Air Quality Assessment of Abnormal Operations

Recycling, Recovery and Renewable Energy Facility, Wealden Brickworks

For Britaniacrest Recycling Ltd

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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 planning application for the proposed Recycling, Recovery and Renewable Energy (3Rs) Facility at Langhurstwood Road, Horsham, West Sussex. The results are presented in Chapter 7, and associated Appendices, of the Environmental Statement (ES).

1.2 This report provides the results of an assessment of the potential long and short-term air quality impacts during abnormal operations.

2 Abnormal Operations

Background

2.1 Article 46 of the Industrial Emissions Directive (IED) [1] provides operators with some operational flexibility to resolve plant problems without initiating a complete shutdown of the energy recovery 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 energy recovery facility must shutdown.

2.3 The modelling results presented in Chapter 7 of the ES were prepared assuming continuous operations, with emissions to air for each pollutant considered being at the IED limits for the entire time. In practice, for the majority of plant operating conditions, emissions would be well below the IED 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 The SNCR air pollution control system is expected to abate nitrogen oxides (NO_x) down to levels well below the IED daily-mean emissions limit value of 200 $mg.m^{-3}$. Unabated concentrations of NO_x are estimated to be 400 $mg.m^{-3}$, i.e. twice the daily-mean emissions limit value.

2.6 The IED emission limit applies to NOx emissions. In order to assess the human-health related impacts of abnormal operations NO_x concentrations need to be converted to nitrogen dioxide (NO_2). Total conversion (i.e. 100%) of NO to NO_2 is sometimes used for the estimation of the absolute upper limit of the annual mean NO_2. This technique is based on the assumption that all NO emitted is converted to NO_2 before it reaches ground level. However, in reality the conversion is an equilibrium reaction and even at ambient concentrations a proportion of NO_X remains in the form of NO.

2.7 Historically, the Environment Agency has recommended that for a 'worse case scenario', a 70% conversion of NO to NO_2 should be considered for calculation of annual average concentrations. Following the withdrawal of the Environment Agency's H1 guidance document, there is no longer

an explicit recommendation; however, for the purposes of determining the impacts during abnormal operations, a 70% conversion of NO to NO_2 has been assumed for annual average NO_2 concentrations in line with the Environment Agency's historic recommendations and an assumed conversion of 35% follows the Environment Agency's recommendations [2] for the calculation of 'worse case scenario' short-term NO_2 concentrations. This is consistent with the methodology adopted for the ES and set out in ES Chapter 7, paragraphs 7.3.36 to 7.3.38.

2.8 The ground-level concentrations under abnormal operations are then compared to the relevant Environmental Assessment Levels (EALs) for ambient NO_2 concentrations set out in ES, Chapter 7, Table 7.18 and Table 7.19 but repeated, as appropriate, throughout this report for ease of reference.

Short-term Impacts

2.9 Under abnormal operations, the maximum emission rate has been considered to be twice the normal emission rate and this will have the effect of increasing the modelled Process Contribution (PC) by a factor of 2. The predicted short-term contributions from the energy recovery facility under normal and abnormal operations are set out in Table 2.1.

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

Pollutant	Averaging Period	EAL	AC	Normal	Abnormal			
				Max PC	Max PC	Max PC as % of EQS	PC <10% EAL?	Screen Out
NO_2	1 hour (99.79th %ile)	200	23.8	5.8	11.5	5.8	Yes	Yes

2.10 Under abnormal operations, the estimated short-term NO_2 PC is 11.5 µg.m^{-3}. This equates to 5.8% of the EAL of 200 µg.m^{-3} and the impacts can be screened out as insignificant.

Long-term Impacts

2.11 The maximum long-term PC for NO_2 under normal operating conditions is 0.6 µg.m^{-3} (or 0.56 µg.m^{-3} prior to rounding). Under abnormal operations, emissions are expected to be twice 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 0.56 x [(2 x 60/8760) + (8700/8760)], based on continuous operation throughout the year. The predicted long-term contributions from the energy recovery facility under normal and abnormal operations are set out in Table 2.2.

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

Pollutant	Averaging Period	EAL	AC	Normal	Abnormal					
				Max PC	Max PC	PC as % of EQS	PC <1% EAL?	Screen Out	PEC	PEC as % of EAL
NO_2	Annual	40	11.9	0.56	0.56	1.4	No	No	12.5	31

2.12 Under abnormal operations, the maximum long-term NO_2 PC is predicted to be 0.56 µg.m^{-3}. This equates to 1.4% of the EAL of 40 µg.m^{-3} and cannot therefore be screened out without considering the PEC. The PEC during abnormal operations is 12.5 µg.m^{-3}, which is 31% of the EAL. The 69% 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 Bag Filters (Control of Particulates and Heavy Metals)

Short-term Impacts

2.13 The EAL makes provisions for a daily-mean PM_{10} concentration of 50 µg.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 energy recovery facility must cease operating.

