Brooks Bros. (UK) Limited
The Timber Yard
Off Runsell Lane
Danbury
Essex
CM3 4PG

Air Emissions Risk Assessment
(formerly known as H1)

ehrc

Environmental Health Resource Centre Limited, 41 Elsiedene Road, London N21 2RN

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1.0   Introduction

Brooks Bros. (UK) limited – "the Operator" has applied to Chelmsford City Council "the Regulator" for a Part B permit for a clean waste wood combustion activity. In the determination processes, the Regulator has requested that an air emissions assessment be undertaken for confirmation of chimney stack height.

The Environment Agency 'Air emissions risk assessment for your environmental permit' methodology has been used in this assessment, including the downloadable H1 tool. The tool compares the anticipated impact of emissions to air to the following environmental standards:

- ➢ Air Quality Standards Regulations 2010 Limit Values and Target Values
- ➢ UK Air Quality Strategy Objectives
- ➢ Environmental Assessment Levels

The air emissions risk assessment process is as follows:

1) Calculate the environmental concentration of each substance you release into the air – known as the process contribution (PC).
2) Identify PCs with insignificant environmental impact so that they can be 'screened out' – this means that you do not have to assess them any further.
3) For substances not screened out in step 2, calculate the predicted environmental concentration (PEC) for each substance you release to air – the PEC is the PC plus the concentration of the substance already present in the environment.
4) Identify emissions that have insignificant environmental impact – these can be screened out.
5) Get 'detailed modelling' (also known as detailed assessment or computer modelling) done for the emissions you cannot screen out.
6) For each substance you've released to air, compare the PC and PEC with the relevant environmental standard and summarise your results.
7) Check if you need to take further action.
8) Check if you need to do any other risk assessments.

The Environment Agency sometimes refers to the following stages of air emissions risk assessment:

- ➢ 'stage 1' – this is steps 1 and 2
- ➢ 'stage 2' – this is steps 3 and 4

Where process emissions can be screened out from either stage of the assessment process, detailed dispersion modelling is not required.

The tool is highly conservative for small appliances: the figures the tool provides are 'worst case' estimates, meaning the results you get may be higher than if you calculate PCs or PECs using other methods, for example dispersion modelling software (which analyses how air pollutants disperse in the atmosphere). For this reason, actual emissions from similar operations are used in this assessment rather than PG Note emission limits.

2.0   Input data

2.1   Combustion equipment & stack location

The Operator proposes to install and operate a Talbott's MWE600 waste wood biomass boiler rated at 600kW. The appliance will be equipped with a ceramic filter system for flue gas cleaning. Emissions to air will be via a single 13m tall insulated stainless steel chimney.

The specific location of the stack is:

OS X (Eastings)	579285 (579500 centre)
OS Y (Northings)	206047 (206500 centre)

At the time of writing, the appliance has not yet been installed, so emissions data from the actual appliance is not available. Actual emissions data from a Talbott's MWE600 waste wood biomass boiler equipped with ceramic filtration has been acquired from Chilfen Joinery (also a permitted installation), and is summarised as follows:

Parameter		Units	Limit
Average particulate matter emission	13.3	mg/Nm^3	90
Average Carbon monoxide emission	77.0	mg/Nm^3	375
Average Hydrocarbon (VOC) emission	4.2.0	mg/Nm^3	30
Average NOx as NO$_2$ emission	234.0	mg/Nm^3	600
Average Hydrogen cyanide emission	<0.67.0	mg/Nm^3	7.5
Average Formaldehyde emission	<0.44	mg/Nm^3	7.5
Volumetric flow rate	1557.0	Am3/hr	N/A
Corrected gas volume	848.0	Nm3/hr	N/A
Mean duct velocity	2.4	m/s	N/A
Anticipated exit velocity	7.55	m/s	N/A
Mean stack temperature	87 (360)	°C (°K)	N/A
Stack inside diameter	350 (coned down to 270	mm	N/A
STP referenced to 6% oxygen			

Table 1: Boiler emissions data
Environmental Monitoring Consultants Report 2325:
Chilfen Joinery Letchworth Talbott's Boiler, 15th & 16th March 2023

2.2   Effective stack height

The proposed stack will be 13m tall, and the apex of the nearest building is advised as 5.4m. When the effective height of release is more than 3 metres above the ground or building, but less than 2.5 times the building's height, as in this case, the effective stack height is estimated as follows:

1. Take the actual height of release, and subtract the height of the tallest building within a distance 5 times L (this can be the building where the emissions are coming from, if it's the tallest).

