Conclusions on BAT from the Waste Incineration BAT Reference Document

READ ME:

COMMISSION IMPLEMENTING DECISION (EU) 2019/2010 of 12 November 2019 establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for waste incineration.

In this case, you are required to identify the Conclusions on BAT relevant to your installation. Please use the 'Scope' box to describe the relevant activities/processes that come within the scope of this BREF and clearly identify the Conclusions on BAT (sections and subsections) that are 'Not Applicable'.

For each applicable BAT, in the following table, state the status; 'Yes' or 'Will be' as appropriate in the 'State whether it is in place or state schedule for implementation' box. The use of each of these terms is described below.

Information on compliance in the 'Applicability Assessment' box should include, where applicable, the following:

(i) Identification of the relevant process/ activity or individual emission points that the BAT requirement applies to at your installation;

(ii) Where BAT is to use one or a combination of listed techniques, specify the technique(s) implemented/proposed at your installation to achieve the BAT; and

(iii) A comment on how the requirements are being met or will be met, e.g., a description of the technology/operational controls/management proposed to meet the requirements.

Use of terms:

(a) 'Yes' – To be entered where the installation is currently complaint with this BAT requirement.

(b) 'Will be' – To be entered where a further technique is required to be installed to achieve compliance with the BAT requirement. In this case you must also specify the date by which the installation will comply with the BAT Conclusion requirement.

Dublin Waste to Energy (the Facility) assessment of compliance - Conclusions on BAT from the Waste Incineration BAT Reference Document (extracts)

The full and complete text from the Final BAT reference document for waste incineration (December 2019) is available at the EIPPC Bureau website: http://eippcb.jrc.ec.europa.eu/reference/

SCOPE: Dublin Waste to Energy Ltd (hereafter referred to as DWtE) (Industrial Emissions Licence Register number W0232-01), is applying to the EPA for an increase in the permitted maximum annual quantity of waste that can be accepted at the DWtE facility from 600,000 tonnes per annum (tpa) to 690,000 tpa (an increase of 15%). DWtE have assessed their operations against this BREF. DWtE would like to point out that compliance with requirements in Commission Implementing Decision (CID) 2019/2010 of 12 November 2019 on BAT Conclusions for Waste Incineration will be achieved by November 2023 as set out in Article 21 of the Industrial Emissions Directive.

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
5.1.1 Environmental management systems		
BAT 1. In order to improve the overall environmental performance, BAT is to elaborate and implement an environmental management system (EMS) that incorporates all of the following features: i. commitment, leadership, and accountability of the management, including senior management, to the implementation of an effective EMS; ii. an analysis that includes the determination of the organisation's context, the identification of the needs and expectations of interested parties, the identification of characteristics of the installation that are associated with	Applicable DWtE has implemented an EMS as per Condition 2.3 of the site's IE Licence. This EMS meets the requirements of BAT 1. Highlights of the site EMS include: • An environmental policy approved and endorsed by site leadership; • A communications strategy to deal with the needs and expectations of interested parties as well as raising and investigating non-conformances; • A methodology for establishing and monitoring objectives and targets, aspects and impacts, Key	In place

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
possible risks for the environment (or human health) as well as of the applicable legal requirements relating to the environment; iii. development of an environmental policy that includes the continuous improvement of the environmental performance of the installation; iv. establishing objectives and performance indicators in relation to significant environmental aspects, including safeguarding compliance with applicable legal requirements; v. planning, and implementing the necessary procedures and actions (including corrective and preventive actions where needed), to achieve the environmental objectives and avoid environmental risks; vi. determination of structures, roles and responsibilities in relation to environmental aspects and objectives and provision of the financial and human resources needed; vii. ensuring the necessary competence and awareness of staff whose work may affect the environmental performance of the installation (e.g. by providing information and training); viii. internal and external communication; ix. fostering employee involvement in good environmental management practices; x. establishing and maintaining a management manual and written procedures to control activities with significant environmental impact as well as relevant records; xi. effective operational planning and process control; xii. implementation of appropriate maintenance programmes;	Performance Indicators and IE Licence monitoring requirements; • A training programme to ensure staff are adequately trained and competent; • A variety of standard operating procedures to ensure the compliant running of the facility with the site IE Licence; • Documented maintenance schedules and programmes; • A documented Emergency Response Plan (ERP) and Accident Prevention Policy (APP) as per the site IE Licence; • A change request procedure which considers the environmental impact of proposed site changes; • A review and audit programme. Specifically with respect to benchmarking (Conclusion on BAT 1xvi), an Energy Efficiency Audit of the Facility was conducted in April 2018 with a follow up audit completed in 2020. A benchmarking exercise was undertaken during this audit. The DWtE facility was assessed against similar European facilities in terms of its energy performance. The result of this benchmarking was that DWtE was rated above the other waste to energy facilities in terms of electrical efficiency.	

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
xiii. emergency preparedness and response protocols, including the prevention and/or mitigation of the adverse (environmental) impacts of emergency situations; xiv. when (re)designing a (new) installation or a part thereof, consider its environmental impacts throughout its life, which includes construction, maintenance, operation and decommissioning; xv. implementation of a monitoring and measurement programme. If needed, information can be found in the Reference Report on Monitoring of Emissions to Air and Water from IED Installations; xvi. application of sectoral benchmarking on a regular basis; xvii. periodic independent (as far as practicable), internal auditing and periodic, independent external auditing in order to assess the environmental performance and to determine whether or not the EMS conforms to planned arrangements and has been properly implemented and maintained; xviii. evaluation of causes for nonconformities, implementation of corrective actions in response to nonconformities, review of the effectiveness of corrective actions, and determination of whether similar nonconformities exist or could potentially occur; xix. periodic review, by senior management, of the EMS and its continuing suitability, adequacy and effectiveness; xx. following and taking into account the development of cleaner techniques. Specifically, for incineration plants and, where relevant, bottom ash treatment plants, BAT is also to incorporate the following features in the EMS: xxi. for incineration plants, waste stream management (see BAT 9);	Specifically for incineration plants: • xxi – DWtE meet the requirements of BAT 9 as discussed later in this document;	

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
xxii. for bottom ash treatment plants, output quality management (see BAT 10); xxiii. residues management plan including measures aiming to: a. minimise the generation of residues; b. optimise the reuse, regeneration, recycling of, and/or energy recovery from the residues; c. ensure the proper disposal of residues; xxiv. for incineration plants, other than normal operating conditions management plan (see BAT 18); xxv. for incineration plants, accident management plan (see Section 2.4); xxvi. for bottom ash treatment plants, diffuse dust emissions management (see BAT 23); xxvii. odour management plan where an odour nuisance at sensitive receptors is expected and/or has been substantiated (see Section 2.4); xxviii. noise management plan (see also BAT 37) where a noise nuisance at sensitive receptors is expected and/or has been substantiated (see Section 2.4)	• xxii – not applicable, DWtE does not treat bottom ash on site ; • xxiii – DWtE has a residues management plan in place which meets this BAT requirement (see BAT 7 & BAT 24 later in this document); • xxiv – please see discussion of BAT 18 below; • xxv – DWtE have a documented Accident Prevention Policy (APP) in place; • xxv - please see discussion of BAT 23 below; • xxvi – a negative air system is installed at the DWtE facility. The air from the bottom ash conveyor hoods and bunker area is drawn into the combustion chamber via the secondary air system therefore eliminating dust emissions from the plant. All ash loading occurs indoors. • xxvii –A negative air system is installed at the DWtE facility. The air from the tipping floor and the waste bunker areas is drawn into the combustion chamber via the primary air system therefore eliminating the odours from the plant. All waste storage takes place indoors; • xxviii – not applicable as noise is not a nuisance at the DWtE facility. Nevertheless, DWtE comply with the requirements of their IE Licence and EPA guidance document NG4 with respect to noise and	

