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Consulting Engineers Limited

Killoch Energy Recovery Park

Barr Environmental Limited

Abnormal Emissions Assessment

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Document approval

	Name	Signature	Position	Date
Prepared by:	HKL		Environmental Scientist	01/04/2021
Checked by:	RSF		Senior Consultant	01/04/2021

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1 Introduction

Fichtner Consulting Engineers Ltd ("Fichtner") has been engaged to undertake an Abnormal Emissions Assessment to support the Pollution Prevention and Control (PPC) Permit application for the proposed Energy Recovery Park (the Facility) in Killoch, East Ayrshire. The PPC Regulations require that abnormal event scenarios are considered.

Article 46(6) of the Industrial Emissions Directive (IED) states that:

"… the waste incineration plant … shall under no circumstances continue to incinerate waste for a period of more than 4 hours uninterrupted where emission limit values are exceeded.

The cumulative duration or operation in such conditions over 1 year shall not exceed 60 hours."

Article 47 continues with:

"In the case of a breakdown, the operator shall reduce or close down operations as soon as practicable until normal operations can be restored."

The conditions detailed in Article 46(6) are considered to be "abnormal operating conditions" for the purpose of this assessment that apply to the Facility.

2 Identification of Abnormal Operating Conditions

The following are considered to be examples of abnormal operating conditions which may lead to ‘abnormal emission levels’ of pollutants:

1. Reduced efficiency of lime injection system such as through blockages or failure of fans leading to elevated acid gas emissions (with the exception of hydrogen chloride);
2. Complete failure of the lime injection system leading to unabated emissions of hydrogen chloride. (Note: this would require the plant to have complete failure of the bag filter system. As a plant of modern design the plant would have shut down before reaching these operating conditions);
3. Reduced efficiency of particulate filtration system due to bag failure and inadequate isolation, leading to elevated particulate emissions and metals in the particulate phase;
4. Reduced efficiency of the Selective Non-Catalytic Reduction (SNCR) system as a result of blockages or failure of ammonia injection system, leading to elevated oxides of nitrogen emissions; and
5. Complete failure of the activated carbon injection system and loss of temperature control leading to high levels of dioxin reformation and their unabated release.

As a modern design, it is anticipated that the Facility will be operated to a high degree of compliance. Therefore, the identification of plausible abnormal emission levels has been based primarily on the data obtained from modern plants. Where actual data is not available, worst case conservative assumptions have been made.

2.1 Plant start-up and shutdown

Start-up of the Facility from cold will be conducted with clean support fuel (low sulphur fuel oil). Waste is not introduced into the furnace unless the temperature is above the minimum requirement (850°C) and other operating parameters (for example, air flow and oxygen levels) are within the range stipulated in the permit. During the warming up period the flue gas treatment plant will be operational as will be the control systems and monitoring equipment.

The same is true during plant shutdown. The waste remaining in the furnace is allowed to burn out, the temperature not being permitted to drop below 850°C by the simultaneous introduction of clean support auxiliary fuel. After complete burnout of the waste, the auxiliary fuel burners are turned off and the system is allowed to cool. During this period the gas cleaning equipment is fully operational, as will be the control systems and monitoring equipment.

It should also be noted that start-up and shutdown are infrequent events; the Facility is designed to operate continuously, and ideally only close down for its annual maintenance programme.

In relation to the magnitude of dioxin emissions during plant start-up and shutdown, research has been undertaken by AEA Technology on behalf of the Environment Agency (EA). Whilst elevated emissions of dioxins (within one order of magnitude) were found during shutdown and start-up phases where the waste was not fully established on the grate, the report concluded that:

“The mass of dioxin emitted during start-up and shutdown for a 4-5 day planned outage was similar to the emission which would have occurred during normal operation in the same period. The emission during the shutdown and restart is equivalent to less than 1% of the estimated annual emission (if operating normally all year).”

Therefore, there is no reason why start-up and shutdown operations will affect the long-term impact of the Facility.

