Air Quality Assessment of Abnormal Operations

Energy from Waste Facility

Shelton Road, Corby

For Encyclis Limited

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Quality Management

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1 Introduction

1.1 An air quality impact assessment has been undertaken to accompany the permit application for the proposed energy from waste (EfW) facility at Shelton Road, Corby.

1.2 This report provides the results of an assessment of the potential long and short-term air quality impacts during abnormal operations. The assessment methodology and the results during normal operations are presented in the RPS December 2022 Air Quality Assessment Proposed Energy from Waste Facility report [1].

2 Abnormal Operations

Background

2.1 Article 46 of the Industrial Emissions Directive (IED) [2] provides operators with some operational flexibility to resolve plant problems without initiating a complete shutdown of the facility. These scenarios are termed 'abnormal operations' and include incidents such as technically unavoidable stoppages, disturbances, or failures of the air pollution control equipment or monitoring equipment.

2.2 The IED requires that such abnormal operations must not exceed a maximum of four hours at any one time and the cumulative duration of these periods must not exceed 60 hours in a year. If the failure cannot be rectified after four hours, then the facility must shutdown.

2.3 The modelling results presented in the Air Quality Assessment were prepared based on continuous operations, with emissions to air for each pollutant considered being at the IED limits or the BAT-AELs for the entire time. In practice, for most plant operating conditions, emissions would be well below these limits.

2.4 The potential long-term and short-term air quality impacts during abnormal operations are summarised below.

Failure of the Selective Non-Catalytic Reduction (SNCR) System

2.5 Under abnormal operations, the maximum short-term NOx emission rate is expected to be 600 mg/m^3 i.e. 1.5 times the normal emission concentration modelled for the 99.79th percentile hourly mean of 400 mg/m^3 and 6 times the normal emission concentration modelled for the annual mean of 100 mg/m^3, with the SNCR air pollution control system operating effectively. This in turn increases the modelled Process Contribution (PC) by a factor of 1.5 and 6 respectively.

2.6 The ground-level concentrations under abnormal operations have been compared with the relevant Environmental Assessment Levels (EALs) for ambient NO_2 concentrations set out in Table 2.5 of the Air Quality Assessment but repeated, as appropriate, throughout this report for ease of reference.

2.7 The maximum long-term PC for NO_2 under normal operating conditions is 0.6 µg.m^{-3}. Under abnormal operations, emissions are expected to be 6 times the normal operating concentration for a maximum of 60 hours out of the year and, as such, the PC can be calculated using the following formula 0.6 x [(6 x 60/8760) + (8700/8760)], based on continuous operation throughout the year.

2.8 The maximum short-term PC for NO_2 under normal operating conditions is 17.1 µg.m^{-3}. This has been multiplied by 1.5 to derive the PC under abnormal operating conditions.

2.9 The predicted NO_2 PCs under normal and abnormal operations are set out in Table 2.1.

Table 2.1 Predicted Concentrations (µg.m^{-3}) During Normal and Abnormal Operations

			Normal		Abnormal					
Pollutant	Averaging Period	EAL	Max PC	Max PC as % of EAL	Max PC	PC as % of EAL	Is PC Potentially Significant?	AC	PEC	PEC as % of EAL
NO_2	99.79th Percentile Hourly mean	200	19.6	10	29.35	15	Yes	36.8	66.2	33
	Annual mean	40	0.7	2	0.70	2	Yes	18.4	19.1	48

PCs drawn from Table 5.1 of the Air Quality Assessment

2.10 Under abnormal operations, the maximum 99.79th Percentile hourly mean NO_2 PC is predicted to be 29.35 µg.m^{-3}. This is 15% of the EAL of 200 µg.m^{-3} and cannot therefore be screened out without considering the PEC. The PEC during abnormal operations is 66.2 µg.m^{-3}, which is 33% of the EAL. The headroom between the PEC and the EAL of 200 µg.m^{-3} is considered to provide sufficient headroom to avoid significant adverse effects to human health and the environment.

2.11 Under abnormal operations, the maximum annual mean NO_2 PC is predicted to be 0.70 µg.m^{-3}. This is 2% of the EAL of 40 µg.m^{-3} and cannot therefore be screened out without considering the PEC. The PEC during abnormal operations is 19.1 µg.m^{-3}, which is 48% of the EAL. The headroom between the PEC and the EAL of 40 µg.m^{-3} is considered to provide sufficient headroom to avoid significant adverse effects to human health and the environment.

