7.1 The air dispersion modelling study has considered an area covered by a Cartesian grid of 12.5 km x 12.5 km centred on the stack.

1.7.2 The modelled domain has been considered using a gridded receptor spacing of 125 m. An additional grid was also centred on the stack and comprised an area of 5 km x 5 km with a receptor spacing of 50 m.

1.7.3 The above grids, thus provide the coverage, required by "Horizontal Guidance Note H1 – Annex (f)", of 10 km from the principal emissions sources of the Project. The grid spacings are less than the EA recommended maximum of 1.5 times the stack height.

Receptors for the Protection of Human Health

1.7.4 As discussed in Section 1.4, no AQMAs have been designated within the study area. Therefore no specific receptors for the protection of human health have been included in the model. The assessment of potential impacts across the wider study area has been undertaken using the background mapping data obtained from DEFRA.

1.8 Meteorology / Surface Characteristics

1.8.1 The meteorological data used for this modelling exercise was that used in previous modelling studies for the Development; it is considered that this data has been accepted as being representative of the conditions experienced at the Development site. The data period considered was 2003-2007 inclusive as per current EA guidelines for the consideration of recent meteorological data over five consecutive years and for consistency with the modelling undertaken for the Development.

1.8.2 For each year the predominant wind direction was from the south west.

1.8.3 The modelled domain consists of predominantly industrial / residential topography. The surface roughness for the modelled domain could therefore been set to 0.5 ('parkland, open suburbia') could be used for the models. However it is noted that the River Tees contributes a large stretch of open water to the topography in the immediate vicinity of the Development. Open water ('sea') in the ADMS software has an associated surface roughness of 0.0001; the use of lower values for surface roughness is expected to reduce the predicted ground level concentrations of the pollutants modelled given that friction effects will be reduced, thus improving dispersion.

1.8.4 It is therefore considered that use of the ADMS default setting of 0.1 represents a suitable and robust average for the roughness across the study area.

1.9 Terrain and Building Effects

1.9.1 Terrain effects generally occur when ground levels within 1 km of the stack vary by more than a third of the stack height (c.25-30 m).

1.9.2 Terrain data for the area shows that, Ground levels do not rise above c.10 m AOD within 1 km of the Operations Area (which will be approximately 5 m AOD) therefore terrain data has not been included in the dispersion model. This is consistent with previous modelling studies for the Development.

1.9.3 Building downwash is created by structures in the vicinity of an emissions source and subjects the plume from the stack to wake effects. The effect is generally to pull the plume down to the ground at locations closer to the stack thereby restricting the dispersion of the plume and increasing the ground level concentration of pollutants and, potentially, the environmental impact of emissions from the Project.

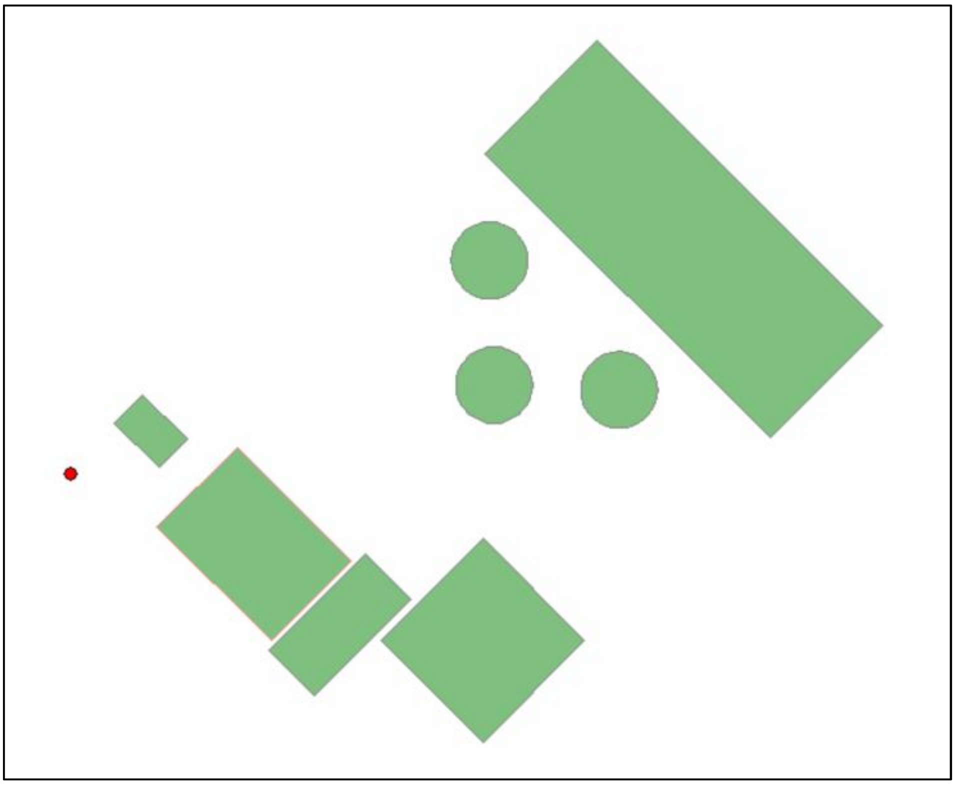
1.9.4 Potential downwash structures are those which are located within 5L of the stack, where L is the lesser of either the height of the building or the maximum projected width of the building. An additional point to note is that if a stack is higher than the height of the building plus 1.5L, then the building is not classed as a downwash structure.