2. Multiply the figure that's left by 1.66.

   Effective Stack height (Uff) = **12.6m**

2.3   Air emissions inventory

The Operator advises that the appliance will be used 24 hours a day Monday to Friday and 12 hours on a Saturday. This equates to 132 hours per week and 6864 hours per year, therefore giving an operating mode of 78% of the year.

Emissions concentrations in table 1 have been converted to their respective long-term and short-term emission concentrations, relevant to the respective Air Quality Objective averaging period (see: Calculating averaging periods: Air emissions risk assessment for your environmental permit), and operating mode as follows:

Particulate matter as PM_{10} and $PM_{2.5}$:			
Long term emission:	8.2	mg/m3	annual mean (PM10 & PM2.5)
Short term emission:	7.8	mg/m3	24-hour mean (PM10)
HCN:			
Long term emission:	0.4	mg/m3	annual mean
Short term emission:	0.7	mg/m3	1-hour mean
Formaldehyde:			
Long term emission:	0.3	mg/m3	annual mean
Short term emission:	0.4	mg/m3	1-hour mean
VOC (assumed as benzene as not speciated):			
Long term emission:	2.6	mg/m3	annual mean
Short term emission:	4.2	mg/m3	1-hour mean
Carbon monoxide:			
Long term emission:	57.8	mg/m3	8-hour running average over a 24-hour period
Short term emission:	47.3	mg/m3	1-hour mean
Nitrogen dioxide:			
Long term emission:	143.7	mg/m3	annual mean
Short term emission:	117	mg/m3	50% of actual
Nitric oxide:			
Long term emission:	143.7	mg/m3	annual mean
Short term emission:	2	mg/m3	1-hour mean

Table 2: Air emissions data

The calculation spreadsheet summary is provided in Appendix 1.

3.0   Air emissions risk assessment

3.1   Stage 1

To screen out a Process contribution (PC) PC for any substance such that further assessment is not required, the PC must meet both of the following criteria:

- ➤ the short-term PC is less than 10% of the short-term environmental standard
- ➤ the long-term PC is less than 1% of the long-term environmental standard

Any PC not screened out at Stage 1 must progress to stage 2 screening to determine the impact of the PEC. The output from Stage 1 of the screening assessment is as follows:

Substance	Long Term EAL	Short Term EAL	Long Term			Short Term		
			PC	% PC of EAL	> 1% of EAL?	PC	% PC of EAL	> 10% of EAL?
	µg/m³	µg/m³	µg/m³	%		µg/m³	%	
Particulates (PM$_{10}$) (24hr mean)	-	50.0	0.0375	-	-	0.866	1.74	No
Particulates (PM$_{10}$) (Annual mean)	40.0	-	0.0375	0.0937	No	0.866	-	-
Particulates (PM$_{2.5}$)	25.0	-	0.0375	0.150	No	0.866	-	-
Nitrogen Dioxide	40.0	200	0.657	1.65	**Yes**	13.0	6.50	No
Nitrogen monoxide	310	4,100	0.657	0.212	No	26.0	0.591	No
Formaldehyde	5.0	100	0.00138	0.0275	No	0.0444	0.0444	No
Hydrogen cyanide	-	220	0.00183	-	-	0.0777	0.0354	No
Carbon monoxide	-	10,000	0.265	-	-	5.25	0.0525	No
Benzene	5.0	195	0.0119	0.238	No	0.467	0.239	No

Table 3: Stage 1 Screening output

Long term emissions of Nitrogen dioxide cannot be screened out at stage 1 of the assessment and progress to stage 2. All other emissions are screened out and require no further assessment.