Failure of the Acid Gas Abatement System

2.12 The unabated emission of each acid gas during a failure of the abatement system is expected to be: HCl 1720 mg.m^{-3}, HF 66 mg.m^{-3} and SO_2 659 mg.m^{-3}. The short-term abnormal PC has been calculated based on the ratio of unabated (abnormal) emissions to normal operation emission concentration and is reported in Table 2.2.

2.13 The maximum monthly-mean PC for HF under normal operating conditions is 0.01 µg.m^{-3}. Under abnormal operations, emissions are expected to be 66 times the normal operating concentration for a maximum of 60 hours out of the year. Assuming that those 60 hours occur within the same month, the PC can be calculated using the following formula 0.01 x [(66 x 60/730) + (670/730)], based on continuous operation throughout the year.

Table 2.2: Predicted Concentrations (µg.m^{-3}) During Normal and Abnormal Operations

Pollutant	Averaging Period	EAL	Criteria	Normal		Abnormal					
				Max PC	PC as % of EAL	Max PC	PC as % of EAL	Is PC Potentially Significant?	AC	PEC	PEC as % of EAL
HCl	1 hour (max)	750	10	17.9	2	512.1	68	Yes	0.30	512.42	68
HF	1 hour (max)	160	10	1.2	1	19.7	12	Yes	2.50	22.15	14
	1 hour (monthly mean)	16	1	0.01	0	0.08	0	No	-	-	-
SO_2	15 min (99.9th %ile)	266	10	32.1	12	105.8	40	Yes	4.36	110.16	41
	1 hour (99.73th %ile)	350	10	27.7	8	91.1	26	Yes	4.36	95.46	27
	Daily-mean (99.18th %ile)	125	10	17.2	14	56.7	45	Yes	4.36	61.04	49

PCs drawn from Table 5.1 of the Air Quality Assessment

2.14 Short-term emissions of HF monthly mean can be screened out as insignificant based on the PC being less than 10% of the EAL. The PECs for 15-minute, 1 hour and daily-mean SO_2, HF (1 hour mean) and HCl (1 hour mean) are below the EALs over the relevant averaging periods and as such will have no significant adverse effect.

Failure of the Activated Carbon Injection System (Vapour phase heavy metal control)

2.15 It has been conservatively assumed that in the event of a failure of the activated carbon system all emissions will increase by an order of 100 times.

Metals

2.16 It should be noted that the activated carbon injection system is used to control vapour phase emissions of metals. Most metals will be in the particulate phase, with only Hg and a limited amount of Cd emitted as vapour. The results for other metal have been included to ensure the assessment is conservative.

Short-term Impacts

2.17 Based on the assumption above it has been assumed that heavy metals are emitted at 100 times the mass emitted under normal operations. Table 2.3 sets out the PC under abnormal operations.

Table 2.3: Predicted Short-term Concentrations (µg.m^{-3}) During Normal and Abnormal Operations

Pollutant	EAL	Normal		Abnormal					
		Max PC	PC as % of EAL	Max PC	PC as % of EAL	Is PC Potentially Significant?	AC	PEC	PEC as % of EAL
Tl	30	0.015	0	1.49	5	No	-	-	-
Hg	7.5	0.015	0	1.49	20	Yes	0.038	1.53	20
Sb	150	0.149	0	14.89	10	No	-	-	-
Cr	150	0.149	0	14.89	10	No	-	-	-
Cu	200	0.149	0	14.89	7	No	-	-	-
Mn	1500	0.149	0	14.89	1	No	-	-	-
V	1	0.061	6	6.13	613	Yes	0.001	6.13	613

PCs drawn from Table 5.1 of the Air Quality Assessment

2.18 The PECs for all short-term emissions, except vanadium and mercury are below the EAL and can be screened out as insignificant.

2.19 For mercury , the PC is more than 10% of the EAL. However, the PEC is below the EAL over the relevant averaging period and as such can be screened out as insignificant.