3 Plausible Abnormal Emission Levels

The following plausible abnormal emission levels for the Facility have been identified based on the performance of similar plants in the UK. The plausible abnormal emissions concentrations are presented in Table 1, where available, these have been based on measured data from a comparable Facility.

Table 1: Plausible Abnormal Emissions from an EfW

Pollutant	Permitted Emission Limit, (mg/Nm³)(1)		Plausible Abnormal Emission, (mg/Nm³)	% Above Max Permitted Emission
	Daily Average	½ hourly max		
Oxides of nitrogen	120	400	500(2)	25
Particulate matter (PM_{10})	5	30	150(3)	400
Sulphur dioxide	30	200	450(4)	163
Hydrogen chloride	6	60	1750(4)	2,817
Hydrogen fluoride	1	4	20(1)	400
Dioxins	0.04 ng/Nm³		4 ng/Nm³	9900(5)
Dioxin-like PCBs	0.06 ng/Nm³		6 ng/Nm³	9900(5)
PCBs	0.005 mg/Nm³(6)		0.5 mg/Nm³	9900(7)

NOTES:

(1) All emission concentrations expressed as Nm³ based (dry, 0°C, 11% reference oxygen content).

(2) Taken as the upper end of the range of monitored raw flue gas after the boiler from the Waste Incineration BREF (Table 3.6)

(3) Taken from the IED maximum permitted level.

(4) Unabated mass concentration in the flue gas as calculated using a combustion calculation assuming a waste throughput of 300,000 tpa with a net calorific value (NCV) of 9.5 MJ/kg. The fuel is assumed to be a comprised of 200,000 tpa of residual municipal waste and 100,000 tpa of commercial and industrial waste. The fuel input for the combustion calculator has a sulphur content of 0.14% and 0.93% chlorine content by mass.

(5) Assumes a 99% removal efficiency in lieu of any other information as set out in the Devonport Decision Document (Reference: EPR/WP3833FT).

(6) The Waste Incineration BREF provides a range of values for PCB emissions to air from European municipal waste incineration plants. This states that the annual average total PCBs is less than 0.005 mg/Nm³ (dry, 11% oxygen, 273K). In lieu of other available data, this has been assumed to be the emission concentration for the Facility.

(7) In lieu of any publicly available information, the plausible emissions multiplier for PCBs is assumed to be the same as for dioxins.

A number of assumptions have been made with regard to the emissions of individual metals.

1. Emission concentration of mercury has been assumed to be 100% of the Best Available Techniques Associated Emission Level (BAT-AEL) concentration of 0.02mg/m³.

2. Emission concentration of cadmium and thallium has been taken as half the BAT-AEL concentration for cadmium and thallium and compounds of 0.02mg/m³.
3. Emission concentration of heavy metals that have a short or long term AQAL have been considered (antimony, arsenic, chromium, copper, lead, manganese, nickel, vanadium) and have been taken from the EA guidance document "Guidance on assessing group 3 metal stack emissions from incinerators" (version 4). This guidance summarises the existing emissions from 18 Municipal Waste Incinerators (MWIs) and Waste Wood Co-incinerators in the UK over a period between 2007 and 2015. This has been used in lieu of any guidance from SEPA.
4. The Predicted Abnormal Emissions are calculated based on 30 times the emission concentration, as it is assumed that metals are in the particulate phase with the exception of mercury where it has been assumed there 100 times the emissions due to a failure of the carbon dosing system.

The plausible abnormal emissions concentrations for metals are presented in Table 2.

Table 2: Predicted Abnormal Metal Emissions from an EfW

Pollutant	Emission Concentrations (µg/Nm³)	Predicted Abnormal Emission (µg/Nm³)	% Above Max Permitted Emission
Mercury	20	2,000	9,900
Cadmium	10	300	2,900
Thallium	10	300	2,900
Antimony	11.5	345	2,900
Arsenic	25	750	2,900
Chromium	92	2,760	2,900
Chromium (VI)	0.13	3.9	2,900
Cobalt	5.60	168	2,900
Copper	29	870	2,900
Lead	50.3	1,509	2,900
Manganese	60	1,800	2,900
Nickel	220	6,600	2,900
Vanadium	6	180	2,900
NOTE: All emission concentrations expressed as Nm³ based (dry, 0°C, 11% reference oxygen content).			

