PROPOSED WASTE TYRE FACILITY

PORT OF SUNDERLAND

Schedule 5 Response

Air Emissions Risk Assessment

Dispersion Modelling Assessment: Abnormal Operation

Prepared for: Wastefront AS

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BASIS OF REPORT

CONTENTS

DOCUMENT REFERENCES

TABLES

FIGURES

1.0 INTRODUCTION

SLR Consulting Ltd (SLR) has been commissioned by Wastefront AS to undertake an Air Emissions Risk Assessment (AERA) for a proposed waste tyre facility ('Proposed Development') at the Port of Sunderland (the 'Site'). The Site lies within the administrative area of Sunderland City Council (SCC).

The Proposed Development comprises a series of regulated Emission Points (A1 – A19), including a 30m flue stack (A1- Regenerative Thermal Oxidiser (RTO)). Exhaust gases associated with pyrolysis process (which do not meet the end of waste protocol) are released at A1 during normal operation.

1.1 Scope of Assessment

Following submission of the original AERA, the Environment Agency (EA) issued a Schedule 5 notice (Notice of Requirement for More Information) – seeking clarification and/or further assessment of air emissions. Furthermore, in the interim the design of the process has also evolved.

The AERA has been revised to account for these design changes and Schedule 5 comments, where relevant. Of relevance to this assessment is the dispersion modelling assessment of emissions to air associated with abnormal waste incineration operations - and the likelihood for significant effects to arise.

For those facilities regulated as waste incineration by the Industrial Emissions (IED), the Environmental Permitting Regulations (EPR) require that abnormal events are considered. The IED (implemented in England through the EPR) legislatively contextualises abnormal events as:

> ***Article 46(6)***
>
> *"… 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***
>
> *"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) have been used to define the "abnormal operating conditions" for the purposes of the assessment.

Abnormal operation means any technically unavoidable stoppages, disturbances, or failures of the abatement plant, during which the emissions into the air may exceed the prescribed emission limit values (ELVs). Under such abnormal operating conditions, waste feed to the plant must be stopped and the plant is required to cease the incineration of waste as soon as practicable, within a maximum timeframe of 4 hours.

The dispersion modelling assessment has considered all active emissions points that are proposed to be utilised during abnormal operating conditions. This includes:

- RTO (A1); and
- Flare (A2).

Other active on-site cumulative sources (that emit the same pollutants) have been considered. This includes three dust filters (A5, A6 and A7). Abnormal emission releases have not been considered for the three dust filters.

With the exception of emission release characteristics and sources (i.e. those proposed to be utilised during abnormal operating conditions – Section 2.0), the approach to the dispersion modelling assessment is consistent with the assessment of normal conditions.

The scope of the modelled assessment is based on the approach prescribed within the EA's Air Emissions Risk Assessment guidance[1] (herein referred to as the AERA guidance).

The following assessments will be issued separately:

- dispersion modelling of emissions to air (under normal conditions) for those pollutants which require detailed assessment (A1, A5, A6 and A7); and
- dispersion modelling assessment of normal conditions.

Consideration of these task elements are excluded from this assessment and not referred to herein – as agreed with the EA.

[1] https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit

2.0 ABNORMAL OPERATING CONDITONS

During normal operation, exhaust gases from the regenerative thermal oxidiser (RTO) are emitted from A1. The RTO treats exhaust gases from the pyrolyser burners and light distillate fuelled generators, as well as excess pyrolysis gas. These are all products of the pyrolysis process. Fugitive dust/particulate matter (PM) emissions are released at three dust filters (A5, A6 and A7).

During abnormal operating conditions:

- pyrolysis gas will be diverted to the flare (A2) – bypassing the Gas Treatment Package (RTO and Quench / Scrubber); and
- exhaust gases generated from the light distillate fuelled generators are released at A1; and
- fugitive dust/particulate matter (PM) emissions continue to be released at A5, A6 and A7. This remains unchanged during abnormal conditions.

Further details are included within the supporting information submitted as part of the Environmental Permit (EP) application.

2.1 Emission Sources

Table 2-1 details the emissions sources considered within the dispersion modelling assessment (abnormal conditions).

A5, A6 and A7 represent three dust filters. Abnormal emission releases have not been considered for the three dust filters (i.e. modelled outputs remain unchanged vs. normal scenario), however normal emissions have been considered to inform the cumulative assessment with respect to predicted particulate matter concentrations.