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
	in particular with Schedule C.6.2 on Ambient Noise Monitoring.	
5.1.2. Monitoring		
BAT 2. BAT is to determine either the gross electrical efficiency, the gross energy efficiency, or the boiler efficiency of the incineration plant as a whole or of all the relevant parts of the incineration plant	Applicable Under the terms of their IE Licence (W0232-01 Section 7.3), the Facility was required to complete an energy audit within one year of the date of commencement of waste acceptance, and every year thereafter. An energy audit was conducted on the 20th of April 2018 with a follow up audit completed in 2020. An energy efficiency of 71.5% has been calculated which is above the 65% efficiency required by the IE Licence. During this Audit, and as required by this BREF, benchmarking was undertaken of DWtE against similar European facilities in terms of its energy performance. The result of this benchmarking was that DWtE was rated above the other facilities in terms of electrical efficiency. The DWtE facility had a 35% higher measured export efficiency compared to the best other facility researched.	In place
BAT 3. BAT is to monitor key process parameters relevant for emissions to air and water	Applicable	In place

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
<table><tr><th>Stream/Location</th><th>Parameter (s)</th><th>Monitoring</th></tr><tr><td>Flue-gas from the incineration of waste</td><td>Flow, oxygen content, temperature, pressure, vapour content</td><td rowspan="4">Continuous measurement</td></tr><tr><td>Combustion chamber</td><td>Temperature</td></tr><tr><td>Waste water from wet FGC</td><td>Flow, pH, temperature</td></tr><tr><td>Waste water from bottom ash treatment plants</td><td>Flow, pH, conductivity</td></tr></table>	The Facility has two separate waste treatment lines and therefore two separate stacks for emission to atmosphere. These emission points are monitored and controlled in accordance with Schedules B and C of the Facility IE licence. The flue gas is monitored continuously for flow, oxygen content, temperature, pressure and vapour content. Temperature is continuously monitored in both combustion chambers to make sure the temperature remains above 850^{0}C. The Facility has two stage wet scrubbers but there is no discharge of process wastewater from the Facility. Process wastewater is collected for recycling in the flue gas treatment system or used for cooling of the bottom ash outlet.	
BAT 4. BAT is to monitor channelled emissions to air with at least the frequency given below and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.	Applicable In order to reduce the stack emissions to the level specified by the EPA in the DWtE IE Licence, flue gas from the combustion process is treated by a comprehensive Flue Gas Cleaning (FCG) system. At first, NOx is reduced by ammonia injection (Selective Non-Catalytic Reduction or SNCR), then the flue gas enters the semi dry reactor where activated carbon and lime are added to the flue gas to bind dioxins and other components to the fly ash then the fly ash is removed from the flue gas by a	If required under the terms of the revised IE Licence monitoring for Ammonia will be undertaken

Conclusions on BAT					Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
Substance/ Parameter	**Process**	**Standard(s)** (1)	**Minimum monitoring** frequency(2)	**Monitoring associated with**	baghouse fabric filter and finally a two-stage wet scrubber is used for reduction of HCI, SO_2, HF and Hg emissions. Currently the facility measures parameters as required by the site IE Licence. All measured parameters are monitored according to EN standards. The following notes in respect of application of BAT4 monitoring are set out: 1. NH_3 (ammonia) NH_3 is not required to be monitored under the terms of the current IE licence. DWtE applies SNCR. Via this technique only small and well controlled quantities of ammonium hydroxide are delivered via a spray system. This minimises ammonia 'slip' (whereby over-dosing can result in excess ammonia resulting from the NOx reduction process often associated with catalytic reduction systems). Furthermore, wet scrubbing follows from the SNCR process and operates at pH neutral, removing ammonia that may be present in the flue gas. DWtE therefore proposes that it is not required to monitor for ammonia in the flue gases.	
NO_X	Incineration of waste	Generic EN standards	Continuous	BAT 29		
NH_3	Incineration of waste when SNCR and/or SCR is used	Generic EN standards	Continuous	BAT 29		
N_2O	Incineration of waste in fluidised bed furnace Incineration of waste when SNCR is operated with urea	EN 21258 (3)	Once every year	BAT 29		
CO	Incineration of waste	Generic EN standards	Continuous	BAT 29		
SO_2	Incineration of waste	Generic EN standards	Continuous	BAT 27		
HCI	Incineration of waste	Generic EN standards	Continuous	BAT 27		
HF	Incineration of waste	Generic EN standards	Continuous(4)	BAT 27		
Dust	Bottom ash treatment	EN 13284-1	Once every year	BAT 26		
	Incineration of waste	Generic EN standards and EN 13284-2	Continuous	BAT 25		

Conclusions on BAT					Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
Metals and metalloids except mercury (As, Cd, Co, Cr, Cu, Mn, Ni, Pb, Sb, Tl, V)	Incineration of waste	EN 14385	Once every six months	BAT 25	2. Bottom ash is not treated on site, hence annual testing for dust related to bottom ash treatment is not applicable. 3. HF is monitored quarterly but not continuously. However, hydrochloric acid (HCl) flue gas emissions are low and stable, hence under footnote (4) to BAT 4, the alternative minimum frequency of once every 6 months is complied with. 4. Hg (mercury): in accordance with footnote (5) to BAT4, wastes received at the Facility are non-hazardous wastes and are well characterised. Rigorous and regular audits are undertaken by DWtE on waste sources. The mercury content in residues from the thermal recovery process is measured regularly and is present only at trace levels. Hg in the flue gas is measured quarterly at the Facility and within the minimum 6 month period set out in footnote (5) to BAT4. 5. PBDD/F: is not required to be monitored under the terms of the current IE licence. Furthermore, in line with footnote (6) to BAT4, brominated fire retardants are not incinerated on site and bromine is not injected into the incineration system. 6. TECORA - Dioxin Emission Continuous Sampling takes place as required by the site IE Licence.	
Hg	Incineration of waste	Generic EN standards and EN 14884	Continuous [5]	BAT 31		
TVOC	Incineration of waste	Generic EN standards	Continuous	BAT 30		
PBDD/F	Incineration of waste[6]	No EN standard available	Once every 6 months	BAT 30		
PCDD/F	Incineration of waste	EN 1948-1, EN 1948-2, EN 1948-3	Once every 6 months for short-term sampling	BAT 30		
		No EN standard available for long-term sampling, EN 1948-2, EN 1948-3	Once every month for long-term sampling [7]	BAT 30		
Dioxin-like PCBs	Incineration of waste	EN 1948-1, EN 1948-2, EN 1948-4	Once every 6 months for short-term sampling[8]	BAT 30		
		No EN standard available for long-term sampling, EN 1948-2, EN 1948-4	Once every month for long-term sampling [7][8]	BAT 30		

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
Benzo[a]pyrene / Incineration of waste / No EN standard available / Once every year / BAT 30 (1) Generic EN standards for continuous measurements are EN 15267-1, EN 15267-2, EN 15267-3, and EN 14181. EN standards for periodic measurements are given in the table or in the footnotes. (2) For periodic monitoring, the monitoring frequency does not apply where plant operation would be for the sole purpose of performing an emission measurement. (3) If continuous monitoring of N_2O is applied, the generic EN standards for continuous measurements apply. (4) The continuous measurement of HF may be replaced by periodic measurements with a minimum frequency of once every six months if the HCl emission levels are proven to be sufficiently stable. No EN standard is available for the periodic measurement of HF. (5) For plants incinerating wastes with a proven low and stable mercury content (e.g. mono-streams of waste of a controlled composition), the continuous monitoring of emissions may be replaced by long-term sampling (no EN standard is available for long-term sampling of Hg [to check before publication if an EN standard has become available]) or periodic measurements with a minimum frequency of once every six months. In the latter case the relevant standard is EN 13211. (6) The monitoring only applies to the incineration of waste containing brominated flame retardants or to plants using BAT 31 d with continuous injection of bromine. (7) The monitoring does not apply if the emission levels are proven to be sufficiently stable. (8) The monitoring does not apply where the emissions of dioxin-like PCBs are proven to be less than 0.01 ng WHO-TEQ/Nm^3.	7. Benzo[a]pyrene - is not required to be monitored under the terms of the current IE licence.	
BAT 5. BAT is to appropriately monitor channelled emissions to air from the incineration plant during other than normal operating conditions (OTNOC).	Applicable Monitoring of two points source emissions are undertaken through the use of SICK UK (MCS 100) certified continuous emissions monitoring systems	In place

<table>
<tr><th>Conclusions on BAT</th><th>Applicability Assessment
(describe how the technique applies or not to your installation)</th><th>State whether it is in place or state schedule for implementation</th></tr>
<tr><td>(The monitoring can be carried out by direct emission measurements (e.g. for the pollutants that are monitored continuously) or by monitoring of surrogate parameters if this proves to be of equivalent or better scientific quality than direct emission measurements. Emissions during start-up and shutdown while no waste is being incinerated, including emissions of PCDD/F, are estimated based on measurement campaigns, e.g. every three years, carried out during planned start-up/shutdown operations.)</td><td>(CEMS). The Facility has MCS 100 for each line and one for redundancy, if the main monitoring equipment malfunctions, the system can switch to the back-up monitor. The CEMS allows identification of OTNOCs, and monitoring of emissions during OTNOCs.</td><td></td></tr>
<tr><td>BAT 6.