1.9.5 The buildings that form part of the modelling scenario for the June 2015 ES Addendum are shown in Table 4. The orientation of the buildings is taken from the layout shown in Figure 1.

TABLE 4: DISPERSION MODELLING BUILDING DATA – JUNE 2015

Building	Height (m)	Angle	Dimension (m)	
			X	Y
Boiler House	71	45	82	61
Turbine Hall	32		71	42
Fabric Filters	26		53	34
Air-cooled condenser	40		100	78
Covered fuel store	35		210	50
Fuel silos (x3)	65		40 (diameter)	

Figure 1: Dispersion Modelling Building Data – June 2015

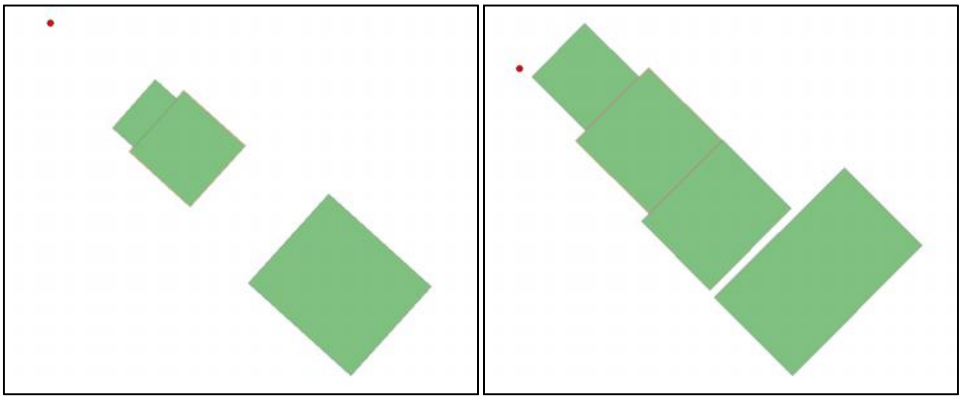


1.9.6 The modelling of previous scenarios for the Development has been based on the building data shown in Table 5 and Figure 2.

TABLE 5: DISPERSION MODELLING BUILDING DATA – JUNE 2015

Building	July 2008 ES				January 2010 ES Addendum			
	Height (m)	Angle	Dimension (m)		Height (m)	Angle	Dimension (m)	
			X	Y			X	Y
Boiler House	55		45	45	71		82	61
Turbine Hall	-		-	-	32		62	52
Fabric Filters	45	42	35	16	26	45	40	40
Air-cooled condenser	40		65	75	40		98	59

FIGURE 2: DISPERSION MODELLING BUILDING DATA – PREVIOUS MODELS



1.10 Assessment of Potential Impacts

1.10.1 Air dispersion modelling can predict the ground level concentrations that occur due to the emissions from an elevated stack point source such as the 95 m to be incorporated as part of the Development.

1.10.2 The flue gases discharged from a stack have two sources of momentum. One is related to the velocity of discharge. This is usually designed to be in excess of 15 m/s as this value has been found to be sufficient to avoid immediate downwash of the plume. Immediate downwash of a plume would not allow for adequate dispersion of the emissions from the stack and could result in significantly elevated ground level concentrations of pollutants in the immediate vicinity of the stack. Whilst contributing to the dispersion of stack emissions, the momentum from the velocity of discharge is soon dissipated.

1.10.3 The second source of momentum is much more significant and is related to the discharge temperature of the flue gases. The flue gases, being warmer than the surrounding atmosphere into which they are discharged, have buoyancy and thus rise. This process continues until the flue gases have cooled to the same temperature as the surrounding air.

1.10.4 Mathematical models are used to calculate the effects of these two sources of momentum and determine the height to which the flue gases will rise. This height plus the height of the stack gives an ‘effective stack height’.

1.10.5 The mathematical model then determines the dispersion of the flue gases from this effective stack height. Note that the effective height can be many times greater than the actual stack height as constructed due to the large amount of heat present in the flue gases.

1.10.6 Dispersion occurs as a result of turbulence, and turbulence can result from both buoyancy effects and wind shear (also called mechanical) effects.

