FICHTNER

Consulting Engineers Limited

Baronet Road

Ingevity UK Ltd

Air Quality Addedundum

ENGINEERING ⫟ CONSULTING

Document approval

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Contents

1 Introduction

1.1 Background

Ingevity UK Ltd (Ingevity) has submitted an application for a Variation to the Environmental Permit (EP) for the Baronet Road site (application ref: EPR/PP3139XA/V005). The Air Quality Assessment (AQA) submitted with the EP application was prepared by Uniper[1]. In the dispersion modelling undertaken as part of the AQA, it was assumed that the internal diameter of each boiler flue would be 0.8 m and the flue gas flow rate would be 10.24 m³/s at actual conditions. Whilst it was not stated in the AQA, this would result in an efflux velocity of 20 m/s. A velocity of 20 m/s is much higher than would be typical for a boiler and would be likely to result in an unacceptable back-pressure which would affect the overall performance of the boilers.

Ingevity has received a quotation from Willis & Thornley Ltd (WT) for the stack. WT has proposed a stack with an internal diameter of 0.9 m for each flue. As well as a slight reduction in the design flue gas flow rate proposed from the boiler supplier (Bosch), this results in a reduction in flue gas velocity to approximately 11 m/s at full load, which is in line with a 'typical' velocity for a boiler. Taking this into consideration, revised flue gas parameters for dispersion modelling have been determined using Fichtner's combustion calculator for a thermal input of 14.65 MWth per boiler. The flue gas parameters are presented in Appendix A.

The dispersion model has been re-run using the increased diameter of 0.9 m and flue gas parameters as specified in WT's quotation, which have been taken from the technical data sheets for the boilers. The results of the modelling are presented in sections 2.1 and 2.2.

This report is to be read in conjunction with Uniper's AQA. All model inputs and methodology are unchanged from Uniper's AQA, with the exception of the model inputs presented in Appendix A.

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[1]   Air Quality Assessment for Ingevity Boiler Development (Permitting), Uniper, ref ENG/22/PSP/EC/2701/R

2 Results

In accordance with the Environment Agency's screening criteria applied in the AQA, where the process contribution (PC) is less than 1% of the long-term or 10% of the short-term environmental standard, the impact can be screened out as 'insignificant'. The exception is for impacts on local nature sites, for which the screening criteria are 100% of the long-term or short-term environmental standard.

If the PC exceeds 1% of the long-term environmental standard but the predicted environmental concentration (PEC) is less than 70% of the long-term environmental standard, the impact is described as 'not significant'.

2.1 Human Health

The results of the dispersion modelling (the PC and PEC as a concentration and as a percentage of the air quality standard (AQS) for the protection of human health) are presented in Table 1 to Table 4. These are presented in the same format as in Uniper's AQA.

Table 1:   Annual Mean Nitrogen Dioxide

Receptor	AQS (µg/m³)	Background (µg/m³)	PC (µg/m³)	PC/AQS (%)	PEC (µg/m³)	PEC/AQS (%)	Descriptor
Grid Maximum	40	21.4	0.60	1.49%	22.00	54.99%	Not significant
R1: Mill Lane 1	40	21.4	0.11	0.27%	21.51	53.77%	Insignificant
R2: Mill Lane 2	40	21.4	0.09	0.23%	21.49	53.73%	Insignificant
R3: Turf Farm	40	21.4	0.13	0.34%	21.53	53.84%	Insignificant
R4: Forrest Way	40	21.4	0.13	0.33%	21.53	53.83%	Insignificant
R5: Baronet Mews	40	21.4	0.22	0.56%	21.62	54.06%	Insignificant
R6: Baronet Road	40	21.4	0.25	0.62%	21.65	54.12%	Insignificant
R7: Morley Road	40	21.4	0.20	0.49%	21.60	53.99%	Insignificant
R8: Pool Lane	40	21.4	0.21	0.52%	21.61	54.02%	Insignificant
R9: Walton Lea Cottages	40	21.4	0.30	0.75%	21.70	54.25%	Insignificant
R10: AQMA 1	40	37.1	0.16	0.41%	37.26	93.16%	Insignificant
R11: AQMA 2	40	37.1	0.16	0.40%	37.26	93.15%	Insignificant
R12: AQMA 3	40	37.1	0.15	0.37%	37.25	93.12%	Insignificant

