Acciona

NESS Energy from Waste

Pollution Prevention and Control Permit Application. Determination question responses - Emission limit values

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Contents

1 Introduction

SEPA have reviewed the Environmental Permit application of the NESS Energy from Waste facility, submitted in December 2019. This report provides responses to the information requested in relation to the following points in Table 1.

Table 1: SEPA Schedule 4 determination queries

Question number	SEPA comment
20	Provide confirmation of the emission limit values (ELVs) that the proposed Installation is designed to meet, justifying the values adopted and demonstrating that the plant can meet them. This confirmation shall include as a minimum but not be restricted to:
20a	A justification for the selection of the emission limit values (ELVs) proposed, addressing the fact that the Commission Implementing Decision (EU) 2019/2010 of 12 November 2019 establishing the best available techniques (BAT) conclusions does not describe a single BAT Associated Emission Limit (AEL) but provides a range of values. There is an expectation that newly designed/built plant should be capable of meeting the lower end of the BAT AEL range;
20b	Clarification of the proposed ELV concentration for PM2.5 and PM10 that the plant is described as designed to meet. This is stated as being 10mg/m3 while the equivalent BAT AEL range is given as 2 to 5mg/m3; and
20c	A demonstration that the proposed plant can meet the proposed ELVs described. Any such demonstration needs to be supported by evidence such as a manufactures guarantee or emissions data from similarly designed plant etc.

2 Emission to air

2.1 Emission limit values

The NESS EfW facility stack emissions are guaranteed to meet the daily average Emission Limit Values (ELVs) set out in column 2 of Table 2.

Table 2: NESS EfW facility ELVs

Pollutant	**Daily average** **mg/Nm³**	**BAT AELs** **mg/Nm³**
NOx (as NO_2)	120	5 – 120 (1)
CO	50	10 - 50
VOCs	10 (<3 – 10)	3 - 10
PM_{10} (assumed same as TSP)	5	<2 - 5
$PM_{2.5}$ (assumed same as TSP)	5	<2 – 5
HCl	6	<2 – 6
HF	<1	<1
SO_2	30	5 - 30
Cd + Tl	0.02	0.005 – 0.02
Hg	0.02	5 – 20 (ug/m³)
NH_3	10	2 - 10
Group III Metals Total	0.3	0.01 – 0.3
Dioxins and furans	0.04 (ng I-TEQ/m³)	0.01 – 0.04 (ng I-TEQ/m³)

The emission limits are guaranteed by the technology supply but typically the emission concentrations will be significantly below these limits. To demonstrate that the EfW facility will meet the adopted ELVs the emission limit guarantees are included in Appendix A.

2.2 Air Quality modelling

The air quality assessment submitted with the permit application considered the effects of emission from the EfW stack on local air quality, based on detailed dispersion modelling. The modelling was completed prior to issue of the updated BREF guidance document and the modelling therefore used the emission limits associated with BAT (BAT AELs) in the earlier BREF guidance[1] for all pollutants, except NOx for which was modelled at a lower level of 140 mg/m³, to match the limit agreed in the Town and Country Planning consent for the EfW facility.

The higher emission concentration used in the model provided a robust assessment of the potential for impact on air quality, because it considers higher concentrations that those that will be emitted from the facility. Where these are shown to have no impact then it can be confirmed that lower emission limits would be better still. It

[1] Reference Document on the Best Available Techniques for Waste Incineration 2006

was therefore agreed that this would be appropriate to support the permit application. The assessment showed that, even at the higher emission concentration, there would be no significant impacts at human receptors for long-term EALs or for short-term EALs. The relevant pollutant concentrations in the soil were found to be well below soil quality criteria and the potential for exposure to dioxins, furans and dioxin-like PCBs were found to be not significant. At ecological receptors there are predicted to be no significant impacts.

In response to question 26 of the SEPA information request the air quality modelling and assessment has now been updated and submitted to SEPA. The updated assessment confirms that there are no significant impact on human health or ecological receptors.

2.3 Justification for Emission Limit Values adopted

2.3.1 NOx

Guaranteed ELV for NOx 120 mg/m^3

BAT AEL 5 – 120 mg/m^3

The design ELV of 120 mg/m3 will be achieved through the use of primary and secondary NOx abatement, including air supply and temperature control, supported by flue gas recirculation and furnace designed to assure a complete combustion/oxidation of the flue gases with reducing excess O_2 and avoiding hot spots in the combustion chamber, to reduce the initial creation on NOx.