1.10.7 As an example of buoyancy effects, on a sunny day, solar heating creates turbulence by heating the ground and the air near the ground. The buoyancy of the heated air causes it to rise, creating turbulence. These are the thermals used by small plane and glider pilots on sunny days. These can also rapidly disperse a plume in the surrounding air. At night, during stable conditions, the buoyancy effect is to suppress rather than cause or enhance turbulence.

1.10.8 Wind shear as a cause of turbulence is well known to pilots as well. Wind shear effects, important to air pollution modelling, result from high (several metres per second) wind speeds near the ground. Since the wind speed at the ground is zero, any high wind speeds result in substantial wind shear. Wind shear dominates over buoyancy effects not only under high wind conditions, but also near the ground under any conditions.

1.10.9 As a result of this, two parameters are used to define the “stability” of the atmosphere. The first is the friction velocity which is a measure of wind shear.

1.10.10 The second parameter is a stability term called the Monin-Obukhov length. As mentioned above, shear stress always dominates near the ground. The height above the ground, where buoyancy effects begin to dominate (generating turbulence in convective conditions or suppressing turbulence in stable conditions) is called the Monin-Obukhov length. This can be thought of as a depth of the neutral (i.e. shear-dominated) flow.

Conversion of Oxides of Nitrogen to Nitrogen Dioxide

1.10.11 NO_x emissions from the Development will consist of the gases NO and NO_2. It is only NO_2 that is of concern in terms of direct health effects; however NO is a source of NO_2 in the atmosphere. The gases are in equilibrium in the air, with NO predominating at the stack exit. The equilibrium changes as the plume disperses and is exposed to oxidants, such as atmospheric ozone. The rate of conversion of NO to NO_2 increases with rising ozone concentration and wind speed (turbulence and mixing effects) whilst the level of solar radiation controls the rate of the reverse dissociation reaction of NO_2 to NO.

1.10.12 For assessing the impacts on air quality of emissions to atmosphere from sources such as power stations, it is important that realistic estimates are made of how much NO would be oxidised to NO_2 at all receptors considered.

1.10.13 The rate of oxidation of NO to NO_2 depends on both the chemical reaction rates and the dispersion of the plume in the atmosphere. The oxidation rate is dependent on a number of factors that include the prevailing concentration of ozone, the wind speed and the atmospheric stability.

1.10.14 In order to determine the true impact of operation of the Development it is important that a realistic estimate of the actual process contribution to ground level concentrations of NO_2 is made.

1.10.15 Between 1975 and 1985 about 60 sets of measurements were taken of the concentrations of nitric oxide and nitrogen dioxide in plumes from a variety of power stations[5]. These measurements were carried out under widely varying weather conditions at altitudes between 200 m and 700 m. From the data collected, an empirical relationship for the percentage oxidation in a power station plume based on downwind distance, season of the year, wind speed and ambient ozone concentration may be described by the following equation (which is sometime referred to as Janssen's equation):

$$NO_2 / NO_x = A\left(1 - \exp^{(-\alpha x)}\right)$$

where x is the distance downwind (km) of the emission point and α and A are constants dependent on time of year and derived from the measurements of wind speed and ozone concentrations.

1.10.16 For a typical power station the peak ground level concentration of the oxides of nitrogen will occur within a few kilometres. Calculations have been undertaken , in order to present a worst case, assuming that there is sufficient ozone present in order to fully oxidise NO to NO_2.

1.10.17 Table 6 shows the minimum, maximum and annual average estimates of NO_2 in the plume for selected distances downwind of the plume, the figure takes into account the ratio of NO to NO_2 in the plume on exit from the stack.

TABLE 6: ESTIMATES OF THE PERCENTAGE OF NO_2 IN NO_X

Downwind Distance (km)	Percentage NO_2		
	Lowest One Hour Average	Highest One Hour Average	Annual Average
1	5.9	16.0	9.3
2	11.4	29.0	17.5
3	16.5	39.7	24.7
5	25.7	55.6	36.5
10	43.8	76.1	56.1

1.10.18 In order to present the worst case, the highest one-hour average factors have been used for all averaging periods considered (for NO_x / NO_2) within this study.

Significance Criteria

1.10.19 For screening purposes, by the EA which, in "Horizontal Guidance Note H1 – Annex (f)", states:

[5]A Classification of NO Oxidation Rates in Power Plant Plumes based on Atmospheric Conditions (Janssen et al, 1987)

"Process contributions can be considered insignificant 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."

1.10.20 Where process contributions cannot be screened out, further criteria is required in order to determine whether the potential impacts to local air quality are acceptable.

1.10.21 This is provided, by the EA, which states that detailed modelling is required (as impacts may potentially be significant) where:

- The long term process contribution (PC) added to the existing background concentration (i.e. predicted environmental concentration, PEC) is greater than 70 per cent of the appropriate long-term standard; or

- The short term PC is greater than 20 per cent of the difference between the short-term standard and the existing short-term background concentrations.