Table 2: 99.79th Percentile of Hourly Mean Nitrogen Dioxide

Receptor	AQS (µg/m³)	Background (µg/m³)	PC (µg/m³)	PC/AQS (%)	PEC (µg/m³)	PEC/AQS (%)	Descriptor
Grid Maximum	200	42.8	17.31	8.66%	60.11	30.06%	Insignificant
R1: Mill Lane 1	200	42.8	3.61	1.81%	46.41	23.21%	Insignificant
R2: Mill Lane 2	200	42.8	3.85	1.93%	46.65	23.33%	Insignificant
R3: Turf Farm	200	42.8	2.98	1.49%	45.78	22.89%	Insignificant
R4: Forrest Way	200	42.8	1.38	0.69%	44.18	22.09%	Insignificant
R5: Baronet Mews	200	42.8	2.16	1.08%	44.96	22.48%	Insignificant
R6: Baronet Road	200	42.8	2.51	1.25%	45.31	22.65%	Insignificant
R7: Morley Road	200	42.8	1.94	0.97%	44.74	22.37%	Insignificant
R8: Pool Lane	200	42.8	1.94	0.97%	44.74	22.37%	Insignificant
R9: Walton Lea Cottages	200	42.8	1.90	0.95%	44.70	22.35%	Insignificant
R10: AQMA 1	200	74.2	1.55	0.77%	75.75	37.87%	Insignificant
R11: AQMA 2	200	74.2	1.60	0.80%	75.80	37.90%	Insignificant
R12: AQMA 3	200	74.2	1.47	0.74%	75.67	37.84%	Insignificant

Table 3:   Maximum 8 Hour Mean Carbon Monoxide

Receptor	AQS (µg/m³)	Background (µg/m³)	PC (µg/m³)	PC/AQS (%)	PEC (µg/m³)	PEC/AQS (%)	Descriptor
Grid Maximum	10,000	832	16.76	0.17%	848.8	8.49%	Insignificant
R1: Mill Lane 1	10,000	832	3.41	0.03%	835.4	8.35%	Insignificant
R2: Mill Lane 2	10,000	832	3.59	0.04%	835.6	8.36%	Insignificant
R3: Turf Farm	10,000	832	3.16	0.03%	835.2	8.35%	Insignificant
R4: Forrest Way	10,000	832	1.56	0.02%	833.6	8.34%	Insignificant
R5: Baronet Mews	10,000	832	2.40	0.02%	834.4	8.34%	Insignificant
R6: Baronet Road	10,000	832	2.44	0.02%	834.4	8.34%	Insignificant
R7: Morley Road	10,000	832	2.03	0.02%	834.0	8.34%	Insignificant
R8: Pool Lane	10,000	832	1.80	0.02%	833.8	8.34%	Insignificant
R9: Walton Lea Cottages	10,000	832	1.82	0.02%	833.8	8.34%	Insignificant
R10: AQMA 1	10,000	832	1.42	0.01%	833.4	8.33%	Insignificant
R11: AQMA 2	10,000	832	1.63	0.02%	833.6	8.34%	Insignificant
R12: AQMA 3	10,000	832	1.53	0.02%	833.5	8.34%	Insignificant