BAT is to monitor emissions to water from FGC and/or bottom ash treatment with at least the frequency given below and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.

<table>
<tr><th>Substance/ Parameter</th><th>Process</th><th>Standard(s)</th><th>Minimum monitoring frequency</th><th>Monitoring associated with</th></tr>
<tr><td>Total organic carbon (TOC)</td><td>FGC</td><td>EN 1484</td><td>Once every month</td><td rowspan="4">BAT 34</td></tr>
<tr><td></td><td>Bottom ash treatment</td><td></td><td>Once every month(1)</td></tr>
<tr><td>Total suspended solids (TSS)</td><td>FGC</td><td>EN 872</td><td>Once every day(2)</td></tr>
<tr><td></td><td>Bottom ash treatment</td><td></td><td>Once every month(1)</td></tr>
<tr><td>As</td><td>FGC</td><td></td><td>Once every month</td><td></td></tr>
</table>
</td><td>Not applicable

- No bottom ash treatment is undertaken at the facility.

- The Facility has a secondary stage wet scrubber for reduction of HCl, SO_2 and HF emissions. However, there is no discharge of process wastewater from the Facility. All process waste waters (e.g. boiler blow down, boiler water treatment reject water, scrubber water) are collected for recycling in the Flue Gas Treatment System or used for cooling of the bottom ash outlet.</td><td>Not applicable</td></tr>
</table>

Conclusions on BAT					Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
Cd	FGC	Various EN standards available (e.g. EN ISO 11885, EN ISO 15586 or EN ISO 17294-2)	Once every month	BAT 34		
Cr	FGC					
Cu	FGC					
Mo	FGC					
Ni	FGC					
Pb	FGC					
	Bottom ash treatment		Once every month(1)			
Sb	FGC		Once every month			
Tl	FGC					
Zn	FGC					
Hg	FGC	Various EN standards available (e.g. EN ISO 12846 or EN ISO 17852)				
NH_4-N	Bottom ash treatment	Various EN standards available (e.g. EN ISO 11732, EN ISO 14911)				
Chloride (Cl^-)	Bottom ash treatment	Various EN standards available	Once every month (1)			

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation

		(e.g. EN ISO 10304- -1, EN ISO 15682)		
Sulfate (SO_4^{2-})	Bottom ash treatment	EN ISO 10304-1		
PCDD/F	FGC	No EN standard available	Once every month(1)	
	Bottom ash treatment		Once every 6 months	BAT 34

(1) The monitoring frequency may be at least once every six months if the emissions are proven to be sufficiently stable.

(2) The daily 24-hour flow-proportional composite sampling measurements may be substituted by daily spot sample measurements.

BAT 7.

BAT is to monitor the content of unburnt substances in slags and bottom ashes at the incineration plant with at least the frequency given below and in accordance with EN standards.

Parameter	Standard(s)	**Minimum m**onitoring frequency	**Monitoring associated with**
Loss on ignition(1)	EN 14899, and either EN 15169 or EN 15935	Once every three months	BAT 14
Total organic carbon(1)(2)	EN 14899, and either EN 13137 or EN 15936		

Applicable

Monitoring of Total Organic Carbon (TOC) in the incinerator residues is carried out as per schedule C.4.1 of IE licence W0232-01. DWtE, as part of this IE Licence review application, is requesting a change in the monitoring frequency of Schedule C.4.1 to match this BAT requirement i.e. once every three months. At present the DWtE facility undertakes such monitoring per consignment. Currently, the monitoring requirement per consignment is proving to be unnecessarily expensive and logistically complicated.

In place

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
(1) Either the loss on ignition or the total organic carbon is monitored. (2) Elemental carbon (e.g. determined according to DIN 19539) may be subtracted from the measurement result.	The applied standard at DWtE is EN 15936.	
BAT 8. For the incineration of hazardous waste containing POPs, BAT is to determine the POP content in the output streams (e.g. slags and bottom ashes, flue-gas, waste water) after the commissioning of the incineration plant and after each change that may significantly affect the POP content in the output streams.	Not applicable DWtE does not accept hazardous waste[1]. DWtE has been planned and designed for the acceptance of residual household, commercial and non-hazardous industrial waste.	Not applicable
5.1.3 General environmental and combustion performance		
BAT 9. In order to improve the overall environmental performance of the incineration plant, as part of the waste stream management plan (see BAT 1), BAT is to use all of the techniques (a) to (c) given below, and, where relevant, also techniques (d), (e) and (f). Technique Description	Applicable DWtE has a list of wastes that can be accepted at the DWtE facility, these are listed in Section 4.3 of the EDEN IE Licence review application form. DWtE has a documented waste acceptance procedure (Attachment-4-3-5 of this IE Licence Review Application) which details which wastes the facility can accept and how these are accepted on site.	In place

[1] In 2020 the EPA granted approval for the acceptance of waste 18 01 03* for COVID19 pandemic purposes. This is a temporary change to the site IE Licence.

Conclusions on BAT		Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
a) Determination of the types of waste that can be incinerated	Based on the characteristics of the incineration plant, identification of the types of waste which can be incinerated in terms of, for example, the physical state the chemical characteristics, the hazardous properties, and the acceptable ranges of calorific value, humidity, ash content and size.	DWtE takes part in annual REPAK studies which incorporates detailed waste characterisation of wastes arriving on site (including incorporation of hand-picking in the assessment). DWtE assesses and approves customers in advance of waste delivery trucks arriving at the site. When waste vehicles arrive on site, information that is unique to that particular waste load such as the vehicle registration number, weight, producer/collector information, carrier, origin of the waste, and EWC code and all other requirements as per the IE Licence condition 11.3.2 are stored on the weighbridge software system. This information is also be stored on a Radio Frequency Identification (RFID) tag, which is attached to all regular customer vehicles. The vehicle then proceeds onto the weighbridge (there are three weighbridges at the DWtE facility, two incoming and one outgoing) where the RFID tag is read automatically by the RFID tag reader. The driver will input only certain information into the Data Acquisition Terminal (DAT). The required information from the driver is as follows: 1. Driver Name; 2. Customer Origin; and	
b) Set-up and implementation of waste characterisation and pre-acceptance procedures	These procedures aim to ensure the technical (and legal) suitability of waste treatment operations for a particular waste prior to the arrival of the waste at the plant. They include procedures to collect information about the waste input and may include waste sampling and characterisation to achieve sufficient knowledge of the waste composition. Waste pre-acceptance procedures are risk-based considering, for example, the hazardous properties of the waste, the risks posed by the waste in terms of process safety, occupational safety and environmental impact, as well as the information provided by the previous waste holder(s).		
c) Set-up and implementation of waste acceptance procedures	Acceptance procedures aim to confirm the characteristics of the waste, as identified at the pre-acceptance stage. These procedures define the elements to be verified upon the delivery of the waste at the plant as well as the waste acceptance and rejection criteria. They may include waste sampling, inspection and analysis. Waste acceptance procedures are risk-based considering, for example, the hazardous properties of the waste, the risks posed by the waste in terms of process safety, occupational safety and environmental impact, as well as the information provided by the previous waste holder(s). The elements to be monitored for each type of waste are detailed in BAT 11		
d) Set-up and implementation a waste	A waste tracking system and inventory aims to track the location and quantity of waste in the plant. It holds all the		