Table 2-1
Emission Sources Considered Within the Modelling Assessment (Abnormal Conditions)

Emission Point	Name	Digitised Source	NGR	
			X	Y
A1	Main Emissions Stack	Point	441363.1	556875.2
A2	Flare (Enclosed)	Point	441436.3	556853.4
A5	Jet Mill Dust Filter	Point	441402.4	556920.0
A6	Tyre Shredding Dust Filter	Point	441300.0	556963.3
A7	Tyre Shredding Dust Filter	Point	441300.1	557009.9

Figure 2-1 provides an illustration of the dispersion model set-up. There is no change in modelled buildings considered within the abnormal dispersion model set-up vs. normal assessment.

Figure 2-1
Abnormal Assessment Dispersion Model Visualisation

2.1.1 Emission Release Parameters

Table 2-2 details the emission release input parameters for all sources considered in the plausible abnormal dispersion modelling assessment. These values have been confirmed by the design engineering team.

Table 2-2
Emission Characteristics (Abnormal Operation)

Parameter		A1	A2	A5	A6	A7
Stack Internal Diameter (m)		0.97	2.0	0.20	0.20	0.20
Stack Exhaust Height (m)		30.0	30.0	26.6	11.6	11.6
Volumetric Flow Rate	Normalised (Nm^3/s)	0.334	37.475	0.439	0.439	0.439
	Actual (Am^3/s)	0.634	47.584	0.471	0.471	0.471
Emission Temperature (°C)		500.0	240.0	20.0	20.0	20.0
Oxygen Content (% O_2 dry gas)		3.62	3.57	-	-	-
Moisture content (% H_2O)		14.30	15.09	0.0	0.0	0.0
Emission Velocity (m/s)		0.86	15.15	15.00	15.00	15.00

Actual Conditions:
- **A1 and A2**: At stack conditions (wet).
- **A5, A6 and A7**: At stack conditions (assumed dry).

Reference Conditions:
- **A1 and A2**: Temperature: 237.15K, Moisture Content: Dry (0%), Oxygen Content: 11%.
- **A5, A6 and A7**: Temperature: 237.15K, Moisture Content: Dry (0%), Oxygen Content: No Correction.

2.1.2 Emission Concentrations

Emission release concentrations applied in the assessment of abnormal operating conditions at A1 and A2 are detailed in Table 2-3 and Table 2-4, respectively. Emission rates have been calculated with use of the emission release characteristics detailed in Table 2-1. Emission concentrations for A5-A7 remain unchanged vs. normal operation (Table 2-5).

Emission concentrations released at A1 under abnormal operating conditions relate to light distillate fuelled generators and have been confirmed by the engineering design team.

Emission concentrations released at A2 under abnormal operating conditions relate to the combustion of unabated pyrolysis gas (bypassing the Gas Treatment Package (RTO and Quench / Scrubber). These plausible abnormal emission levels have been identified based on the following:

- maximum permitted values prescribed within the IED;
- upper end of the EA's recommended values for unabated emissions from waste incineration (Schedule 5 responses).
- performance of similar modern plants in the UK.

As a modern design, it is anticipated that the facility will be operated to a high degree of compliance. Where actual data is not available, worst case conservative assumptions have been made.

Table 2-3
Plausible Abnormal Emissions: A1

Pollutant	Emission Concentration (mg/Nm^3) (1)	Emission Rate (g/s)
Nitrogen Dioxide	35.3	0.011785
Sulphur Dioxide	29.3	0.009789
Carbon Monoxide	56.4	0.018826
Hydrogen Chloride	0.3	0.000099
Particulate Matter	13.4	0.004480

Table Notes:
(1) Reference Conditions: Temperature: 237.15K, Moisture Content: Dry (0%), Oxygen Content: 11%.

Table 2-4
Plausible Abnormal Emissions: A2

Pollutant	IED ELV		Plausible Abnormal		
	Emission Concentration (mg/Nm^3) (1)		Emission Concentration (mg/Nm^3) (1)	Emission Rate	
	Daily Average	½ Hourly Max		Value	Unit
NOx	200	400	600 (2)	22.485278	g/s
PM	10	30	150 (3)	5.621319	g/s
SO_2	50	150	500 (2)	18.737731	g/s
CO	50	200	400	14.990185	g/s
HCl	10	60	900 (2)	33.727916	g/s
HF	1	4	10	0.374755	g/s
TOC	10	20	100	3.747546	g/s