The definition of 'abnormal operating conditions' also encompasses periods where the continuous emission monitoring equipment is not operating correctly and data relating to the actual emission concentrations are not available. This assessment has only used data where the concentration of continuously monitored pollutants has been quantified. Furthermore, no data on flow characteristics (flow rate, temperature etc.) during these abnormal operating conditions is available, so for the purposes of this assessment the design flow characteristics have been applied to the plausible emission levels to derive an emission rate and assess impact.

In defining abnormal operating conditions Annex VI, Part 2 (2) notes that under no circumstances shall the total dust concentration exceed 150 mg/Nm³ expressed as a half hourly average. As such total dust has been included in this analysis. However, this section continues to state that the limits prescribed for TOC set must not be exceeded. As such there is no potential for the impact of emissions of TOC to be greater than that outlined in the Air Quality Analysis for PPC Permit Application note, and TOC has not been considered further within this assessment.

4 Impact Resulting from Plausible Abnormal Emissions

4.1 Impact from normal operations

The Air Quality Assessment, submitted as a separate document in the application, has considered the impact of the Facility in isolation. There are no local developments that have the potential to cause point source cumulative impacts with the Facility. Therefore, the process contribution used in this assessment is that of the Facility operating in isolation. This data is presented in Appendix B.

4.2 Predicted abnormal short-term impacts

In order to assess the effect on short term ground level concentrations associated with the Facility operating at the identified abnormal emission concentration, the calculated ground level concentration has been increased pro-rata as presented in Table 3.

Table 3: Short-term Impacts Resulting from Plausible Abnormal Emissions

Pollutant	AQAL (µg/m³)	Predicted Impact – Normal Operation		Predicted Impact – Abnormal Operations	
		Conc. µg/m³	% of AQAL	Conc. µg/m³	% of AQAL
Nitrogen dioxide	200	14.87(1)	7.44%	18.59	9.30%
Particulate matter (PM_{10})	50	0.20	0.40%	6.04	12.07%
Sulphur dioxide (24-hour)	125	20.90	5.97%	47.04	13.44%
Sulphur dioxide (1-hour)	350	30.16(1)	11.34%	67.87	25.52%
Sulphur dioxide (15-min)	266	21.52(1)	2.87%	627.74	83.70%
Hydrogen chloride	750	1.43(1)	0.90%	7.17	4.48%
Hydrogen fluoride	160	20.90(1)	5.97%	47.04	13.44%
Pollutant	**AQAL (ng/m³)**	**Predicted Impact – Normal Operations**		**Predicted Impact – Abnormal Operations**	
		Conc. ng/m³	**% of AQAL**	**Conc. ng/m³**	**% of AQAL**
Mercury	7,500	7.20	0.10%	719.77	9.60%
Cadmium	1,500	3.60	0.24%	107.97	7.20%
Thallium	30,000	3.60	0.01%	107.97	0.36%
Antimony	150,000	0.28	<0.01%	8.28	0.01%
Arsenic	1,500	9.00	0.60%	269.91	17.99%
Chromium	150,000	2.21	<0.01%	66.22	0.04%
Chromium (VI)	3,000	0.05	<0.01%	1.40	0.05%
Cobalt	6,000	2.02	0.03%	60.46	1.01%
Copper	200,000	0.70	<0.01%	20.87	0.01%
Manganese	1,500,000	1.44	<0.01%	43.19	<0.01%

Nickel	30,000	79.17	0.26%	2,375.23	7.92%
Vanadium	1,000	0.14	0.01%	4.32	0.43%
PCBs	6,000	1.80	0.03%	179.94	3.00%
NOTES: (1) Assumes operation at the half-hourly ELV from the IED (2) Assumes operation at the daily BAT AEL					

This is considered to be a highly conservative assessment as it assumes that the plausible abnormal emissions coincide with worst case meteorological conditions. Even with this highly conservative factor, the process contribution is not predicted to exceed any of the short term AQALs. The maximum predicted process contribution (as a % of the applied AQAL) is 83.7% for hydrogen chloride, with all other pollutants lower.