Conclusions on BAT		Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
tracking system and inventory	information generated during waste pre-acceptance procedures (e.g. date of arrival at the plant and unique reference number of the waste, information on the previous waste holder(s), pre-acceptance and acceptance analysis results, nature and quantity of waste held on site including all identified hazards), acceptance, storage, treatment and/or transfer off site. The waste tracking system is risk-based considering, for example, the hazardous properties of the waste, the risks posed by the waste in terms of process safety, occupational safety and environmental impact, as well as the information provided by the previous waste holder(s). The waste tracking system includes clear labelling of wastes that are stored in places other than the waste bunker or sludge storage tank (e.g. in containers, drums, bales or other forms of packaging) such that they can be identified at all times.	3. EWC Code of Waste The weighing of the vehicle is initiated once the items 1-3 above are keyed in by the driver onto the DAT. Once the vehicle has been weighed (gross weight) and recorded on the weighbridge software system, a traffic light at the end of the weighbridge signals green and the barrier will raise, which indicates that the driver can proceed towards the tipping area of the Waste Reception Hall. DWtE only accepts non-hazardous household, commercial industrial waste, therefore, no waste segregation is required. However, if during routine waste inspection, waste is deemed to be unacceptable there is a quarantine procedure which must be adhered to whereby the unacceptable waste is loaded into the quarantine bay area, appropriately stored and clearly labelled and returned to the waste generator. The Tipping Floor Manager randomly selects as a minimum one load a day for inspection from each operator. Once a load is selected, the load is tipped onto the tipping hall floor for inspection.	
e) Waste segregation	Wastes are kept separated depending on their properties in order to enable easier and environmentally safer storage and incineration. Waste segregation relies on the physical separation of different wastes and on procedures that identify when and where wastes are stored.		
f) Verification of waste compatibility prior to mixing or blending of waste	Compatibility is ensured by a set of verification measures and tests in order to detect any unwanted and/or potentially dangerous chemical reactions between wastes (e.g. polymerisation, gas evolution, exothermal reaction, decomposition) upon mixing or blending. The compatibility tests are risk-based considering, for example, the hazardous properties of the waste, the risks posed by the waste in terms of process safety, occupational safety and environmental impact, as well as the information provided by the previous waste holder(s).		

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
BAT 10. BAT is to set up and implement an output quality management system (see BAT 1) in order to improve the overall environmental performance of the bottom ash treatment plant. Description An output quality management system is set up and implemented so as to ensure that the output of the bottom ash treatment is in line with expectations, using existing EN standards where available. This management system also allows the performance of the bottom ash treatment to be monitored and optimised.	Not Applicable Bottom ash is not treated at the Facility.	Not Applicable
BAT 11 In order to improve the overall environmental performance of the incineration plant, BAT is to monitor the waste deliveries as part of the waste acceptance procedures (see BAT 9 c) including, depending on the risk posed by the coming waste, the elements given below. **Waste type** — **Monitoring** Municipal solid waste and other non-hazardous waste — • Radioactivity detection • Weighing of the waste deliveries • Visual inspection • Periodic sampling of individual deliveries and analysis of key properties/substances (e.g. calorific value, content of halogens and metals/metalloids). For municipal solid waste, this involves separate unloading	Applicable for municipal solid waste and other non-hazardous waste. See discussion under BAT 9 above. Two radioactivity detectors were installed on both incoming weighbridges in February 2020.	In place.

Conclusions on BAT		Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
Sewage sludge	• Weighing of the waste deliveries (or measuring the flow if the sewage sludge is delivered via pipeline) • Visual inspection, as far as technically possible • Periodic sampling and analysis of key properties/substances (e.g. calorific value, content of water, ash and mercury)		
Hazardous waste	• Radioactivity detection • Weighing of the waste deliveries • Visual inspection, as far as technically possible • Control and comparison of individual waste deliveries with the declaration of the waste producer • Sampling of the content of: – all bulk tankers and trailers – packed waste (e.g. in drums, intermediate bulk containers (IBCs) or smaller packaging) • and analysis of: – combustion parameters (including calorific value and flashpoint) – waste compatibility, to detect possible hazardous reactions upon blending or mixing wastes, prior to storage (BAT 9 f) – key substances including POPs, halogens and sulphur, metals/metalloids		
Clinical waste	• Radioactivity detection • Weighing of the waste deliveries • Visual inspection of the packaging integrity		
BAT 12.		Applicable	In place

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
In order to reduce the environmental risks associated with the reception, handling and storage of waste, BAT is to use both of the techniques given below: Technique / Description Impermeable surfaces with an adequate drainage infrastructure: Depending on the risks posed by the waste in terms of soil or water contamination, the surface of the waste reception, handling and storage areas is made impermeable to the liquids concerned and fitted with an adequate drainage infrastructure (see BAT 32). The integrity of this surface is periodically verified, as far as technically possible. Adequate waste storage capacity: Measures are taken to avoid accumulation of waste, such as: • the maximum waste storage capacity is clearly established and not exceeded, taking into account the characteristics of the wastes (e.g. regarding the risk of fire) and the treatment capacity; • the quantity of waste stored is regularly monitored against the maximum allowed storage capacity; • for wastes that are not mixed during storage (e.g. clinical waste, packed waste), the maximum residence time is clearly established.	The waste bunker is made of reinforced concrete and has sealed surfaces. The bunker is fully enclosed by walls and a roof. The bunker is maintained under negative air pressure so that odour or dust will not be emitted to the outside from the stored waste, any liquids are absorbed by the waste in the bunker. The bunker has sufficient capacity to store one week's normal throughput of waste. In the event of an emergency shut down, waste deliveries are controlled so that no wastes are delivered to the plant. This is managed by communicating with waste suppliers, etc to control deliveries.	
BAT 13.	Not Applicable	Not Applicable

<table>
<tr><th>Conclusions on BAT</th><th>Applicability Assessment
(describe how the technique applies or not to your installation)</th><th>State whether it is in place or state schedule for implementation</th></tr>
<tr><td>In order to reduce the environmental risk associated with the storage and handling of clinical waste, BAT is to use a combination of the techniques given below.

<table>
<tr><th>Technique</th><th>Description</th></tr>
<tr><td>Automated or semi-automated waste handling</td><td>Clinical wastes are unloaded from the truck to the storage area using an automated or manual system depending on the risk posed by this operation. From the storage area the clinical wastes are fed into the furnace by an automated feeding system.</td></tr>
<tr><td>Incineration of non-reusable sealed containers, if used</td><td>Clinical waste is delivered in sealed and robust combustible containers that are never opened throughout storage and handling operations. If needles and sharps are disposed of in them, the containers are puncture-proof as well.</td></tr>
<tr><td>Cleaning and disinfection of reusable containers, if used</td><td>Reusable waste containers are cleaned in a designated cleaning area and disinfected in a Facility specifically designed for disinfection. Any leftovers from the cleaning operations are incinerated</td></tr>
</table></td><td>No hazardous clinical waste is accepted[2] at the Facility</td><td></td></tr>
<tr><td>BAT 14.

In order to improve the overall environmental performance of the incineration of waste, to reduce the content of unburnt substances in slags and bottom ashes, and to reduce emissions to air from the incineration of waste, BAT is to use an appropriate combination of the techniques given below.</td><td>Applicable

Waste is blended and mixed by the bunker cranes

The operation of the furnace and ash discharge system is continuously monitored , using a variety of techniques</td><td>In place</td></tr>
</table>

[2] In 2020 the EPA granted approval for the acceptance of waste 18 01 03* for COVID19 pandemic purposes. This is a temporary change to the site IE Licence.