2.14 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 during 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)].

2.15 The EALs for heavy metals are based upon hourly values, as such only the maximum hourly abnormal concentration needs to be considered. Assuming that the metals concentrations increase by the same ratio as total dust, the 1-hour PC for each of the heavy metals has been multiplied by five to predict the maximum hourly emissions of each during abnormal operations. The maximum abnormal PC is reported in Table 2.3.

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

Pollutant	EAL	AC	Normal	Abnormal				
			Max PC	Max PC	PC as % of EQS	Screen Out (PC <10% EAL?)	PEC	PEC as % of EAL
PM_{10}	50	-	0.1346	0.2244	0	Yes	-	-
Cd	No EAL	-	-	-	-	-	-	-
Tl	30	-	0.0064	0.0321	0	Yes	-	-
Hg	7.5	-	0.0064	0.0321	0	Yes	-	-
Sb	150	-	0.0641	0.3207	0	Yes	-	-
As	No EAL	-	-	-	-	-	-	-
Cr	150	-	0.0641	0.3207	0	Yes	-	-
Co	6 (a)	-	0.0641	0.3207	5	Yes	-	-
Cu	200	-	0.0641	0.3207	0	Yes	-	-
Pb	No EAL	-	-	-	-	-	-	-
Mn	1500	-	0.0641	0.3207	0	Yes	-	-
Ni	No EAL	-	-	-	-	-	-	-
V	1	0.0010	0.0641	0.3207	32	No	0.3217	32

PCs drawn from ES Chapter 7, Table 7.19.
(a) refers to EALs obtained from the EA's earlier Horizontal Guidance Note EPR H1 guidance note, as no levels are provided in the current guidance.

2.16 All short-term emissions, except vanadium, can be screened-out as being insignificant solely by consideration of their PCs alone, as they are predicted to be below 10% of the short-term EAL.

2.17 For vanadium, further consideration needs to be given to the PEC, which is predicted to be 0.3217 µg.m^{-3}, 32% of the short-term EAL. The PEC is well below the relevant EAL, and this is considered to provide sufficient headroom to avoid significant adverse effects to human health and the environment do not arise.

Long-term Impacts

2.18 Under abnormal operations, emissions will be 5 times the normal operating concentration for a maximum of 60 hours out of the year and, as such, the annual-mean PC for PM_{10} has been calculated using the following formula: [PC (normal) x ((5 x 60/8760) + (8700/8760)].

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

Pollutant	EAL	AC	Normal	Abnormal				
			Max PC	Max PC	PC as % of EQS	Screen Out (PC <1% EAL?)	PEC	PEC as % of EAL
PM_{10}	40	-	0.0398	0.0409	0	Yes	-	-
Cd	0.005	0.0003	0.0002	0.0002	4	No	0.0005	9
Tl	1	-	0.0002	0.0002	0	Yes	-	-
Hg	0.25	-	0.0002	0.0002	0	Yes	-	-
Sb	5	-	0.0020	0.0021	0	Yes	-	-
As	0.003	0.0010	0.0020	0.0021	68	No	0.0030	101
Cr	5	-	0.0020	0.0021	0	Yes	-	-
Cr (VI)	0.0002	-	0.0000	0.0000	0	Yes	-	-
Co (a)	0.2	0.0001	0.0020	0.0021	1	No	0.0022	1
Cu	10	-	0.0020	0.0021	0	Yes	-	-
Pb	0.25	-	0.0020	0.0021	1	Yes	-	-
Mn	0.15	0.0057	0.0020	0.0021	1	No	0.0077	5
Ni	0.02	0.0009	0.0020	0.0021	10	No	0.0029	15
V	5	-	0.0020	0.0021	0	Yes	-	-

PCs drawn from ES Chapter 7, Table 7.19.
(a) refers to EALs obtained from the EA's earlier Horizontal Guidance Note EPR H1 guidance note, as no levels are provided in the current guidance.

2.19 All long-term emissions except Cd, As, Co, Mn and Ni, can be screened out as being insignificant by consideration of the PCs alone, as they are predicted to be below 1% of the long-term EAL.

2.20 The PEC for all pollutants except As is below the relevant EAL, which are considered to provide sufficient headroom to avoid significant adverse effects to human health and the environment.