4.3 Predicted abnormal long-term impacts

In order to assess the effect on long term ground level concentrations associated with the Facility operating at the identified abnormal emission levels, the calculated long term ground level concentrations have been increased pro-rata as presented in Table 4.

There is no AQAL for dioxins and dioxin-like PCBs against which the impact can be assessed. Therefore, to assess the impact of dioxins and dioxin-like PCBs, the increase in concentration at the point of maximum impact has been assessed. As can be seen from the results presented in Table 5, the impact of abnormal emissions is to increase in the maximum ground level concentration by 67.81%.

This assessment assumes that the Facility is operating at the daily average BAT-AELs for 8,700 hours per year and at the plausible abnormal emission levels for 60 hours per year.

Table 4: Long-term Impacts Resulting from Plausible Abnormal Emissions

Pollutant	**AQAL (µg/m³)**	**Predicted Impact – Normal Operations**		**Predicted Impact – Abnormal Operations**	
		Conc. (µg/m³)	**% of AQAL**	**Conc. (µg/m³)**	**% of AQAL**
Nitrogen dioxide	40	0.63	1.57%	0.64	1.60%
Particulate matter (PM_{10})	18	0.04	0.21%	0.04	0.25%
Particulate matter ($PM_{2.5}$)	10	0.04	0.37%	0.04	0.45%
Hydrogen chloride	20	0.04	0.22%	0.05	0.25%
Hydrogen fluoride	16	0.01	0.05%	0.01	0.05%
Pollutant	**AQAL (ng/m³)**	**Predicted Impact – BAT-AELs**		**Predicted Impact – Abnormal Emission**	
		Conc. (ng/m³)	**% of AQAL**	**Conc. (ng/m³)**	**% of AQAL**
Mercury	250	0.15	0.06%	0.25	0.10%
Cadmium	5	0.07	1.50%	0.09	1.79%
Thallium	1,000	0.07	0.007%	0.09	0.009%

Antimony	5,000	0.09	<0.01%	0.10	<0.01%
Arsenic	3	0.19	6.24%	0.22	7.48%
Chromium	5,000	0.69	0.01%	0.83	0.02%
Chromium (VI)	0.2	0.00097	0.49%	0.0012	0.58%
Cobalt	200	0.04	0.02%	0.05	0.03%
Copper	10,000	0.22	<0.01%	0.26	<0.01%
Lead	250	0.38	0.15%	0.45	0.18%
Manganese	150	0.45	0.30%	0.54	0.36%
Nickel	20	1.65	8.24%	1.97	9.87%
Vanadium	5,000	0.04	<0.01%	0.05	<0.01%
PCBs	200	0.04	0.02%	0.06	0.03%

The process contribution is not predicted to exceed any of the long term AQALs. The maximum predicted process contribution (as a % of the applied AQAL) is 9.87% for nickel, with all other pollutants lower.

There is no AQAL for dioxins and dioxin-like PCBs against which the impact can be assessed. Therefore, to assess the impact of dioxins and dioxin-like PCBs, the increase in concentration at the point of maximum impact has been assessed. As can be seen from the results presented in Table 5, the impact of abnormal emissions is to increase in the maximum ground level concentration by 67.81%.

Table 5: Long Term Impacts from Predicted Dioxin Emissions

Pollutant	**Predicted Impact – Normal Operations**	**Predicted Impact – Abnormal Operations**	
	fg/m³	**fg/m³**	**% increase**
Dioxins and dioxin like PCBs	0.67	1.131	67.81%

4.4 Impact of plausible abnormal emissions – Human Health Risk Assessment

Based on the results of the Human Health Risk Assessment (HHRA), the highest dose of dioxins and dioxin-like PCBs is predicted to be 2.48% of the TDI. This is based on the ingestion and inhalation of dioxins and dioxin-like PCBs by a child agricultural receptor at the point of maximum impact. Assuming the impact of abnormal operations, it is calculated that the process contribution at this receptor will be (2.48% x 1.6781) = 4.16% of the UK TDI for dioxins and dioxin-like PCBs. Existing sources contribute 90.65% of the TDI, and therefore the total exposure will be 94.81% of the TDI.