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation

Technique	Description	Applicability
a) Waste blending and mixing	Waste blending and mixing prior to incineration includes for example the following operations: • bunker crane mixing; • using a feed equalisation system; blending of compatible liquid and pasty wastes. In some cases, solid wastes are shredded prior to mixing.	Not applicable where direct furnace feeding is required due to safety considerations or waste characteristics (e.g. infectious clinical waste, odorous wastes, or wastes that are prone to releasing volatile substances). Not applicable where undesired reactions may occur between different types of waste (see BAT 9 f)
b) Advanced control system	See Section2.1	Generally applicable
c) Optimisation of the incineration process	See Section 2.1	Optimisation of the design is not applicable to existing furnaces

Table 1.0: BAT-associated environmental performance levels for unburnt substances in slags and bottom ashes from the incineration of waste

Parameter	Unit	BAT-AEPL
TOC content in slags and bottom ashes (1)	Dry wt-%	1–3 (2)
Loss on ignition of slags and bottom ashes (1)	Dry wt-%	1–5 (2)

(1) Either the BAT-AEPL for TOC content or the BAT-AEPL for the loss on ignition applies.

(for example advanced automated control, CCTV cameras, parameter monitoring including substantial redundancy in monitoring systems and a 24/7 personnel resourced control room))

The DCS system and the Combustion Control Systems (CCS+) are used to monitor the performance of the boiler in order to:

- Optimise furnace and boiler geometry so as to improve combustion performance;
- Optimise combustion air injection so as to improve combustion performance;

The waste feed rate, the supply of primary and secondary combustion air and the grate speed are controlled by an advanced combustion control system which measures flow rate, flue gas oxygen and combustion temperature in order to obtain the best possible operational conditions and maximise steam production.

The TOC content in slags and bottom ashes is analysed at present weekly as per current license requirements and current results are less than 1%.

DWtE continues to optimise all aspects of plant performance and has a dedicated Process Performance

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
(2) The lower end of the BAT-AEPL range can be achieved when using fluidised bed furnaces or rotary kilns operated in slagging mode.	Engineer assigned in this regard, using established performance improvement techniques such as 6-Sigma.	
BAT 15. In order to improve the overall environmental performance of the incineration plant and to reduce emissions to air, BAT is to set up and implement procedures for the adjustment of the plant's settings, e.g. through the advanced control system (see description in Section 5.2.1), as and when needed and practicable, based on the characterisation and control of the waste (see BAT 11).	Applicable Each incineration line has its own independent train of Air Pollution Control (APC) equipment. The system consists of an SNCR system for NOx reduction, a carbon injection system for heavy metal reduction, a semi-dry flue gas scrubber with reagent feed section, a fabric filter baghouse, a flue gas cooler for energy recovery, a two stage wet scrubber, an induced draft fan, a stack, and associated ductwork. 1) Boiler Temperature The waste is combusted at a minimum temperature of 850°C for 2 secs to ensure there are no dioxins formed as a result of the combustion process. 2) Selective Non-Catalytic Reduction System An aqueous ammonia solution is injected at four levels into the flue gas in the radiation zone of the boiler, using compressed air as a carrier medium, to minimize NOx emissions. The system is designed to meet the emission limits for NOx indicated in the IED.	In place

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
	3) Semi-Dry Scrubber Acid gases are neutralized using lime in a semi-dry scrubber reactor. The system utilises hydrated lime as a reagent prepared from quicklime. Activated carbon is also injected for heavy metal control. 4) Filter Bag-house Emissions of particulate matter are controlled primarily through the use of a filter baghouse. This system employs over 5,000 filter bags though which the flue gas must pass. Baghouses - one (1) pulse jet type per boiler unit, contain 12 isolatable modules (arranged in 2 parallel rows), all operating in parallel and each with its own hopper. The number of modules ensure that taking a compartment out for cleaning and having another compartment out for maintenance will not compromise performance. Baghouses have been designed for variations of temperature and pressure due to failure of other components in the system (such as scrubber malfunction, loss of an ID or CA fan or the malfunction of a flue gas damper).	

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
	5) Wet-Scrubber Before flue gas finally exits through the stack water is used in a wet scrubber to reduce temperature and remove any residual HCl. In addition, a sodium hydroxide solution is used to remove residual SO_2. The wet scrubber consists of a co-current quenching flow section (Quench stage) and a co-concurrent flow absorption column (Packed bed stage) which is fed via a common sump. Wet scrubber effluent is re-circulated within the scrubber system. Continuous Emission Monitoring and Stack Testing Throughout the air pollution treatment process the emissions are continuously monitored using a real time continuous monitoring system (CEMS). Each stack has its own CEMS and in addition a redundant CEMS is continuously on stand-by in the event of one of the live systems going down. These systems are calibrated weekly and certified on an annual basis. (Annual Surveillance Testing-AST) DWtE completed a very rigorous and extended performance evaluation period where the incineration system was extensively tested to well beyond normal capacity and maintaining emissions to well within license requirements.	

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
	Independent stack testing of the parameters is carried out on a quarterly basis to ensure compliance with all the ELVs.	
BAT 16. In order to improve the overall environmental performance of the incineration plant and to reduce emissions to air, BAT is to set up and implement operational procedures (e.g. organisation of the supply chain, continuous rather than batch operation) to limit as far as practicable shutdown and start-up operations.	Applicable The incineration process is operated continuously to avoid shutdown and start-up operations. The Facility is equipped with the latest technique such as e.g. Inconel cladding and online cleaning in order to obtain/achieve maintenance intervals in excess of the standard 12-month maintenance interval thus reducing the number of start-ups and shutdowns over the lifetime of the Facility. The Facility has two parallel independent incineration lines, if one line is in maintenance, the second line can run to avoid a shutdown. Both boilers in the DWTE facility have two auxiliary burners each. Each burner is fitted with a retractable lance and an electronic ignition system. The burners switch on automatically when the temperature of the combustion gas after the last injection of air falls below 875°C thus ensuring that the temperature remains above 850°C at all times. The burners are also used at	In place

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
	start-up and shut-down in order to ensure that the temperatures are maintained at all times during these operations and as long as unburned waste is in the combustion chamber. The auxiliary burners are fed using gas oil that complies with the Article 2(2) of Council Directive 1999/32/EC. . The DWTE facility has an automated system that prevents feeding of waste in the event of the following situations: 1) Until the minimum temperature of 850°C is reached as per part 2 of Article 50 in Annex VI of the IED; 2) Whenever the temperature specified in part 2 of Article 50 in Annex VI of the IED is not maintained; and 3) Plant fail-safes and other safety interlocks already submitted to the Agency can prevent waste feed.	
BAT 17. In order to reduce emissions to air and, where relevant, to water from the incineration plant, BAT is to ensure that the FGC system and the waste water treatment plant are appropriately designed (e.g. considering the maximum flow rate and pollutant concentrations), operated within their design range, and maintained so as to ensure optimal availability.	Applicable A large percentage of the total capital investment in the DWtE facility was spent on the state-of-the-art FGC system. The design of the FGC system utilises a combination of a semi-dry and a two -stage wet system thus utilising the benefits of each system while reducing	In place

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
	the disadvantages. Maximum flow rate and pollutant concentrations were taken into account when designing of FGC system. Wastewater from the scrubbers is used in the semi-dry stage of the FGC system Therefore there is no wastewater discharged from the FGC system.	
BAT 18. In order to reduce the frequency of the occurrence of OTNOC and to reduce emissions to air and, where relevant, to water from the incineration plant during OTNOC, BAT is to set up and implement a risk-based OTNOC management plan as part of the environmental management system (see BAT 1) that includes all of the following elements: a. identification of potential OTNOC (e.g. failure of equipment critical to the protection of the environment ('critical equipment')), of their root causes and of their potential consequences, and regular review and update of the list of identified OTNOC following the periodic assessment below; b. appropriate design of critical equipment (e.g. compartmentalisation of the bag filter, techniques to heat up the flue-gas and obviate the need to bypass the bag filter during start-up and shutdown, etc.); c. set-up and implementation of a preventive maintenance plan for critical equipment (see BAT 1 xii); d. monitoring and recording of emissions during OTNOC and associated circumstances (see BAT 5);	Applicable DWtE has designed and implement a strict preventative maintenance regime which meets the requirement of BAT 18. The design of the facility ensures that the frequency of an OTNOC occurrence is minimised as discussed in BAT 14 to 17 above. In the event of a breakdown DWTE can reduce or close down operations as soon as practicable until normal operations can be restored. DWtE has in place a specific protocol to follow in the event of such an occurrence. Attachment 4-11-4 of the IE Licence review application discusses this protocol in detail. The following definitions apply at DWtE: • Abnormal operations: Any technical stoppage, disturbance, or failures of the purification devices or the measurement devices, during which the	In place