Selective Non-Catalytic Reduction (SNCR) will be used as the secondary NOx measure, using a urea-solution as the reagent. The urea solution is diluted with water and injected into the primary combustion chamber, where it vaporises and reacts with the NOx in the flue gas.

Reducing NOx levels further using SNCR would require a higher addition of urea. This can lead to emissions of ammonia, also known as ammonia slip, with risk of non compliance with the ammonia ELV.

Ammonia as an alternative reagent to urea, is able to achieve slightly lower NOx emissions, however this is not considered preferable due to increased hazard risks associated with its storage and handling and it has a narrow effective temperature band, therefore requiring greater plant optimisation and process control through the life of the plant, to ensure effective NOx abatement. SNCR using urea is preferred compared to ammonia due to safety reasons.

Alternatively, NOx abatement may be achieved using the Selective Catalytic Reduction (SCR) process. This process could result in a reduced NOx emission concentration, to achieve emission concentration in line with the lower end of the BAT-AEL range. However, the process operates at a lower temperature to SNCR, as it is downstream of the boiler, where the flue gas temperature is lower. The process therefore requires energy to be added to the process, to optimise catalyst performance, which results in a lower energy efficiency and higher effective CO_2 emissions.

The design ELV for NOx has been shown not to cause any impact to air quality that would result in significant effect on human health or impact ecological receptors. It is therefore considered that the ELV of 120mg/m3, achieved with SNCR using urea solution, represents BAT for the Aberdeen NESS EfW facility.

The facility has been designed with enough space to retrofit the SCR process into the flue gas treatment (FGT) in the event that future BREF revisions require tighter NOx ELVs.

2.3.2 Carbon Monoxide and VOCs

Guaranteed ELV for CO is 50 mg/m^3

BAT AEL for CO 10 – 50 mg/m^3

Guaranteed ELV for VOCs is 10 mg/m^3

BAT AEL for VOCs 3 – 10 mg/m^3

CO and VOC emissions are determined primarily by furnace technical parameters and the degree of waste heterogeneity when it reaches the combustion stage, the latter of which cannot be completely controlled within an MWS incineration process. The process control within the combustion chamber, including temperature control, air supply and the furnace designed to ensure uniform air flow and limit hot spots, mitigates the effect of the non-homogeneous waste stream.

However, while higher O_2 concentrations within the combustion chamber would support improved combustion of CO and VOCs, primary NOx abatement controls excessive O_2 concentrations. This can limit the complete combustion of CO and VOCs and result in very low levels remaining within the flue gas emissions.

The design ELV for CO and VOCs of 50 mg/m^3 and 10 mg/m^3, respectively, have been shown not to result in a significant impact on local air quality concentrations and in the context of the wider emission parameters the design ELV are considered to represent BAT.

2.3.3 PM10 and PM2.5

Guaranteed ELVs for PM10 and PM2.5 are both 5 mg/m^3

BAT AEL 2 – 5 mg/m^3

Particulate matter, or dust, emissions from waste incineration plants consists of the fine ash from the incineration process and flue gas treatment reagents that are entrained in the gas flow. Particulate matter is removed from the flue gas by the bag filters. The guaranteed emissions concentration limit for PM2.5 and is 5 mg/m^3, however, the filter bags are designed with an additional 20% capacity, which means that under normal operating conditions the typical discharge concentration be 4 mg/m^3. In case of an abnormal filter bag rupture the system will proactively readjust the process conditions to minimize air emissions. Furthermore, a ruptured bag can be rapidly isolated while also reducing the risk of emission limit exceedance.

The design ELV for PM10 and PM2.5 of 5 mg/m^3 each have been shown not to result in a significant impact on local air quality concentrations. The proposed ELV of 5 mg/m^3 is therefore considered to be BAT.