In addition, the HHRA considers the impact of the ingestion of dioxins by an infant being breast fed by an adult agricultural receptor at the point of maximum impact. The impact of dioxins and dioxin like PCBs is predicted to be 14.9% of the UK TDI. There are no other significant pathways for infant receptors. Assuming the impact of abnormal operations, it is calculated that this receptor will be exposed to (14.9% x 1.6781) = 25.00% of the UK TDI for dioxins and dioxin like PCBs.

The HHRA also considers the impact of dioxins and dioxin like PCBs on cows' milk and soil concentrations. The predicted impact of dioxins at the point of maximum impact for long term limits for cows' milk is 0.07% of the EU limit[1]. Assuming the impact of abnormal operations, it is calculated that the process contribution at this receptor will be (0.07% x 1.6781) = 0.12%. The predicted impact of dioxins at the point of maximum impact for long term limits for soil concentrations is 1.46% of the mean rural Scotland soil concentration[2]. Assuming the impact of abnormal operations, it is calculated that the process contribution at this point will be (1.46% x 1.6781) = 2.45%.

A summary of results of the HHRA and likely impact during abnormal operations are displayed in Table 6.

Table 6: Impact of dioxins and dioxin like PCBs.

Impact to	Units	Pollutants	Predicted impacts – Normal Operations	Predicted impact – Abnormal Operations
Breast milk	% of TDI	Dioxins	2.48%	4.16%
		Dioxins and dioxin like PCBs	14.9%	25.00%
Cows' milk	% of EU limit	Dioxins	0.04%	0.07%
		Dioxins and dioxin like PCBs	0.07%	0.12%
Soil concentration	% of mean rural Scotland soil concentration	Dioxins	1.74%	2.92%
		Dioxins and dioxin like PCBs	1.46%	2.45%

Based on the conservative assumptions used within the modelling, there will be no exceedances of the TDI for dioxins and dioxin-like PCBs and the change in concentration of these components in cows' milk and soil would not be significant.

[1] Commission Regulation (EU) No. 1259/2011

[2] The UK Soil and Herbage Pollutant Survey, 2007.

5 Predicted Environmental Concentration – Abnormal Operations

IPPC H1 includes the following method for identifying which emissions require further assessment by applying the following criteria:

- 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.

Where the impact of abnormal emissions is greater than the above criteria, consideration of the background concentration has been made to ensure that the AQAL is not exceeded as a result of abnormal operations.

5.1 Baseline concentrations

Appendix A outlines the values for the annual average background concentrations that have been used to evaluate the impact of the Facility. These are the baseline concentrations, presented in the Air Quality Assessment submitted with the PPC Permit application.

5.2 Predicted short term impacts

Table 7 presents the predicted impacts of plausible abnormal operations in the short term at the point of maximum impact and the Predicted Environmental Concentration (PEC) (process contribution plus baseline) for those pollutants for which the impact presented in Table 3 is greater than 10%. The short term baseline concentration is assumed to be twice the calculated long-term baseline concentration in accordance with IPPC H1.

Table 7: Short Term PEC Resulting from Plausible Abnormal Emissions

Pollutant	AQAL (µg/m³)	Baseline Conc.	PC – Abnormal Operations	PEC – Abnormal Operations	
		µg/m³	µg/m³	µg/m³	% of AQAL
Particulate matter (PM_{10})	50	22.16	6.04	28.20	56.4%
Sulphur dioxide (24-hour)	125	6.76	22.51	29.27	23.4%
Sulphur dioxide (1-hour)	350	6.76	47.04	53.80	15.4%
Sulphur dioxide (15-min)	266	6.76	67.87	74.63	28.1%
Hydrogen chloride	750	1.42	627.74	629.16	83.9%

As shown, the PEC is not predicted to exceed the AQAL at the point of maximum impact for any pollutant during abnormal operations.