3.2   Stage 2

In the second stage of screening if both of the following requirements are met, the detailed modelling of emissions that do not meet both of the following requirements:

- ➤ the short-term PC is less than 20% of the short-term environmental standards minus twice the long-term background concentration
- ➤ the long-term PEC is less than 70% of the long-term environmental standards

The output from Stage 2 of the screening assessment is as follows:

Substance	Air Bkgnd Conc	Long Term					Short Term		
		PC	% PC of hdrm (EAL – Bkgnd)	PEC	% PEC of EAL	% PEC of EAL >=70?	PC	% PC of hdrm (EAL – Bkgnd)	> PC% of hdrm >=20?
	µg/m³	µg/m³		mg/m³	%		µg/m³		
Nitrogen Dioxide	8.250508	0.657	2.07	8.91	22.3	**No**	13.0	7.08	**No**

Table 4: Stage 2 Screening output

Long term and short-term emissions of Nitrogen dioxide can be screened out at stage 2, meaning that dispersion modelling will not be required. The full air summary tables from H1 are provided in Appendix 2.

4.0   Summary and conclusions

The Air emissions risk assessment has confirmed that the proposed appliance served by a ceramic filter and 13m stack:

✓ Should not lead to the exceedance of any Local Air Quality Objectives, and detailed dispersion modelling is not required.

✓ A 13m stack satisfies the general requirement that any stack should be at least 3m above any ventilation intake, window, or general access area.

✓ The stack will discharge vertically upwards, and will not be impeded by any plate, cap or cowl at the top of the stack.

Resources:

Process Guidance Note PG5/1(18), Combustion of Waste Wood
https://cdn.naturalresources.wales/media/687128/nrw-final-draft-epr-technical-note-5118.pdf?mode=pad

.GOV.UK UK Guideline air quality data
https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit

UK Background air quality data
https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2018

Appendices

Appendix 1: Air Emissions Inventory Calculation Summary
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Appendix 1:
Air Emissions Inventory Calculation Summary

PC

					hrs/day	hrs/pa	Operating mode				hrs use per day
					24	6864.0	78%				24 Monday
Flow:	0.24 m3/sec					8760.0					24 Tuesday
											24 Wednesday
											24 Thursday
					hrs/day	hrs/pa	load		kg/yr	T/yr	24 Friday
Particulate Emission:	13.3 mg/m3	0.00313 g/s	11.28 g/hr	0.59	24	6864.0	78%		60.65	0.061	12 Saturday
											0.0 Sunday
		Long term emission:	8.2 mg/m3	annual mean (PM10 & PM2.5)			40 PM10 25 PM2.5				132.0 hrs per week
		Short term emission:	7.8 mg/m3	24-hour mean (PM10)			50 PM10				52 wks per year
											6864.0 Hours per year

					hrs/day	hrs/pa	load		kg/yr	T/yr
HCN Emission:	0.67 mg/m3	0.00016 g/s	0.57 g/hr	1	24	6864.0	78%		3.06	0.003
		Long term emission:	0.4 mg/m3	annual mean						
		Short term emission:	0.7 mg/m3	1-hour						

					hrs/day	hrs/pa	load		kg/yr	T/yr
Formaldehyde Emission:	0.44 mg/m3	0.00010 g/s	0.37 g/hr	1	24	6864.0	78%		2.01	0.002
		Long term emission:	0.3 mg/m3	annual mean						
		Short term emission:	0.4 mg/m3	1-hour						

					hrs/day	hrs/pa	load		kg/yr	T/yr
VOC Emission:	4.2 mg/m3	0.00099 g/s	3.56 g/hr	1	24	6864.0	78%		19.15	0.019
		Long term emission:	2.6 mg/m3	annual mean						
		Short term emission:	4.2 mg/m3	1-hour						