2.20 For vanadium, the predicted PC is more than 10% of the EAL and the PEC is above the EAL. These predictions assume that vanadium individually comprise the total of the group 3 metals emissions. In reality, the emission limit applies to all nine of the group 3 metals. The Environment Agency '*Releases from waste incinerators – Guidance on assessing group 3 metal stack emissions from incinerators'* version 4 (undated), provides a summary of 34 measured values for each metal recorded at 18 municipal waste and waste wood co-incinerators between 2007 and 2015. For vanadium, the measured concentration varies from <0.05% to 1.2% of the emission

concentration limit. Table 2.4 shows the predicted PC if vanadium is 1.2% of the emission limit. In this case, the predicted abnormal PC remains more than 10% of the EAL; however, the PEC is below the EAL. The vanadium impacts are therefore not considered to be significant.

Table 2.4: Predicted Long-term Concentrations (µg.m^{-3}) During Normal and Abnormal Operations – Step 2

Pollutant	EAL	Normal		Abnormal					
		Max PC	PC as % of EAL	Max PC	PC as % of EAL	Is PC Potentially Significant?	AC	PEC	PEC as % of EAL
V	1	0.001	0	0.07	7	No	0.001	0.07	7

2.21 As set out above, the activated carbon injection system is used to control vapour phase emissions of metals. Most metals will be in the particulate phase, with only Hg and a limited amount of Cd emitted as vapour. As such failure of the activated carbon injection system is unlikely to lead to any significant short-term emissions of metals. No significant adverse effect on human health is anticipated

Long-term Impacts

2.22 Based on the assumption used above that heavy metals are emitted at 100 times the normal emission concentration for a maximum of 60 hours then under abnormal operations the impact can be calculated using the following formula: PC (normal) x [(100 x 60/8760) + (8700/8760)]. Table 2.5 sets out the PC under abnormal operations.

Table 2.5: Predicted Long-term Concentrations (µg.m^{-3}) During Normal and Abnormal Operations

Pollutant	EAL	Normal		Abnormal					
		Max PC	PC as % of EAL	Max PC	PC as % of EAL	Is PC Potentially Significant?	AC	PEC	PEC as % of EAL
Cd	0.005	0.0002	4	0.0003	6	Yes	0.0001	0.0004	9
Tl	1	0.0002	0	0.0003	0	No	-	-	-
Hg	0.25	0.0002	0	0.0003	0	No	-	-	-
Sb	5	0.003	0	0.005	0	No	-	-	-
As	0.0006	0.003	48	0.005	81	Yes	0.001	0.006	95
Cr	5	0.003	0	0.005	0	No	-	-	-
Cr(VI)	0.0002	8.68E-07	0	1.46E-06	1	No	-	-	-
Co	0.2	0.003	1	0.005	2	Yes	0.0001	0.005	2
Pb	0.25	0.003	1	0.005	2	Yes	0.005	0.010	4
Mn	0.15	0.003	2	0.005	3	Yes	0.003	0.007	5
Ni	0.02	0.003	14	0.005	24	Yes	0.001	0.005	27

PCs drawn from Table 5.1 of the Air Quality Assessment

2.23 The PEC for all long-term emissions are below the EAL and can be screened out as insignificant.

PCBs

2.24 As for heavy metals, it has been assumed that PCBs are emitted at 100 times the mass emitted under normal operations. Table 2.6 sets out the PC under abnormal operations.

Table 2.6: Predicted Concentrations (µg.m^{-3}) During Normal and Abnormal Operations

Pollutant	Averaging Period	EAL	Normal		Abnormal		
			Max PC	PC as % of EAL	Max PC	PC as % of EAL	Is PC Potentially Significant?
PCBs	1 hour (annual mean)	0.2	7.71E-10	0	1.29E-09	0	No
	1 hour (maximum)	6	2.38E-08	0	2.38E-06	0	No

PCs drawn from Table 5.1 of the Air Quality Assessment

2.25 The PC for PCBs is less than 10% of the EAL and can be screened out as insignificant.

Dioxins and Furans

2.26 There is no reliable figure available for the likely unabated concentration of dioxins. As such, in-line with EA assessment methodology, the normal emission limit has been multiplied by a factor of 100, giving an emission concentration of 4E-06 µg.m^{-3} to assess the effects. In practice, given that dioxins are most likely to be associated with the particulate phase, this is a very conservative assumption as the factor of 5 derived for unabated particulate emissions would be a more realistic assumption.