Pollutant	IED ELV		Plausible Abnormal		
	Emission Concentration (mg/Nm³) (1)		Emission Concentration (mg/Nm³) (1)	Emission Rate	
	Daily Average	½ Hourly Max		Value	Unit
Group 1 Metals	0.05	-	5 (2)	187.377313	mg/s
Group 2 Metals	0.05	-	5 (2)	187.377313	mg/s
Group 3 Metals	0.5	-	50 (2)	1873.773135	mg/s
Dioxins Furans	0.00000010	-	0.00001 (2)	374.754627	ng/s
PAH (BaP)	0.001	-	0.1 (4)	3.747546	mg/s
PCBs	0.005	-	0.5 (4)	18.737731	mg/s

Table Notes:
(1) Reference Conditions: Temperature: 237.15K, Moisture Content: Dry (0%), Oxygen Content: 11%.
(2) Upper end of the EA's recommended values for unabated emissions from waste incineration (Schedule 5).
(3) Taken from the IED maximum permitted level.
(4) In lieu of any publicly available information, the plausible emissions multiplier used for dioxins (100 fold increase) is assumed to be appropriate.

Table 2-5
Dust Filter (A5, A6 and A7) Emission Rates

Pollutant	BAT-AEL (mg/Nm³)	Daily Average Emission Rate	
		Value	Unit
Particulate Matter	5	0.002195	g/s

2.2 Assessment Approach

2.2.1 Long-Term Impacts

The calculated long-term ground level concentrations have been weighted in accordance with EA guidance:

- normal operating conditions have assumed to occur for 8,700-hours per year; and
- abnormal operating conditions have assumed to occur for 60-hours per year (the maximum permissible period).

2.2.2 Short-Term Impacts

For the assessment of 24-hour mean AQALs, the maximum concentrations predicted from each scenario (normal and abnormal) have been adjusted according to the following, to derive a composite concentration:

- normal operating conditions have assumed to occur for 20-hours (83.3%); and
- abnormal operating conditions have assumed to occur for 4-hours (the maximum permissible period) (16.6%).

For the assessment of all other short-term averaging periods (15 minute, 1 hour and 8 hour means), the full suite of emission release concentrations that are likely to occur under abnormal operating conditions at all sources (Table 2-3 - Table 2-5) will be released throughout a full year (8,760 hours) in order to capture all meteorological conditions.

3.0 ASSESSMENT RESULTS

3.1 Long-Term Impacts

Table 3-1 presents the potential short-term impacts arising from abnormal operating conditions for 60 hours per year (alongside normal operation 8,700 hours per year).

Table 3-1
Predicted Maximum Ground Level Long-Term Impacts (Abnormal Emissions)

AQAL			PC (µg/m³)	PC % of AQAL	PEC (µg/m³)	PEC % of AQAL
Pollutant	Period	µg/m³				
NO_2	Annual	40	5.7	14.1	27.0	67.4
PM_{10}	Annual	40	0.52	1.3	15.5	38.8
$PM_{2.5}$	Annual	20	0.52	2.6	8.5	42.6
Benzene	Annual	5	0.41	8.3	0.84	16.7
Cadmium	Annual	0.005	0.0028	55.7	0.0029	57.5
Mercury	Annual	0.25	0.0028	1.1	0.0028	1.1
Antimony	Annual	5	0.00022	<0.1	n/c	n/c
Arsenic	Annual	0.006	0.000088	1.5	0.00042	7.0
Chromium (III)	Annual	5	0.00074	<0.1	n/c	n/c
Chromium (VI)	Annual	0.00025	0.00000056	0.2	n/c	n/c
Copper	Annual	10	0.0032	<0.1	n/c	n/c
Lead	Annual	0.25	0.018	7.1	0.022	8.9
Manganese	Annual	0.15	0.00022	0.1	n/c	n/c
Nickel	Annual	0.02	0.0055	27.6	0.0060	30.0
HF	Monthly	16	0.14	0.9	n/c	n/c
PCB	Annual	0.2	0.00028	0.1	n/c	n/c
PAH (BaP)	Annual	0.00025	0.000056	22.3	0.00020	81.5
Dioxins	Annual	0.0000003	0.0000000056	1.9	0.000000018	5.9

Table Notes:
n/c = not calculated: following AERA guidance the PEC has only been calculated where the PC is 1% or above.

Maximum ground level PCs are below 1% of the corresponding AQAL for the majority of emissions and therefore classed as insignificant. For those PCs that cannot be considered insignificant, the PEC is below the AQAL.