2.21 The Environment Agency Group 3 guidance requires the assessment to progress to the second stage assessment for those metals that cannot be screened out based on 100% of the emission limit. As cannot be screened out at Step 1, this metal has to be considered in more detail as part of the Step 2 assessment which assumes each element is emitted at 11% of the total Group 3 limit. The results are shown below.

Table 2.5: Predicted Long-term Concentrations (µg.m^{-3}) During Normal and Abnormal Operations – Step 2

Pollutant	EAL	AC	Normal	Abnormal				
			Max PC	Max PC	PC as % of EAL	Screen Out (PC <1% EAL?)	PEC	PEC as % of EAL
As	0.003	0.0010	0.00022	0.00023	8	No	0.0012	41

2.22 The results of the step 2 assessment show the PC for As to be below the relevant EAL.

Dioxins and Furans

2.23 There is no reliable figure available for the likely unabated concentration of dioxins. As such, in-line with EA assessment methodology, the IED emission limit has been multiplied by a factor of 100, giving an emission concentration of 10 ng.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 and the factor of 5 derived for unabated particulate emissions would be a more realistic assumption.

Short-term Impacts

2.24 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

2.25 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.

2.26 Table 4.3 of the Human Health Risk Assessment (HHRA) 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)

2.27 The PCs presented in Table 4.3 has been increased by a factor of 1.67 to determine an abnormal PC. The results are provided in Table 2.6Table 2.6.

Table 2.6: Impact Analysis TDI Maximum for Dioxins During Normal and Abnormal Operations

Maximum Impacted Receptor	MDI as % of TDI	Process Contribution as % of TDI (Normal)	Process Contribution as % of TDI (Abnormal)	Overall % of TDI (sum of MDI and Abnormal)
Farmer - Adult	35.00%	2.20%	3.67%	38.67%
Farmer - Child	90.00%	3.30%	5.51%	95.51%
Resident - Adult	35.00%	0.04%	0.07%	35.07%
Resident - Child	90.00%	0.11%	0.18%	90.18%

2.28 The results show that the overall dioxins for adult and child receptors are below the TDI.

Failure of the Acid Gas Abatement System

Short-term Impacts

2.29 Failure of the acid gas abatement system has been considered as follows. The unabated emission of each acid gas is expected to be HCl - 1000 $mg.m^{-3}$, HF - 10 $mg.m^{-3}$ and SO_2 - 250 $mg.m^{-3}$. The abnormal PC has been calculated based on the ratio of unabated emissions to IED short-term emission limits and reported in Table 2.7.

Table 2.7: Predicted Short-term Concentrations (µg.m^{-3}) During Normal and Abnormal Operations

Pollutant	Averaging Period	AC	EAL	Normal	Abnormal				
				Max PC	Max PC	PC as % of EQS	Screen Out (PC <10% EAL?)	PEC	PEC as % of EAL
HCl	1 hour (max)	0.38	750	7.7	128.3	17	No	128.64	17
HF	1 hour (max)	-	160	0.5	1.3	1	Yes		-
SO_2	15 min (99.9th %ile)	-	266	19.2	24.0	9	Yes	-	-
	1 hr (99.73th %ile)	-	350	15.1	18.8	5	Yes	-	-
	Daily-mean (99.18th %ile)	-	125	4.9	6.1	5	Yes	-	-

PCs drawn from ES Chapter 5, Table 5.29

2.30 Short-term emissions of HF and SO_2 can be screened out as insignificant based on the PC being less than 10% of the EAL. For HCl the short-term PEC is below the EAL and as such will have no significant adverse effect.

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

2.31 Chemosphere, Vol 45, No 8 pp 1151 - 1157 reports that activated carbon injection systems are up to 98.7% efficient in the removal of dioxins and furans. i.e. only 1.3% of dioxins and furans pass through. It has been conservatively assumed that, in the event of a failure of the activated carbon system, all predicted impacts will increase by an order of 100 times i.e. more than 1/1.3%.

Dioxins and Furans

2.32 Abnormal emissions with an increase by an order of 100 times for Dioxins and Furans has already been discussed in paragraphs 2.23 to 2.28.

Metals

Short-term Impacts

2.33 Table 2.8 sets out the PC under abnormal operations assuming that heavy metals are emitted at 100 times the mass emitted under normal operations.