5.3 Predicted long term impacts

Table 8 presents the predicted impacts of plausible abnormal operations in the long term at the point of maximum impact, and the PEC. This assessment assumes that the Facility is operating at the BAT-AELs for 8,700 hours per year and at the plausible abnormal emission levels for 60 hours per year.

Table 8: Long Term PEC Resulting from Plausible Abnormal Emissions

Pollutant	AQAL ($\mu g/m^3$)	Baseline Conc.	PC – Abnormal Emissions	PEC – Abnormal Emission	
		$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	% of AQAL
Nitrogen dioxide	40	4.79	0.64	5.43	13.6%
Pollutant	**AQAL (ng/m^3)**	**Baseline Conc.**	**PC – Abnormal Emissions (1)**	**PEC – Abnormal Emission**	
		ng/m^3	**ng/m^3**	**ng/m^3**	**% of AQAL**
Arsenic	3	1.1	0.22	1.32	44.1%
Cadmium	5	0.57	0.09	0.66	13.2%
Nickel	20	2.7	1.97	4.67	23.4%

As shown, the PEC is not predicted to exceed the AQAL at the point of maximum impact for any pollutant during abnormal operations.

6 Summary

An assessment of the impact on air quality associated with abnormal operating conditions from the Facility has identified plausible abnormal emissions based on a review of monitoring data from operational facilities of a similar type in the UK. Notwithstanding the low frequency of occurrence of such abnormal operating conditions identified by the review, the potential impact on air quality has been assessed.

The predicted impact on air quality associated with the identified plausible abnormal emissions has been calculated by pro-rating the impact associated with normal operations by the ratio between the normal and plausible abnormal emission values. This is considered to be a highly conservative assessment as it assumes that the plausible abnormal emissions coincide with the worst-case meteorological conditions for dispersion.

Even with these conservative factors, there are no predicted exceedances of any of the short term or long term AQALs associated with abnormal operation. The maximum predicted short term process contribution (as % of the applied AQAL) is 83.70%; and the maximum predicted long term process contribution (as % of the applied AQAL) is 9.60%. In addition, the assessment has shown that there will not be any exceedances of the TDI for dioxins and dioxin like PCBs and the change in concentration of these components in cows' milk and soil would not be significant.

It is concluded that during periods of abnormal operation as permissible under the IED (Article 46), the Facility is not predicted to give rise to an unacceptable impact on air quality or the environment.

Appendices

A Baseline Concentrations

Table 9: Summary of Baseline Concentrations

Pollutant	Concentration	Units	Justification
Nitrogen dioxide	4.79	µg/m^3	Maximum mapped background concentration from within 5 km of Site- Scottish 2018 dataset.
Sulphur dioxide	3.38	µg/m^3	Maximum mapped background concentration from within 5 km of Site- DEFRA 2001 dataset.
Particulate matter (as PM10)	11.08	µg/m^3	Maximum mapped background concentration from within 5 km of Site- Scottish 2018 dataset.
Hydrogen chloride	0.71	µg/m^3	Maximum monitored concentration across the UK 2012 to 2015
Cadmium	0.57	ng/m^3	Maximum annual concentration averaged across all urban industrial sites across the UK 2015 to 2019 (excluding data from Sheffield Tinsley and Swansea Coedgwilym for nickel)
Arsenic	1.10	ng/m^3	
Nickel	2.70	ng/m^3	