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
e. periodic assessment of the emissions occurring during OTNOC (e.g. frequency of events, duration, amount of pollutants emitted) and implementation of corrective actions if necessary	concentration in the discharges to the air may exceed the prescribed emission limit values. • Breakdown: Any malfunction or technical stoppage, disturbance or failure of the incineration plant or equipment. The monitoring data is continuously recorded therefore during an occurrence of OTNOC, the emission data is still logged.	
5.1.4 Energy Efficiency		
BAT 19. In order to increase the resource efficiency of the incineration plant, BAT is to use a heat recovery boiler. "The energy contained in the flue-gas is recovered in a heat recovery boiler producing hot water and/or steam, which may be exported, used internally, and/or used to produce electricity."	Applicable The facility is designed to optimise heat recovery and power output. The facility is also designed to accommodate future district heating and when a district heating system comes into operation this can be implemented with minor modifications to the equipment. Electricity is generated on-site from the thermal energy produced by the combustion of waste. The two lines supply steam to one complete turbine/generator set with high-voltage system that is connected to the electrical grid. A small portion of this electricity is used to power the plant with the remainder exported to the national grid. The turbine	In place

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
	design optimises the power output and thus the electricity supply regime, as no heat supply regime is in place at present. Cooling of the exhaust steam from the turbine takes place in a seawater-cooled condenser. The condenser temperature is minimised using cooling water from the River Liffey estuary thus securing a higher electrical efficiency compared to that obtained with air-cooled condensers and/or wet cooling towers. The design results in the net (electrical) power output from the DWtE site of approximately 62-63MW equivalent to a net energy efficiency of approximately 32%. The Dublin District Heating system (DDHS) is currently being developed and is expected to be in operation within 18 months. The DWTE facility will be the baseload for the DDHS which on its own will supply a heat source for over 50,000 homes. Once this is operational the DWTE facility is anticipated to have a net energy efficiency of over 88%. .	
BAT 20. In order to increase the energy efficiency of the incineration plant, BAT is to use an appropriate combination of the techniques given below.	Applicable Sewage sludge is not dried at the DWtE facility. The flue gas is recirculated, the supply of primary and secondary combustion air and the grate speed are controlled by an advanced combustion control system	In place

Conclusions on BAT				Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
	Technique	Description	Applicability	which measures flow rate, flue gas oxygen and combustion temperature in order to obtain the best possible operational conditions and maximise steam production. Integral furnace boilers are used at the Facility. The boilers are equipped with water-cooled panel walls in the grate furnaces and the secondary combustion chamber. The boiler is further equipped with adequate internal/external insulation. Flue gas is recirculated. Incineration ash is discharged into a water bath. Heat recovery from plant unit operations (e.g., the baghouse and from the turbines via turbine bleeds) is deployed to pre-heat feed water and/or primary combustion air. Boilers were designed taking into account flue gas velocity and distribution, water/steam circulation and convection bundles. The boiler is cleaned using a combination of online and offline boiler cleaning techniques to reduce dust residence and accumulation in the boiler. The applied techniques are: - Mechanical rapping (online)	
a)	Drying of sewage sludge	After mechanical dewatering, sewage sludge is further dried, using for example low-grade heat, before it is fed to the furnace. The extent to which sludge can be dried depends on the furnace feeding system	Applicable within the constraints associated with the availability of low-grade heat		
b)	Reduction of the flue-gas flow	The flue-gas flow is reduced through, e.g.: • improving the primary and secondary combustion air distribution; • flue-gas recirculation (see Section 2.2) A smaller flue-gas flow reduces the energy demand of the plant (e.g. for induced draft fans).	For existing plants, the applicability of flue-gas recirculation may be limited due to technical constraints (e.g. pollutant load in the flue-gas, incineration conditions)		
c)	Minimisation of heat losses	Heat losses are minimised through, e.g.: • use of integral furnace-boilers, allowing for heat to also be recovered from the furnace sides; • thermal insulation of furnaces and boilers; • flue-gas recirculation (see Section 2.2); • recovery of heat from the cooling of slags and bottom ashes (see BAT 20 i).	Integral furnace-boilers are not applicable to rotary kilns or to other furnaces dedicated to the high-temperature incineration of hazardous waste		
d)	Optimisation of the boiler design	The heat transfer in the boiler is improved by optimising, for example, the: • flue-gas velocity and distribution; • water/steam circulation;	Applicable to new plants and to major retrofits of existing plants		

Conclusions on BAT			Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
		• convection bundles; • on-line and off-line boiler cleaning systems in order to minimise the fouling of the convection bundles.	- High or low – pressure water praying (online) - Periodic manual cleaning (offline)	
e)	Low-temperature flue-gas heat exchangers	Special corrosion-resistant heat exchangers are used to recover additional energy from the flue-gas at the boiler exit, after an ESP, or after a dry sorbent injection system	Applicable within the constraints of the operating temperature profile of the FGC system. In the case of existing plants, the applicability may be limited by a lack of space.	Corrosion-resistant heat exchangers are used throughout the facility. The optimum steam parameters for the Facility are set at approximately 80 bar/450°C, therefore part of the boiler is protected against corrosion by means of nickel/chromium alloy cladding.
f)	High steam conditions	The higher the steam conditions (temperature and pressure), the higher the electricity conversion efficiency allowed by the steam cycle. Working at high steam conditions (e.g. above 45 bar, 400 °C) requires the use of special steel alloys or refractory cladding to protect the boiler sections that are exposed to the highest temperatures.	Applicable to new plants and to major retrofits of existing plants, where the plant is mainly oriented towards the generation of electricity. The applicability may be limited by: • the stickiness of the fly ashes; • the corrosiveness of the flue-gas.	Part of the reasoning behind the selection of the site on the Poolbeg Peninsula was its close proximity to a potential future district-heating network in the Dublin Docklands Area. The Facility was constructed with built-in provisions for the supply of district heating to the city of Dublin should a future district heating scheme come into place (refer also BAT19). The heat from flue gas is used in the boilers to generate steam and that steam is utilised for electricity generation. District Heating will become available in the next 18 months.
g)	Cogeneration	Cogeneration of heat and electricity where the heat (mainly from the steam that leaves the turbine) is used for producing hot water/steam to be used in industrial	Applicable within the constraints associated with the local heat and power	

Conclusions on BAT			Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
	processes/activities or in a district heating/cooling network	demand and/or availability of networks.		
h) Flue-gas condenser	A heat exchanger where the water vapour contained in the flue-gas condenses, transferring the latent heat to water at a sufficiently low temperature (e.g. return flow of a district heating network). The flue-gas condenser also provides co-benefits by reducing emissions to air (e.g. of dust and acid gases). The use of heat pumps can increase the amount of energy recovered from flue-gas condensation	Applicable within the constraints associated with the demand for low-temperature heat, e.g. by the availability of a district heating network with a sufficiently low return temperature.	The energy audit dated April 2018 which was repeated in 2020 concluded that the gross energy efficiency of the Facility is 33%. At present DWtE calculate gross electrical efficiency of 33.7%. Once the DDHS is operational the DWTE facility is anticipated to have a net energy efficiency of over 88%.	
i) Dry bottom ash handling	Dry, hot bottom ash falls from the grate onto a transport system and is cooled down by ambient air. Useful energy is recovered by using the cooling air for combustion	Only applicable to grate furnaces. There may be technical restrictions that prevent retrofitting to existing furnaces.		