3.2 Short-Term Impacts

Table 3-2 presents the potential short-term impacts arising from abnormal operating conditions – based upon the methodology detailed in Section 2.2.2.

Table 3-2
Predicted Maximum Ground Level Short-Term Impacts (Abnormal Emissions)

AQAL			PC (µg/m³)	PC % of AQAL	PEC (µg/m³)	PEC % of AQAL
Pollutant	Period	µg/m³				
NO_2	1-Hour (99.79%ile)	200	128.5	64.3	171.1	85.6
PM_{10}	24-Hour (90.4%ile)	50	3.4	6.7	n/c	n/c
Benzene	24-Hour	30	9.4	31.4	10.3	34.2
CO	Daily 8-Hour	10,000	240.6	2.4	n/c	n/c
CO	1-Hour	30,000	260.0	0.9	n/c	n/c
SO_2	24-Hour (99.18%ile)	125	38.2	30.5	46.0	36.8
SO_2	1-Hour (99.73%ile)	350	303.5	86.7	311.3	89.0
SO_2	15-Min (99.9%ile)	266	329.0	123.7	336.8	126.6
HCl	1-Hour	750	584.1	77.9	584.3	77.9
HF	1-Hour	160	6.5	4.1	n/c	n/c
Mercury	1-Hour	7.5	3.2	43.3	3.2	43.3
Antimony	1-Hour	150	0.26	0.2	n/c	n/c
Chromium (III)	1-Hour	150	0.87	0.6	n/c	n/c
Copper	1-Hour	200	3.8	1.9	n/c	n/c
Manganese	1-Hour	1,500	0.26	<0.1	n/c	n/c
Vanadium	24-Hour	1	0.014	1.4	n/c	n/c
PCB	1-Hour	6	0.32	5.4	n/c	n/c

Table Notes:
n/c = not calculated: following AERA guidance the PEC has not been calculated as all PCs are less than 10%.

The maximum ground level PECs are below the majority of short term AQALs assessed for those PCs which cannot be screened out (i.e. >10% of AQAL). This is with the exception of the SO_2 15-minute mean (99.9%ile) AQAL.

The locations of modelled exceedences for the SO_2 15-minute mean (99.9%ile) AQAL associated with abnormal operation of the Proposed Development occur in close proximity to the eastern site boundary and not at locations of relevant exposure. Further detailed consideration has been given to the corresponding concentrations at the nearest sensitive human receptor locations.

3.2.1 SO_2 15-Minute Mean (99.9%ile)

Table 3-3 presents the potential SO_2 15-minute mean (99.9%ile) arising from the generation of plausible abnormal emissions.

Ground level PECs at all sensitive receptor locations are below all short term AQALs assessed for those PCs which cannot be screened out (i.e. >10% of AQAL).

Table 3-3
SO_2 15-Minute Mean (99.9%ile) Impacts (Abnormal Emissions)

Receptor	AQAL: 266µg/m³			
	PC (µg/m³)	PC % of AQAL	PEC (µg/m³)	PEC % of AQAL
R1	30.5	11.4	38.3	14.4
R2	31.2	11.7	39.0	14.7
R3	62.0	23.3	69.8	26.2
R4	58.8	22.1	66.6	25.0
R5	41.7	15.7	49.5	18.6
R6	38.6	14.5	46.4	17.5
R7	37.1	14.0	44.9	16.9
R8	31.8	12.0	39.6	14.9
R9	27.7	10.4	35.5	13.4
R10	44.9	16.9	52.7	19.8
R11	74.1	27.8	81.9	30.8
R12	60.0	22.5	67.8	25.5
R13	46.1	17.3	53.9	20.2
R14	51.9	19.5	59.7	22.4
R15	27.2	10.2	35.0	13.1
R16	28.8	10.8	36.6	13.8
R17	40.4	15.2	48.2	18.1
R18	41.3	15.5	49.1	18.5
R19	34.3	12.9	42.1	15.8
R20	41.9	15.8	49.7	18.7
R21	33.9	12.7	41.7	15.7

Table Notes:
n/c = not calculated: following AERA guidance the PEC has not been calculated as all PCs are less than 10%.

3.3 Summary

Based on the above outcomes, it is concluded that as a result of periods of abnormal operation (permissible under the IED (Article 46)), unacceptable short and long-term impacts on air quality are not likely.

Appendix A – Model Files (Electronic Only)

Wastefront Sunderland_v2.1 Schedule 5_Abnormal_16.zip

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