Table 2.8: Predicted Short-term Concentrations (µg.m^{-3}) During Normal and Abnormal Operations

Pollutant	EAL	AC	Normal	Abnormal				
			Max PC	Max PC	PC as % of EQS	Screen Out (PC <10% EAL)?	PEC	PEC as % of EAL
Cd	No EAL	-	-	-	-	-	-	-
Tl	30	-	0.0064	0.64	2	Yes	-	-
Hg	7.5	-	0.0064	0.64	9	Yes		
Sb	150	-	0.0641	6.41	4	Yes	-	-
As	No EAL	-	-	-	-	-	-	-
Cr	150	-	0.0641	6.41	4	Yes	-	-
Co	6 (a)	0.0001	0.0641	6.41	107	No	6.41	107
Cu	200	-	0.0641	6.41	3	Yes	-	-
Pb	No EAL	-	-	-	-	-	-	-
Mn	1500	-	0.0641	6.41	0	Yes	-	-
Ni	No EAL	-	-	-	-	-	-	-
V	1	0.001	0.0641	6.41	641	No	6.41	641

PCs drawn from ES Chapter 7, Table 7.19
(a) refers to EALs obtained from the EA's earlier Horizontal Guidance Note EPR H1 guidance note, as no levels are provided in the current guidance.

2.34 All short-term emissions, except for Co and V are below 10% of the EAL and can be screened out as insignificant.

2.35 The Environment Agency Group 3 guidance requires the assessment to progress to the second stage assessment for those metals that cannot be screened out based on 100% of the emission limit. Co and V cannot be screened out at Step 1, these two metals have to be considered in more

detail as part of the Step 2 assessment which assumes each element is emitted at 11% of the total Group 3 limit. The results are shown below.

Table 2.9: Predicted Short-term Concentrations (µg.m^{-3}) During Normal and Abnormal Operations – Step 2

Pollutant	EAL	AC	Abnormal					
			Max PC	PC as % of EAL	PC <1% EAL?	Screen Out	PEC	PEC as % of EAL
Co	6	0.0001	0.71	11.9	No	No	0.71	11.9
V	1	0.001	0.71	71.3	No	No	0.71	71.4

2.36 The results of the step 2 assessment show the PECs for Co and V to be below the relevant EAL and can be screened out as insignificant.

2.37 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. 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

2.38 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 2.10 sets out the PC under abnormal operations.

Table 2.10: Predicted Long-term Concentrations (µg.m^{-3}) During Normal and Abnormal Operations

Pollutant	EAL	AC	Normal	Abnormal				
			Max PC	Max PC	PC as % of EQS	Screen Out (PC <1% EAL?)	PEC	PEC as % of EAL
Cd	0.005	0.00025	0.0002	0.0003	7	No	0.0006	12
Tl	1	-	0.0002	0.0003	0	Yes	-	-
Hg	0.25	-	0.0002	0.0003	0	Yes	-	-
Sb	5	-	0.0020	0.0033	0	Yes	-	-
As	0.003	0.00099	0.0020	0.0033	112	No	0.0043	145
Cr	5	-	0.0020	0.0033	0	Yes	-	-
Cr (VI)	0.0002	0.00000	0.0000	0.0000	1	Yes	-	-
Co	0.2 (a)	0.00012	0.0020	0.0033	2	No	0.0035	2
Cu	10	-	0.0020	0.0033	0	Yes	-	-
Pb	0.25	0.00000	0.0020	0.0033	1	Yes	-	-
Mn	0.15	0.03000	0.0020	0.0033	2	No	0.0333	22
Ni	0.02	0.00088	0.0020	0.0033	17	No	0.0042	21
V	5	-	0.0020	0.0033	0	Yes	-	-

(a) refers to EALs obtained from the EA's earlier Horizontal Guidance Note EPR H1 guidance note, as no levels are provided in the current guidance.

2.39 All long-term emissions, with the exception of As are below the EAL and can be screened out as insignificant.

2.40 The Environment Agency Group 3 guidance requires the assessment to progress to the second stage assessment for those metals that cannot be screened out based on 100% of the emission limit. Cr(VI) and As cannot be screened out at Step 1, these metals have to be considered in more detail as part of the Step 2 assessment which assumes each element is emitted at 11% of the total Group 3 limit. The results are shown below.

Table 2.11: Predicted Long-term Concentrations (µg.m^{-3}) During Normal and Abnormal Operations – Step 2

Pollutant	EAL	AC			Abnormal		
			Max PC	PC as % of EQS	Screen Out (PC <1% EAL?)	PEC	PEC as % of EAL
As	0.003	0.00099	0.00037	12	No	0.0014	45

2.41 The results of the step 2 assessment show the PEC for As to be below the relevant EAL.

3 Summary of Conclusions

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

References

1 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)

2 Environment Agency (undated) Conversion Ratios for NOx and NO_2