BAT-associated energy efficiency levels (BAT-AEELs) for incineration

Plant	BAT-AEEL (%)		
	Municipal solid waste, other non-hazardous waste and hazardous wood waste	Hazardous waste other than hazardous wood waste (1)	Sewage sludge

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
<table><tr><th></th><th>Gross electrical efficiency (%)(2) (3)</th><th>Gross energy efficiency (%) (4)</th><th>Boiler efficiency</th><th></th></tr><tr><td>New plant</td><td>25–35</td><td rowspan="2">72–91(5)</td><td rowspan="2">60-80</td><td rowspan="2">60-70(6)</td></tr><tr><td>Existing plant</td><td>20 - 35</td></tr></table> ((1) The BAT-AEEL only applies where a heat recovery boiler is applicable. (2) The BAT-AEELs for gross electrical efficiency only apply to plants or parts of plants producing electricity using a condensing turbine. (3) The higher end of the BAT-AEEL range can be achieved when using BAT 20 f. (4) The BAT-AEELs for gross energy efficiency only apply to plants or parts of plants producing only heat or producing electricity using a back-pressure turbine and heat with the steam leaving the turbine. (5) A gross energy efficiency exceeding the higher end of the BAT-AEEL range (even above 100 %) can be achieved where a flue-gas condenser is used. (6) For the incineration of sewage sludge, the boiler efficiency is highly dependent on the water content of the sewage sludge as fed into the furnace.		
5.1.5 Emission to air 5.1.5.1 Diffuse emissions		
BAT 21. In order to prevent or reduce diffuse emissions from the incineration plant, including odour emissions, BAT is to: a. store solid and bulk pasty wastes that are odorous and/or prone to releasing volatile substances in enclosed buildings under controlled sub	Applicable All waste storage takes place indoors. The single access door can also be closed when required.	In place

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
atmospheric pressure and use the extracted air as combustion air for incineration or send it to another suitable abatement system in the case of a risk of explosion; b. store liquid wastes in tanks under appropriate controlled pressure and duct the tank vents to the combustion air feed or to another suitable abatement system; c. control the risk of odour during complete shutdown periods when no incineration capacity is available, e.g. by: ▪ sending the vented or extracted air to an alternative abatement system, e.g. a wet scrubber, a fixed adsorption bed; ▪ minimising the amount of waste in storage, e.g. by interrupting, reducing or transferring waste deliveries, as a part of waste stream management (see BAT 9); ▪ storing waste in properly sealed bales.	The Facility operates under the containment principle thereby minimising any potential fugitive emissions. All operations take place inside the building. The tipping floor areas and waste bunker areas are under negative air system to prevent dust escaping from the Facility. Instead these emissions drawn into the primary air feed to the furnace where the combustion of waste takes place. No fugitive dust emissions are emitted from the Facility. During normal maintenance only one of the two combustion lines will be shut down, leaving the other line fully operational to prevent any dust and odour emission by creating the sufficient negative pressure in the reception hall and waste bunker. To control the risk of odour during shutdown periods waste deliveries are reduced.	
BAT 22. In order to prevent diffuse emissions of volatile compounds from the handling of gaseous and liquid wastes that are odorous and/or prone to releasing volatile substances at incineration plants, BAT is to feed them to the furnace by direct feeding.	Not applicable The Facility does not accept any gaseous or liquid wastes.	In place
BAT 23.	Applicable	In place

<table>
<tr><th>Conclusions on BAT</th><th>Applicability Assessment
(describe how the technique applies or not to your installation)</th><th>State whether it is in place or state schedule for implementation</th></tr>
<tr><td>In order to prevent or reduce diffuse dust emissions to air from the treatment of slags and bottom ashes, BAT is to include in the environmental management system (see BAT 1) the following diffuse dust emissions management features:
a. identification of the most relevant diffuse dust emission sources (e.g. using EN 15445);
b. definition and implementation of appropriate actions and techniques to prevent or reduce diffuse emissions over a given time frame.</td><td>The Facility has developed an odour and dust abatement procedure which identifies potential diffuse dust mission sources and the techniques and actions to prevent or reduce such potential diffuse emissions.</td><td></td></tr>
<tr><td>BAT 24.

In order to prevent or reduce diffuse dust emissions to air from the treatment of slags and bottom ashes, BAT is to use an appropriate combination of the techniques given below.

<table><tr><th></th><th>Technique</th><th>Description</th><th>Applicability</th></tr><tr><td>a)</td><td>Enclose and cover equipment</td><td>Enclose/encapsulate potentially dusty operations (such as grinding, screening) and/or cover conveyors and elevators.
Enclosure can also be accomplished by installing all of the equipment in a closed building.</td><td>Installing the equipment in a closed building may not be applicable to mobile treatment devices</td></tr></table></td><td>Not Applicable

Residues are not treated on site, they are transported offsite in sealed containers for treatment. However, the Facility uses following techniques to prevent diffuse dust emissions to air:

- All operations take place within the confines of the structure based on the containment principle.
- Dust curtains are provided at each of the dischargers onto the conveyor and at the end of the conveyor into the incinerator bottom ash (IBA) bunker.
- IBA is stored in a separate IBA bunker with sealed surfaces. The IBA bunker is constructed of reinforced water proof concrete.
- The IBA bunker is under negative pressure with the air being drawn into boilers as secondary air</td><td>Not Applicable</td></tr>
</table>

Conclusions on BAT			Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
b) Limit height of discharge	Match the discharge height to the varying height of the heap, automatically if possible (e.g. conveyor belts with adjustable heights)	Generally applicable	- Roof vents provide a natural draft releasing warmed air entering from openings at the lower elevation of the IBA loading area. - The fly ash collected in the hoppers is continuously discharged via a screw conveyor especially developed for refuse incineration plants. The flue gas treatment residues are stored in two silos. The silos are equipped with High Efficiency Particulate Abatement (HEPA) filters to prevent fugitive emissions of flue gas cleaning residues. - Loading of the fly ash is via the "elephant's trunk" system which is a closed sealed system - The fly ash is transported pneumatically in a closed system into the fly ash storage silos Incinerator bottom ash (IBA) passes through a water bath at the bottom of the IBA discharger. The IBA then becomes a moist product that prevents any significant dust. Even then, one of the current DWtE improvement projects is to enclose the vibrating conveyor that carries the IBA post-cooling in the water bath to reduce potential for fugitive dust emissions from the conveyor. Waste is not stockpiled outside the waste bunker. The waste bunker is located inside the building, negative pressure is controlled in that area in order to reduce odour and diffuse dust emissions.	
c) Protect stockpiles against prevailing winds	Protect bulk storage areas or stockpiles with covers or wind barriers such as screening, walling or vertical greenery, as well as correctly orienting the stockpiles in relation to the prevailing wind	Generally applicable		
d) Use water sprays	Install water spray systems at the main sources of diffuse dust emissions. The humidification of dust particles aids dust agglomeration and settling. Diffuse dust emissions at stockpiles are reduced by ensuring appropriate humidification of the charging and discharging points, or of the stockpiles themselves.	Generally applicable		
e) Optimise moisture content	The treatment of slags and bottom ashes is carried out in enclosed equipment or buildings (see technique a) under subatmospheric pressure to enable treatment of the extracted air with an abatement technique (see BAT 26) as channelled emissions	Only applicable to dry-discharged and other low-moisture bottom ashes		

Conclusions on BAT			Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
f) Operate under subatmospheric pressure	The treatment of slags and bottom ashes is carried out in enclosed equipment or buildings (see technique a) under subatmospheric pressure to enable treatment of the extracted air with an abatement technique (see BAT 26) as channelled emissions	Only applicable to dry-discharged and other low-moisture bottom ashes	- All operations take place within the confines of the structure based on the containment principle. - A duct supplying air to the Unit 1 secondary air fan draws air from just above the IBA discharger. - Roof vents provide a natural draft releasing warmed air entering from openings at the lower elevation of the FGC/IBA Storage area.	
5.1.5.2 Channelled emissions ***5.1.5.2.1 Emissions of dust, metals and metalloids***				
BAT 25. In order to reduce channelled emissions to air of dust, metals and metalloids from the incineration of waste, BAT is to use one or a combination of the techniques given below.			Applicable The flue gas cleaning process comprises an active carbon and semi-dry lime scrubbing process followed by particle removal in a fabric filter followed by a two-stage wet scrubbing process. The heat recovery boilers are designed to minimise dioxin formation. Any residual dioxin reformed is removed from the flue gas by adding activated carbon to the flue gas prior to the fabric filter, where the dioxin and activated carbon is collected together with fly ash and Air Pollution Control Residues (APCR).	In place With respect to the AELs DWtE will comply with those set out in the revised IE Licence.
Technique	Description	**Applicability**		
a) Bag filter	See Section .2.2	Generally applicable to new plants. Applicable to existing plants within the constraints associated with the operating temperature profile of the FGC system.		
b) Electrostatic precipitator	See Section 2.2	Generally applicable		