Table 4:   Maximum Hourly Mean Carbon Monoxide

Receptor	AQS (μg/m³)	Background (μg/m³)	PC (μg/m³)	PC/AQS (%)	PEC (μg/m³)	PEC/AQS (%)	Descriptor
Grid Maximum	30,000	832	26.25	0.09%	858.3	2.86%	Insignificant
R1: Mill Lane 1	30,000	832	6.67	0.02%	838.7	2.80%	Insignificant
R2: Mill Lane 2	30,000	832	6.96	0.02%	839.0	2.80%	Insignificant
R3: Turf Farm	30,000	832	3.93	0.01%	835.9	2.79%	Insignificant
R4: Forrest Way	30,000	832	2.08	0.01%	834.1	2.78%	Insignificant
R5: Baronet Mews	30,000	832	2.67	0.01%	834.7	2.78%	Insignificant
R6: Baronet Road	30,000	832	3.12	0.01%	835.1	2.78%	Insignificant
R7: Morley Road	30,000	832	2.49	0.01%	834.5	2.78%	Insignificant
R8: Pool Lane	30,000	832	2.42	0.01%	834.4	2.78%	Insignificant
R9: Walton Lea Cottages	30,000	832	2.42	0.01%	834.4	2.78%	Insignificant
R10: AQMA 1	30,000	832	1.93	0.01%	833.9	2.78%	Insignificant
R11: AQMA 2	30,000	832	2.11	0.01%	834.1	2.78%	Insignificant
R12: AQMA 3	30,000	832	2.10	0.01%	834.1	2.78%	Insignificant

As shown, all impacts are predicted to be 'insignificant' with the exception of annual mean NO_2 at the point of maximum impact (0.60 µg/m³ equal to 1.49% of the AQS). However, the PEC is below 70% of the AQS and is described as 'not significant'. Figure 1 of Appendix B shows the contour plot the PC annual mean impact as a percentage of the AQS. As shown, there are two areas where the impact cannot be screened out as 'insignificant'. The area to the north of the Facility consists of railway sidings whilst the area to the south consists of open agricultural field which means there are no areas of relevant exposure to the annual mean AQS (residential dwellings, schools, care homes, or hospitals) within these areas. Therefore, the PC at all areas of relevant exposure can be screened out as 'insignificant'.

Overall, the conclusions in Uniper's AQA that there will be no significant effect on human health is unchanged.

2.2 Ecology

Uniper's dispersion modelling files included discrete receptor points for each European and UK designated site (which have been used for this assessment), but not each local wildlife site (LWS). For the purpose of this assessment it has been assumed that a LWS is present at the point of maximum impact as a screening assumption. For the assessment of deposition impacts at the LWSs, it has been assumed that the most sensitive habitat is located at the point of maximum impact. If the impact at the point of maximum impact can be screened out as 'insignificant', it follows that the impact at each LWS will also screen out as 'insignificant'. If the impact at the point of maximum impact cannot be screened out as 'insignificant', further assessment has been undertaken.

The results of the dispersion are presented in Table 5 to Table 8. These are presented in the same format as in Uniper's AQA.

Table 5: Annual Mean NOx

Site	Critical Level (µg/m³)	PC (µg/m³)	PC/Critical Level (%)	Descriptor
Manchester Mosses SAC	30	0.02	0.06%	Insignificant
Rixton Clay Pits SAC	30	0.01	0.05%	Insignificant
Mersey Estuary Ramsar and SPA	30	0.01	0.03%	Insignificant
Woolston Eyes SSSI	30	0.04	0.12%	Insignificant
Pt of Max Impact (LWSs)	30	0.85	2.84%	Insignificant

Table 6: Maximum Daily Mean NOx

Site	Critical Level (µg/m³)	PC (µg/m³)	PC/Critical Level (%)	Descriptor
Manchester Mosses SAC	200	0.17	0.09%	Insignificant
Rixton Clay Pits SAC	200	0.17	0.08%	Insignificant
Mersey Estuary Ramsar and SPA	200	0.18	0.09%	Insignificant
Woolston Eyes SSSI	200	0.36	0.18%	Insignificant
Pt of Max Impact (LWSs)	200	24.07	12.03%	Insignificant

Table 7:   Nutrient Nitrogen Deposition

Site	Woodland (W) or Non-woodland (NW)	Critical Load (kgN/ha/yr)	PC (kgN/ha/yr)	PC/Critical Load (%)	Descriptor
Manchester Mosses SAC	NW	5	0.0018	0.037%	Insignificant
Rixton Clay Pits SAC	NW	10	0.0015	0.015%	Insignificant
Mersey Estuary Ramsar and SPA	NW	20	0.0010	0.005%	Insignificant
Woolston Eyes SSSI	Features not sensitive				
Pt of Max Impact (LWSs)	W	10	0.1716	1.716%	Insignificant