2.3.4 SO_2

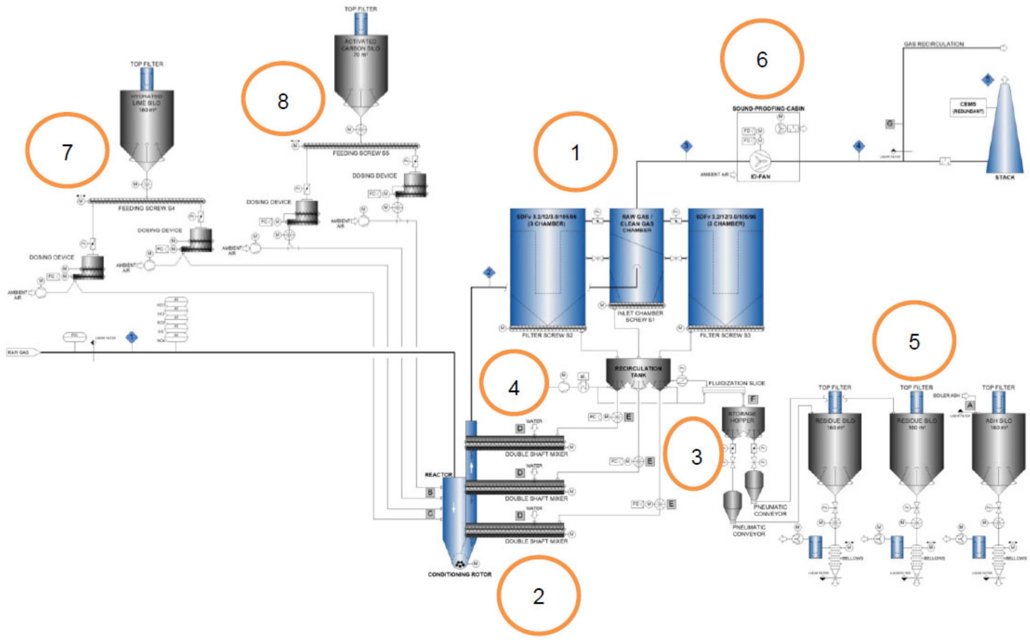
Guaranteed ELV for SO_2 is 30 mg/m3

BAT AEL 5 – 30 mg/m^3

Acid gas abatement consists of dry scrubbing using hydrated lime as the reagent. The process consists of two stages, a dry adsorption stage where dry reagent is injected into the flue gas flow, in the descending reactor shaft prior to a conditioning rotor, followed by addition of recirculated particles containing both reacted and unreacted lime and activated carbon, recirculated from the bag filter, which is wetted by means of water spraying. Downstream of the reactor shaft the reacted particulates are separated from the flue gas in the bag filter.

Dry sorption is considered to be BAT for acid gas scrubbing, as set out in the BAT assessment submitted in response to question 29b of the Information Request.

Figure 1 Flue gas treatment



P.T.O for key

1 Bag filter with DF cleaning device, electric control etc.
2 Conditioning Rotor-Recycle Process with conditioning of the recycled particulate by means of H_2O injection
3 Particle discharge system
4 Air supply system for fluidisation, re-circulation hopper and fluidisation slide
5 Residue storage: residue silo 1 + 2 and boiler ash silo, including silo ventilation filter and discharge
6 ID-fan and stack
7 $Ca(OH)_2$ silo with silo ventilation filter, transport system and 2 volumetrically controlled additive powder dosages and 2 side channel blowers
8 AC silo with silo ventilation filter, transport system, 2 volumetrically controlled additive powder dosages and 2 side channel blowers

The higher end of the BAT-AEL range is identified in the incineration BREF as the limit achieved by dry scrubbing processes[2].

The design of the SO_2 abatement includes a reactor with sufficient retention time prior to the bag filter, and reagent dosing rate automatically controlled using continuous monitoring of the flue gas SO_2 concentrations, so that the necessary reagent will be added to ensure a consistent and reliable emission limit below 30 mg/m^3.

The air quality assessment has shown these emission limits do not to cause any impact to air quality that would result in significant effect on human health or impact ecological receptors. The adoption of the ELV of 30 mg/m^3 is therefore considered to be BAT.

2.3.5 HCl

Guaranteed ELV for HCl is 6 mg/m^3

BAT AEL <2 – 6 mg/m^3

Many wastes contain chlorinated organic compounds or chlorides and in municipal waste approximately 50 % of the chlorides come from PVC. In the incineration process, the organic component of these compounds is destroyed, and the chlorine is converted to HCl.

HCl abatement will consist of dry scrubbing using hydrated lime, as described in Section 2.3.4. The higher end of the BAT-AEL range is identified in the incineration BREF as the limits achieved by dry scrubbing processes[2].

The guaranteed ELV of 6 mg/m^3 will be achieved through process optimisation, including the reactor design and process management, as described in Section 2.3.4. However, based on the design is it expected that levels of 5.5 mg/m3 should be achieved.

To achieve lower emission limits would require a further increase in reagent used and would result in a significant increase in Air Pollution Control residual (APCr), a hazardous waste that is disposal of to landfill both of which would

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[2] Best Available Techniques (BAT) Reference Document for Waste Incineration 2019. Table 4.21

result in increased HGV transport movement and the associated impacts and an increase in operational costs.