					hrs/day	hrs/pa	load		kg/yr	T/yr
Carbon Monoxide Emission:	77 mg/m3	0.01814 g/s	65.29 g/hr	0.75	24	6864.0	78%		351.15	0.351
		Long term emission:	57.8 mg/m3	8-hour running averge across a 24-hour period						
		Short term emission:	47.3 mg/m3	1-hour						

					hrs/day	hrs/pa	load		kg/yr	T/yr
Nitrogen Dioxide Emission:	234 mg/m3	0.0551 g/s	198.41 g/hr	1	24	6864.0	78%		1067.12	1.07
		Long term emission:	143.7 mg/m3	annual mean						
		Short term emission:	117.0 mg/m3	50% of actual						

					hrs/day	hrs/pa	load		kg/yr	T/yr
Nitric Oxide Emission:	234 mg/m3	0.0551 g/s	198.41 g/hr	1	24	6864.0	78%		1067.12	1.067
		Long term emission:	143.7 mg/m3	annual mean						
		Short term emission:	234.0 mg/m3	1-hour						

**Appendix 2:
H1 Screening Assessment Output**

Air Emissions Inventory

Please list all Substances released to Air for each Release Point identified in the previous page.

Number	Substance	Meas'ment Method	Operating Mode (% of Year)	Conc. mg/m3	Release Rate g/s	Meas'ment Basis	Conc. mg/m3	Release Rate g/s	Meas'ment Basis	Annual Rate tonne/yr	ELV Conc. mg/m3
				Data relating to Long Term effects			Data relating to Short Term effects				
e.g.	sulphur dioxide	Estimated*	70% load	1510	3000	annual avg	1510	3000	hourly avg	55,000	2000
1	Particulates (PM10) (24 hr Mean)	Periodic*	78.0%	8.2	0.001932	24 hr Mean	7.8	0.001837	24 hr Mean	0.0475	60.00
2	Particulates (PM10) (Annual Mean)	Periodic*	78.0%	8.2	0.001932	Annual mean	7.8	0.001837	1-hour	0.0475	60.00
3	Particulates (PM2.5)	Periodic*	78.0%	8.2	0.001932	Annual mean	7.8	0.001837	1-hour	0.0475	60.00
4	Nitrogen Dioxide	Periodic*	78.0%	143.7	0.033849	Annual mean	117.0	0.027560	50%	0.8326	300.00
5	Nitrogen monoxide (Nitric oxide)	Periodic*	78.0%	143.7	0.033849	Annual mean	234.0	0.055120	1-hour	0.8326	600.00
6	Formaldehyde	Periodic*	78.0%	0.3	0.000071	Annual mean	0.4	0.000094	1-hour	0.0017	7.50
7	Hydrogen cyanide	Periodic*	78.0%	0.4	0.000094	Annual mean	0.7	0.000165	1-hour	0.0023	7.50
8	Carbon monoxide	Periodic*	78.0%	57.8	0.013615	8-hour runnin	47.3	0.011142	1-hour	0.3349	375.00
9	Benzene	Periodic*	78.0%	2.6	0.000612	Annual mean	4.2	0.000989	1-hour	0.0151	30.00

Air Impact Screening Stage One

Screen out Insignificant Emissions to Air

This page displays the Process Contribution as a proportion of the EAL or EQS. Emissions with PCs that are less than the criteria indicated may be screened from further assessment as they are likely to have an insignificant impact.