Dispersion Modelling Results

1.10.22 A conservative view of the operation of the Development has been adopted in the modelling so that a likely "worst case" is presented. The purpose of using this approach is to ensure that the upper parameter of predicted impacts within the potential operating regime of the Development is considered. This ensures that there is a "factor of safety" built into the air quality assessment. The results of the modelling have been compared to AQS objectives.

1.10.23 Table 7 presents the likely worse case maximum PC to ground level concentrations of the substances considered predicted by the detailed dispersion modelling of the emissions from the stack. The Table also shows the relevant AQS Objectives.

TABLE 7: PREDICTED PROCESS CONTRIBUTIONS (µg/m^3)

Pollutant	Averaging Period	Objective (Ground Level Concentration) (µg/m^3)	July 2008 ES	January 2010 ES Addendum	June 2015 ES Addendum
Nitrogen Dioxide (NO_2)	1 Hour	200	7.1	8.8	7.7
	Annual	40	0.24	0.30	0.31
Sulphur Dioxide (SO_2)	15-minute	266	33.9	72.2	68.9
	1 Hour	350	27.8	66.0	60.1
	24 Hour	125	15.7	28.3	31.9
Particles (PM_{10})	24 Hour	50	0.6	0.8	0.7
	Annual	40	0.13	0.23	0.19
Carbon Monoxide	8-hour rolling	10 000	30.1	63.1	85.8

1.10.24 Table 8 shows the above results as a percentage of the relevant AQS Objective.

TABLE 8: PREDICTED PROCESS CONTRIBUTIONS (PERCENTAGE)

Pollutant	Averaging Period	Objective (Ground Level Concentration) (μg/m^3)	July 2008 ES	January 2010 ES Addendum	June 2015 ES Addendum
Nitrogen Dioxide (NO_2)	1 Hour	200	3.6	4.4	3.9
	Annual	40	0.6	0.8	0.8
Sulphur Dioxide (SO_2)	15-minute	266	12.7	27.1	25.9
	1 Hour	350	7.9	18.9	17.2
	24 Hour	125	12.6	22.6	25.5
Particles (PM_{10})	24 Hour	50	1.2	1.6	1.4
	Annual	40	0.3	0.6	0.5
Carbon Monoxide	8-hour rolling	10 000	0.3	0.6	0.9

1.10.25 The predictions above have been compared with the EA Screening / Significance Criteria. Those shaded in green are less than 1% / 10% of the relevant long-term / short-term objective, respectively and are therefore screened out and are not considered further in this study.

1.10.26 Table 9 presents the predicted PCs that require further analysis together with the assumed background concentrations.

TABLE 9: PREDICTED PROCESS ENVIRONMENTAL CONCENTRATIONS (PERCENTAGE)

Pollutant	Averaging Period	Objective (Ground Level Concentration) (μg/m^3)	Long Term Background (μg/m^3)	July 2008 ES	January 2010 ES Addendum	June 2015 ES Addendum
Sulphur Dioxide (SO_2)	15-minute	266	1.6	14.1	28.7	27.4
	1 Hour	350		-	20.0	18.3
	24 Hour	125		15.5	25.9	28.8

1.10.27 The predictions above have been calculated using H1 Guidance advice for estimating short-term PECs. Those shaded in green are less than 20% the difference between the relevant short-term objective and twice the long-term background and can, therefore, be screened out and are not considered further.

1.10.28 However, the PECs for all modelling scenarios and averaging periods are well within the relevant objectives and are therefore considered to be insignificant.

2 CONCLUSIONS

2.1.1 A conservative view of the operation of the Development has been adopted in the modelling so that a likely "worst case" is presented. The purpose of using this approach is to ensure that the upper parameter of predicted impacts within the potential operating regime of the Project is considered. This ensures that there is a "factor of safety" built into the air quality assessment.

2.1.2 The updated study indicates that, in general, the short-term process contributions from the Development, based on the proposed variation, will be lower than results obtained in the January 2010 ES Addendum. The exceptions are the 24-hour average mean for SO_2 and the 8-hour rolling mean for CO.

2.1.3 All process contributions are well within their respective guideline / limit value therefore the potential impacts to local air quality as a result of operation of the Development will remain not significant.

2.1.4 The updated study has predicted that the long-term process contributions of NO_2 and HCl from the Development, as proposed in this variation application, will be slightly higher than predicted using previous input parameters. For particulates the process contribution is predicted to be lower (due to a reduction in the proposed emissions level).

2.1.5 All long-term process contributions shown in Table 6.4 are less than 1% of the relevant guideline value therefore the potential long term impact is considered to be insignificant.