The air quality assessment has shown these emission limits do not to cause any impact to air quality that would result in significant effect on human health or impact ecological receptors. The selection of the abatement process and the adoption of the ELV of 6 mg/m^3 for HCl is therefore considered to be BAT.

2.3.6 HF

Guaranteed ELV for HF is <1 mg/m3

BAT AEL <1 mg/m^3

The main sources of HF emissions in municipal waste incineration plants are fluorinated plastic or fluorinated textiles. The HF abatement will consist of dry scrubbing using hydrated lime, as described in Section 2.3.4. The higher end of the BAT-AEL range are identified in the incineration BREF as the limits achieved by dry scrubbing processes[2].

The use of dry sorbent injection is associated with a higher concentration of HF**Error! Bookmark not defined.** and the air quality assessment has shown these emission limits do not to cause any impact to air quality that would result in significant effect on human health or impact ecological receptors. The selection of the abatement process and the adoption of the ELV of <1 mg/m^3 for HF is therefore considered to be BAT.

2.3.7 Cadmium and Thallium

Guaranteed ELV for Cd and Ti is 0.02 mg/m3

BAT AEL <0.005 – 0.02 mg/m^3

Common sources of cadmium and thallium in municipal waste incineration plants are electronic devices. The primary abatement measure of source segregation of this waste stream is promoted by the waste collection authorities.

Otherwise, the techniques used to remove particulate matter are the main ones also used to reduce the emissions of dust bound metals. The design ELV for Group III Metals is therefore associated with the same rational as for particulate matter and is at the higher end of the BAT-AEL.

The ELV has been shown not to result in a significant impact on local air quality concentrations and the proposed ELV of 0.02 mg/m^3 is considered to be BAT.

2.3.8 Hg

Guaranteed ELV for Hg is 20 ug/m^3

BAT AEL 5 – 20 ug/m^3

Mercury can currently still be found in municipal waste, notably in the form of batteries, thermometers, dental amalgam, fluorescent tubes or mercury switches. It is highly volatile and therefore almost exclusively passes into the flue-gas stream. Beyond source segregation of the MSW, employed by the waste collection authorities, no further primary measures will be employed at the EfW facility.

Mercury abatement will consist of dry adsorption by injection of activated carbon into the flue gas upstream of the bag filter. The BREF guidance identifies that the lower end of the BAT EAL may be achieved when incinerating wastes with a proven low and stable mercury content (e.g. mono-streams of waste) or when using specific techniques to prevent mercury peak emissions. The higher end of the range is associated with the use of dry sorbent injection[3].

The proposed ELV of 0.02 mg/m3 Hg has been shown not to result in a significant impact on local air quality concentrations and because the waste is MSW with a potentially variable mercury content the proposed ELV is considered to be BAT.

2.3.9 NH_3

Guaranteed ELV for NH_3 is 10 mg/m3

BAT AEL <2 – 10 mg/m^3

Ammonia emissions in the flue gas are associated with ammonia ‘slip’ from the NOx abatement process. As the level of reagent for treatment of NOx is increased, to meet the NOx ELV, there is potential for unreacted ammonia to ‘slip’ out of the flue gas treatment.

The lower end of the BAT-AEL range can be achieved when using SCR, however the upper limit of the BAT-AEL can be met by the SNCR process and the air quality assessment has shown that this emission limit would not cause any impact that would result in significant effect on human health or impact ecological receptors. The selection of the process and the adoption of the ELV of 10 mg/m^3 for NH_3 is therefore considered to be BAT.

2.3.10 Group III Metals Total

Guaranteed ELV for Group III Metals is 0.3 mg/m3

BAT AEL <0.01 – 0.3 mg/m^3

Group III Metals comprises antimony, arsenic, lead, chromium, cobalt, copper, manganese, nickel, vanadium, tin and their respective compounds.

The abatement of these metals depends on an effective separation of dust within the bag filters. The design ELV for Group III Metals is therefore associated with the same rational as for particulate matter and is at the higher end of the BAT AEL. The ELV has been shown not to result in a significant impact on local air quality concentrations and the proposed ELV of 0.3 mg/m^3 is considered to be BAT.

[3] Best Available Techniques (BAT) Reference Document for Waste Incineration 2019. Table 5.8

2.3.11 Dioxins and furans

Guaranteed ELV for CO is 0.04 mg/m^3.

BAT AEL <0.01 – 0.04mg/m^3.