Short-term Impacts

2.27 The effect of elevated short-term emissions of dioxins and furans is not considered likely to be significant as they accumulate slowly in the body over time due to inhalation and ingestion (a time period of 70 years is assumed for lifetime exposure to dioxins and furans). Accordingly, a short-term emission of 100 times the benchmark value for four hours will have no acute effect by inhalation on human health.

Long-term Impacts

2.28 An increase of 100 times the benchmark value for 60 hours per year will increase the amount deposited over a year at any given site by a factor of [(100 x 60/8760) + (8700/8760)] = 1.67.

2.29 A Human Health Risk Assessment (HHRA) was undertaken by Gair Consulting Ltd. Table 4.3 provides the calculated Mean Daily Intake (MDI) which is the typical intake from background sources (including dietary intake) across the UK and the Tolerable Daily Intake (TDI)

2.30 The Process Contribution presented in Table 4.3 has been increased by a factor of 1.67 to determine an abnormal Process Contribution. The results are provided in Table 2.7.

Table 2.7: Comparison of Total Intake with the TDI Maximum for Dioxins During Normal and Abnormal Operations

Maximum Impacted Receptor	Total Intake as % of TDI	Process Contribution as % of TDI (Normal)	Process Contribution as % of TDI (Abnormal)	Overall % of TDI (sum of MDI and Abnormal)
Adult	36.5%	1.5%	2.5%	37.5%
Child	92.2%	2.2%	3.7%	93.7%

2.31 The results show that the overall dioxins are below the TDI at the maximum impact receptors.

Failure of the Bag Filters (Control of Particulates and Heavy Metals)

Particulate Matter

2.32 The EAL makes provisions for a daily-mean PM_{10} concentration of 50 $\mu g.m^{-3}$, not to be exceeded more than 35 times a year. Under the IED, abnormal emissions must not last longer than four hours, after which time the facility must cease operating.

2.33 As the EAL for PM_{10} is based on a daily-average, emissions during the abnormal operation have been calculated assuming that the plant operates abnormally for four hours during any 24 hour period. Part 3 to the IED specifies a maximum emission concentration during abnormal operations of 150 $mg.Nm^{-3}$ for total dust. This is five times greater than the maximum emission concentration of 30 $mg.Nm^{-3}$ specified in the IED for normal operations for short-term emissions. The 24-hour average PC for PM_{10} under abnormal operations has been calculated using the following formula: PC (normal) x [(5 x 4/24) + (20/24)].

2.34 For long-term emissions the maximum emission concentration of 150 $\mu g.m^{-3}$ is 30 times greater than the BAT-AEL of 5 $\mu g.m^{-3}$ for normal operations. The annual-mean PC for PM_{10} has been calculated using the following formula: [PC (normal) x ((30 x 60/8760) + (8700/8760)].

2.35 The maximum abnormal PCs are reported in Table 2.8.

Table 2.8: Predicted PM_{10} Concentrations ($\mu g.m^{-3}$) During Normal and Abnormal Operations

Pollutant	Averaging Period	EAL	Normal		Abnormal		
			Max PC	Max PC as % of EAL	Max PC	PC as % of EAL	Is PC Potentially Significant?
PM_{10}	90.41st Percentile Daily mean	50	1.06	2	1.76	4	No
	Annual mean	40	0.05	0	0.06	0	No

PCs drawn from Table 5.1 of the Air Quality Assessment

2.36 The annual-mean and daily-mean abnormal impacts can be screened out as insignificant as the PCs are less than the EAL.

Metals

2.37 If it assumed that the metals concentrations increase by the same ratio as total dust i.e. 5 times the normal emissions for failure of the bag filters, then the results presented for the failure of the activated carbon system of 100 times the normal emissions are highly conservative estimates of the likely impacts if the bag filters fail. It has therefore already been demonstrated that the abnormal impacts can be screened out as insignificant.

3 Summary of Conclusions

3.1 Under abnormal operations, all air quality impacts are considered to have an insignificant effect.

References

1 RPS (2023) Air Quality Assessment Proposed Energy from Waste Facility, Shelton Road, Corby, For Encyclis Limited.

2 Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (Recast)