Number	Substance	Long Term EAL µg/m3	Short Term EAL µg/m3	PC µg/m3	% PC of EAL %	> 1% of EAL?	PC µg/m3	% PC of EAL %	> 10% of EAL?
				Long Term			Short Term		
1	Particulates (PM10) (	-	50.0	0.0375	-		0.866	1.74	No
2	Particulates (PM10) (	40.0	-	0.0375	0.0937	No	0.866	-	
3	Particulates (PM2.5)	25.0	-	0.0375	0.150	No	0.866	-	
4	Nitrogen Dioxide	40.0	200	0.657	1.65	Yes	13.0	6.50	No
5	Nitrogen monoxide (N	310	4,400	0.657	0.212	No	26.0	0.591	No
6	Formaldehyde	5.00	100.0	0.00138	0.0275	No	0.0444	0.0444	No
7	Hydrogen cyanide	-	220	0.00183	-		0.0777	0.0354	No
8	Carbon monoxide	-	10,000	0.265	-		5.25	0.0525	No
9	Benzene	5.00	195	0.0119	0.238	No	0.467	0.239	No

Air Impact Modelling Stage Two Screening

Identify need for Detailed Modelling of Emissions to Air

This page displays the Process Contributions in relation to the backgound pollutant levels and the EAL or EQS. You should use this information to decide whether to conduct detailed modelling. Note that releases that are insignificant are not shown as they are screened from further assessment. Also complete this page if you have already done detailed modelling.

Number	Substance	Air Bkgrnd Conc. µg/m3	PC µg/m3	% PC of headroom (EAL - Bkgrnd)	PEC mg/m3	% PEC of EAL %	% PEC of EAL >=70?	PC µg/m3	% PC of headroom (EAL - Bkgrnd)	% PC of headroom >=20?
				Long Term				Short Term		
e.g.		12								
4	Nitrogen Dioxide	8.250508	0.657	2.07	8.91	22.3	No	13.0	7.08	No

Air Summary Tables

(Substances screened as insignificant are not shown)

Option 1 - Brooks Bros (Danbury)

Release Points

Number	Description	Location	Effective Height	Efflux Velocity	Total Flow
			metres	m/s	m3/hr
1	Biomass Boiler	New stack	12.6	7.55	848

Long Term Impact

Substance Assessed	Background Contribution	EAL	PC	PEC	% PC of EAL	% PEC of EAL	EQ
	µg/l	µg/m3	µg/m3	µg/m3			
Benzene	0.52	5	0.01188	0.00	0.24	0.00	0.00
Carbon monoxide			0.26418	0.00			
Formaldehyde		5	0.00137	0.00	0.03	0.00	0.00
Hydrogen cyanide			0.00183	0.00			
Nitrogen Dioxide	8.250508	40	0.65679	8.91	1.64	22.27	0.02
Nitrogen monoxide (Nitric oxide)	15.11904	310	0.65679	0.00	0.21	0.00	0.00
Particulates (PM10) (24 hr Mean)	8		0.03748	0.00			
Particulates (PM10) (Annual Mean)	13.2	40	0.03748	0.00	0.09	0.00	0.00
Particulates (PM2.5)	8.83	25	0.03748	0.00	0.15	0.00	0.00
						Total:	**0.02**

Short Term Impact

Substance Assessed	Background Contribution	EAL	PC	PEC	% PC of EAL	% PEC of EAL	EQ
	µg/l	µg/m3	µg/m3	µg/m3			
Benzene	1.04	195	0.46604	0.00	0.24	0.00	0.00
Carbon monoxide		10000	5.24845	0.00	0.05	0.00	0.00
Formaldehyde		100	0.04438	0.00	0.04	0.00	0.00
Hydrogen cyanide		220	0.07767	0.00	0.04	0.00	0.00
Nitrogen Dioxide	16.501016	200	12.98241	29.48	6.49	14.74	0.06
Nitrogen monoxide (Nitric oxide)	30.23808	4400	25.96483	56.20	0.59	1.28	0.01
Particulates (PM10) (24 hr Mean)	16	50	0.86549	16.87	1.73	33.73	0.02
Particulates (PM10) (Annual Mean)	26.4		0.86549	0.00			
Particulates (PM2.5)	17.66		0.86549	0.00			
						Total:	**0.09**

Option Summary

Long Term Option Summary

Substance Assessed	Option	% PC of EAL	% PEC of EAL	EQ
Nitrogen Dioxide	1	1.64	22.27	0.02