PCDD/F form after combustion from precursor compounds in the flue gas. These reactions occur at temperatures between 450 °C and 200 °C. To avoid reformation of dioxins and furans the design of the boiler will maintain critical surface temperatures below the desorption temperature, through the economiser pass, therefore resulting in a quick reduction in temperature to below the de novo temperature region.

Dioxins and furans formed will be treated by injection of powdered activated carbon (PAC) into the flue gas in the reactor. They will be adsorbed on the injected PAC and the generated reaction products will be captured with other particulates in the flue gas in the bag filter.

Dioxins, furans and trace metals in soil were assessed in the Human Health Risk Assessment (HHRA), submitted as part of the permit application. The HHRA found that the predicted emission of dioxins and furans, modelled at 0.1 ng I-TEQ/Nm^3 ([4] more than twice the proposed ELV), would result in well below soil quality criteria limits and the exposure to dioxins, furans and dioxin-like PCBs were found to be not significant.

Additional dosing additional PAC to the flue gas reactor to maintain a higher proportion of unreacted PAC within the reactor and would result in further removal of dioxins and furans, to below the design ELV. However, the additional dosing of PAC and the greater wastage rates of unreacted PAC would require significant increase in raw material use and a subsequent significant increase in the production of APCr produced, which is a hazardous waste. It would require an increase in associated energy demand from both the raw material production and the treatment process and would in turn result in increased HGV transport movement into and out of the plant and the associated impacts. All of these would also result in significant increase in operational cost of the treatment process.

Therefore, any increases in treatment levels and the associated impacts are not considered to be necessary on the basis that the current emission levels are shown not to have any significant impacts on human health.

The selection of the process and the adoption of the ELV of 0.04 mg/m^3 for dioxins and furans is therefore considered to be BAT.

[4] Modelled at upper limit of 2006 BAT-AEL in Reference Document on the Best Available Techniques for Waste Incineration

Appendix A

Standardkessel Baumgarte emission guarantees

A1 Technical pro forma – performance guarantee

A1.1 Flue gas extract

An extract from the Technical proforma with the guarantees for NESS is attached below, providing details of the guaranteed flue gas emission limit values. The guarantee is given in contract with the plant supplier, Standardkessel Baumgarte.

PERFORMANCE GUARANTEES NESS Energy Project - CONTRACTUAL OBLIGATIONS

Table 2 - Contractor guaranteed air emission limit values (Note 11)

Parameter	Units	Basis (Note 12)	Expecteed ELVs (daily avg)	Normal: guaranteed ELVs (daily avg)	Expecteed ELVs (97% / 100% half hourly)	Guaranteed ELVs (half hourly)
Total dust	$mg.m^{-3}$	CEMS	4	5	10/30	10/30
Hydrogen chloride (HCl)	$mg.m^{-3}$	CEMS	5.5	6	10/60	10/60
Hydrogen fluoride (HF)	$mg.m^{-3}$	CEMS	1	1	2/4	2/4
Sulphur dioxide (SO_2)	$mg.m^{-3}$	CEMS	27	30	50/200	50/200
Nitrogen monoxide (NO) and nitrogen dioxide (NO_2) expressed as NO_2	$mgNO_2.m^{-3}$	CEMS	115	120	200/400	200/400
Cadmium + Thallium taken together (avg values over sample period)	$mg.m^{-3}$	Extractive test	0.02	0.02	N/A	N/A
Lead + Other Metals (Sb+As+Pb+Co+Cr+Cu+Mn+V+Ni) taken together (avg values over sample period)	$mg.m^{-3}$	Extractive test	0.2	0.3	N/A	N/A
Mercury (Hg) (avg values over sample period)	$ug.m^{-3}$	Extractive test	10	20	N/A	N/A
Carbon monoxide (CO)	$mg.m^{-3}$	CEMS	20	50	100 / 150	100 / 150
Gaseous and vaporous organic substances expressed as Total Organic Carbon	$mgC.m^{-3}$	CEMS	5	10	10 / 20	10 / 20
Dioxin and furans (expressed in Toxic Equivalents) (avg values over sample period)	$ngl\text{-}TEQ.m^{-3}$	Extractive test	0.04	0.04	N/A	N/A

11. All values are daily averages or stack test results as appropriate, corrected to reference conditions of STP, dry, 11% O_2.

12. Basis refers to the mode of measurement for the determinant in question. "CEM" means the plant installed Continuous Emission Monitoring system (that is installed and operated in accordance with EN14181 and the Facility's Environmental Permit).

13. "Extractive test" means emissions tests undertaken in accordance with appropriate reference test methods as accepted under the terms of the Facility's Environmental Permit.

[redacted]