B Process Contribution – Normal Operations

Table 10: Dispersion Modelling Results – Point of Maximum Impact

Pollutant	Quantity	Units	AQAL	Max PC	
				Conc.	as % of AQAL
Nitrogen dioxide	Annual mean	µg/m³	40	0.63	1.57%
	99.79th %ile of hourly means*	µg/m³	200	14.87	7.44%
Sulphur dioxide	99.18th %ile of daily means	µg/m³	125	1.50	1.20%
	99.73rd %ile of hourly means*	µg/m³	350	20.33	5.81%
	99.9th %ile of 15 min. means*	µg/m³	266	30.16	11.34%
Particulates (PM_{10})	Annual mean	µg/m³	18	0.04	0.21%
	98.1st %ile of daily means	µg/m³	50	0.20	0.40%
Hydrogen chloride	Annual mean	µg/m³	20	0.04	0.22%
	Hourly mean*	µg/m³	750	21.52	2.87%
Hydrogen fluoride	Annual mean	µg/m³	16	0.01	0.05%
	Hourly mean*	µg/m³	160	1.43	0.90%
Mercury	Annual mean	ng/m³	250	0.15	0.06%
	Hourly mean	ng/m³	7500	7.20	0.10%
Cadmium	Annual mean	ng/m³	5.00	0.15	2.99%
	Hourly mean	ng/m³	1500	7.20	0.48%
Thallium	Annual mean	ng/m³	1000	0.15	0.01%
	Hourly mean	ng/m³	30000	7.20	0.02%
Dioxins and furans and dioxin-like PCBs	Annual mean	fg/m³	-	0.45	-
PCBs	Annual mean	ng/m³	200	0.04	0.02%
	Hourly mean	ng/m³	6000	1.80	0.03%
Group 3 metals	Annual mean	ng/m³	-	2.25	-
	Hourly mean	ng/m³	-	107.97	-

Notes:
* Assumes operation at the half-hourly ELV.
All other results based on operation at the daily or period mean ELV.

ENGINEERING + CONSULTING

FICHTNER

Consulting Engineers Limited

Kingsgate (Floor 3), Wellington Road North,
Stockport, Cheshire, SK4 1LW,
United Kingdom

t: +44 (0)161 476 0032
f: +44 (0)161 474 0618

www.fichtner.co.uk

Process Contribution – Normal Operations

Table 11: Dispersion Modelling Results – Point of Maximum Impact

Pollutant	Quantity	Units	AQAL	Max PC	
				Conc.	as % of AQAL
Nitrogen dioxide	Annual mean	µg/m³	40	0.76	1.89%
	99.79th %ile of hourly means*	µg/m³	200	16.80	8.40%
Sulphur dioxide	99.18th %ile of daily means	µg/m³	125	1.89	1.51%
	99.73rd %ile of hourly means*	µg/m³	350	23.81	6.80%
	99.9th %ile of 15 min. means*	µg/m³	266	27.07	10.18%
Particulates (PM_{10})	Annual mean	µg/m³	40	0.05	0.11%
	98.4th %ile of daily means	µg/m³	50	0.15	0.30%
Hydrogen chloride	Annual mean	µg/m³	20	1.27	0.17%
	Hourly mean*	µg/m³	750	12.74	1.70%
Hydrogen fluoride	Annual mean	µg/m³	16	0.01	0.06%
	Hourly mean*	µg/m³	160	0.85	0.53%
Mercury	Annual mean	ng/m³	250	0.18	0.07%
	Hourly mean	ng/m³	7500	4.25	0.06%
Cadmium	Annual mean	ng/m³	5.00	0.18	3.61%
	Hourly mean	ng/m³	1500	4.25	-
Dioxins and furans and dioxin-like PCBs	Annual mean	fg/m³	-	0.54	-
PCBs	Annual mean	ng/m³	200	0.05	0.02%
	Hourly mean	ng/m³	6000	1.06	0.02%
Group 3 metals	Annual mean	ng/m³	-	2.71	-
	Hourly mean	ng/m³	-	63.80	-

Notes:
* Assumes operation at the half-hourly ELV.
All other results based on operation at the daily or period mean ELV.

ENGINEERING CONSULTING

FICHTNER
Consulting Engineers Limited

Kingsgate (Floor 3), Wellington Road North,
Stockport, Cheshire, SK4 1LW,
United Kingdom

t: +44 (0)161 476 0032
f: +44 (0)161 474 0618

www.fichtner.co.uk