Table 8:   Acid Deposition

Site	Woodland (W) or Non-woodland (NW)	Critical Load (keq/ha/yr)	PC (keq/ha/yr)	PC/Critical Load (%)	Descriptor
Manchester Mosses SAC	NW	0.564	0.00013	0.023%	Insignificant
Rixton Clay Pits SAC	NW	0.568	0.00011	0.019%	Insignificant
Mersey Estuary Ramsar and SPA	Features not sensitive				
Woolston Eyes SSSI	Features not sensitive				
Pt of Max Impact (LWSs)	W	1.806	0.0123	0.679%	Insignificant

As shown, the PC at ecological receptor locations remains well below the screening criteria of 1% of the long-term and 10% of the short-term environmental standard at European and UK designated sites. The peak impact across the grid is less than 100% of the long- or short-term environmental standard. As such, the impact at all LWSs would also be less than the environmental standard. Therefore, the impact at all ecological receptors can be screened out as 'insignificant' and the conclusions of the AQA are unchanged.

3 Summary

Dispersion modelling has been undertaken to assess the effect of increasing the flue diameter for each boiler and reducing the flue gas flow rate to reflect the revised design for the boilers.

The results of the modelling show that the predicted impact at ecological receptors and all areas of relevant exposure for human health remains 'insignificant'. As such, the proposed design changes will not result in an unacceptable air quality impact.

Appendices

A Flue Gas Parameters

Table 9: Source Data

Item	Unit	Uniper AQA	Revised Parameters
Stack data			
Height	m		35
Internal diameter (each flue)	m	0.8	0.9
Effective internal diameter (4x flues)	m	1.6	1.8
Location	m, m		359513, 385931
Flue gas conditions			
Temperature	°C		139
Exit moisture content	% v/v	17.16%	17.23%
Exit oxygen content	% v/v dry	8.59%	2.00%[1]
Reference oxygen content	% v/v dry	3%	3%
Volume at reference conditions[2] – 4 boilers	Nm³/s	15.51	16.46
Volume at actual conditions – 4 boilers	Am³/s	40.96	28.43
Flue gas exit velocity	m/s	20.4	11.2
NOx emission concentration	mg/Nm³		100
NOx emission rate – 4 boilers	g/s	1.55	1.65
CO emission concentration	mg/Nm³		40
CO emission rate – 4 boilers	g/s	0.62	0.66
Notes:			
Modelled as a single emission source to represent the 4 boilers as they share a common windshield.			
(1) Revised oxygen content calculated based on excess air required to match the flue gas flow rate from tender of 16,849 m³/h per boiler (273K, no correction for moisture or oxygen content).			
(2) Reference conditions are 273K, dry gas, 3% O_2, 101.3 kPa.			

B Figures

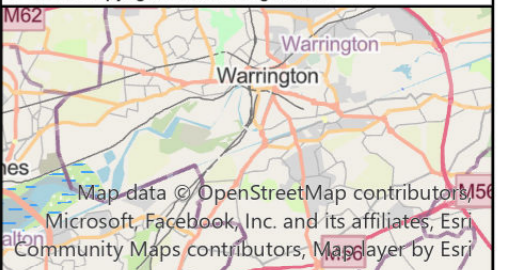Figure 1. Annual Mean Nitrogen Dioxide (% of AQAL)

Legend

- Stack Location
- Human Sensitive Receptors
- Annual Mean Nitrogen Dioxide (as % of AQAL)

Significance Screening Criteria

- <1%
- >1%

Title:

Figure 1. Annual Mean Nitrogen Dioxide (% of AQAL)

Drawn by: MJC	Date: 02/03/2023

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Scale: 1:10,000

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Map labels: Forrest Way, AQMA 3, Baronet Mews, Baronet Road AQMA 2, Morley Road, Pool Lane, AQMA 1, Walton Lea Cottages, Mill Lane 2, Mill Lane 1, Turf Farm

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