Conclusions on BAT			Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
c) Dry sorbent injection	See Section 2.2. Not relevant for the reduction of dust emissions. Adsorption of metals by injection of activated carbon or other reagents in combination with a dry sorbent injection system or a semi-wet absorber that is used to reduce acid gas emissions.	Generally applicable	The reduction of NOx from the combustion process takes place in a selective non-catalytic reduction (SNCR) process by injecting ammonium hydroxide solution in water (NH_4OH) into the first pass of the boiler, thus securing compliance with the site IE Licence. Emissions of particulate matter are controlled primarily through the use of a filter baghouse. This system employs over 5,000 filter bags though which the flue gas must pass. Baghouses - one (1) pulse jet type per boiler unit, contain 12 isolatable modules (arranged in 2 parallel rows), all operating in parallel and each with its own hopper. The number of modules ensure that taking a compartment out for cleaning and having another compartment out for maintenance does not result in any reduction in particulate filter efficiency. Baghouses have been designed for variations of temperature and pressure due to failure of other components in the system (such as scrubber malfunction, loss of an ID or CA fan or the malfunction of a flue gas damper). Before flue gas finally exits through the stack, water is used in a wet scrubber to reduce temperature and remove any residual HCl. In addition, a sodium hydroxide solution is used to remove residual SO_2. The wet scrubber consists of a co-current quenching flow	
d) Wet scrubber	See Section 2.2. Wet scrubbing systems are not used to remove the main dust load but, installed after other abatement techniques, to further reduce the concentrations of dust, metals and metalloids in the flue-gas	There may be applicability restrictions due to low water availability, e.g. in arid areas		
e) Fixed- or moving-bed adsorption	See Section 2.2. The system is used mainly to adsorb mercury and other metals and metalloids as well as organic compounds including PCDD/F, but also acts as an effective polishing filter for dust.	The applicability may be limited by the overall pressure drop associated with the FGC system configuration. In the case of existing plants, the applicability may be limited by a lack of space.		

<table>
<tr><th>Conclusions on BAT</th><th>Applicability Assessment
(describe how the technique applies or not to your installation)</th><th>State whether it is in place or state schedule for implementation</th></tr>
<tr><td>Table 5.1: BAT-associated emission levels (BAT-AELs) for channelled emissions to air of dust, metals and metalloids from the incineration of waste.

<table><tr><th>Parameter</th><th>BAT-AEL (mg/Nm^3)</th><th>Averaging period</th></tr><tr><td>Dust</td><td><2–5 (1)</td><td>Daily average</td></tr><tr><td>Cd + Tl</td><td>0.005–0.02</td><td>Average over the sampling period</td></tr><tr><td>Sb + As + Pb + Cr + Co + Cu+ Mn + Ni + V</td><td>0.01–0.3</td><td>Average over the sampling period</td></tr></table>(1) For existing plants dedicated to the incineration of hazardous waste and for which a bag filter is not applicable, the higher end of the BAT-AEL range is 7 mg/Nm^3.</td><td>section (Quench stage) and a co-concurrent flow absorption column (Packed bed stage) which is fed via a common sump. All water collected from the wet-scrubber is reused on-site as feed water for the semi-dry scrubber, for boiler water make up and/ or in the quench for the bottom ash discharging from the boilers.

Current Emission Limit Values (ELV's) assigned by the EPA to the two stack emissions, are as set out in Schedule B.1 of IE Licence W0232-01 and as contained in Technical Amendment A. These ELV's are higher than BAT-AELs, however, the measured data reported by the site is below that of the BAT-AELs.</td><td></td></tr>
<tr><td>BAT 26.</td><td>Not Applicable</td><td>Not Applicable</td></tr>
</table>

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
In order to reduce channelled dust emissions to air from the enclosed treatment of slags and bottom ashes with extraction of air (see BAT 24 f), BAT is to treat the extracted air with a bag filter (see Section 5.2.2). BAT-associated emission levels (BAT-AELs) for channelled dust emissions to air from the enclosed treatment of slags and bottom ashes with extraction of air. **Parameter** BAT-**AEL (mg/Nm^3)** **Averaging period** Dust 2–5 Average over the sampling period	No channelled dust emissions from slag or bottom ash facilities at the DWtE facility.	
5.1.5.2.2 Emissions of HCl, HF and SO_2		
BAT 27. In order to reduce channelled emissions of HCl, HF and SO_2 to air from the incineration of waste, BAT is to use one or a combination of the techniques given below. a) Wet scrubber — **Applicability**: There may be applicability restrictions due to low water availability, e.g. in arid areas b) Semi-wet absorber — Generally applicable c) Dry sorbent injection — Generally applicable	Applicable Wet scrubber and semi-wet absorbers are used at the Facility. In the semi-wet absorbers, with prior injection of lime and activated carbon, the emissions of dust HCl, HF, SO_2, NOx, heavy metal, dioxins and furans are reduced. The two-stage wet scrubber system implemented subsequent to the semi-wet system ensures very low emissions to air of HCL, HF, SO_2, NH_3/NH_4OH and mercury in gas form (Hg).	In place

<table>
<tr><th>Conclusions on BAT</th><th>Applicability Assessment
(describe how the technique applies or not to your installation)</th><th>State whether it is in place or state schedule for implementation</th></tr>
<tr><td>
<table>
<tr><td>d)</td><td>Direct desulphurisation</td><td>Only applicable to fluidised bed furnaces</td></tr>
<tr><td>e)</td><td>Boiler sorbent injection</td><td>Generally applicable</td></tr>
</table>
</td><td></td><td></td></tr>
<tr><td>
BAT 28.

In order to reduce channelled peak emissions of HCl, HF and SO_2 to air from the incineration of waste while limiting the consumption of reagents and the amount of residues generated from dry sorbent injection and semi-wet absorbers, BAT is to use technique (a) or both of the techniques given below.
<table>
<tr><th></th><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>a)</td><td>Optimised and automated reagent dosage</td><td>The use of continuous HCl and/or SO_2 measurements (and/or of other parameters that may prove useful for this purpose) upstream and/or downstream of the FGC system for the optimisation of the automated reagent dosage</td><td>Generally applicable</td></tr>
<tr><td>b)</td><td>Recirculation of reagents</td><td>The recirculation of a proportion of the collected FGC solids to reduce the amount of unreacted reagent(s) in the residues.
The technique is particularly relevant in the case of FGC techniques operating with a high stoichiometric excess.</td><td>Generally applicable to new plants.
Applicable to existing plants within the constraints of the size of the bag filter.</td></tr>
</table>
</td><td>Applicable

The reagent dosing was optimised and automated by Hitachi at the commissioning phase and verifying phase. Also, an integral part of the optimising process is based on re-agent recirculation to minimise the amount of unreacted reagent in the residues

Continuous flue gas parameter testing (e.g., HCl and SO_2) facilitates optimisation of reagent dosing.</td><td>In place

With respect to the AELs DWtE will comply with those set out in the revised IE Licence.</td></tr>
</table>

<table>
<tr><th>Conclusions on BAT</th><th>Applicability Assessment
(describe how the technique applies or not to your installation)</th><th>State whether it is in place or state schedule for implementation</th></tr>
<tr><td>BAT 5.3: BAT-associated emission levels (BAT-AELs) for channelled emissions to air of HCl, HF and SO_2 from the incineration of waste.

<table>
<tr><th rowspan="2">Parameter</th><th colspan="2">BAT-AEL (mg/Nm^3)</th><th rowspan="2">Averaging period</th></tr>
<tr><th>New plants</th><th>Existing plants</th></tr>
<tr><td>HCl</td><td><2 – 6 (1)</td><td><2 – 8 (1)</td><td>Daily average</td></tr>
<tr><td>HF</td><td><1</td><td><1</td><td>Daily average or average over the sampling period</td></tr>
<tr><td>SO_2</td><td>5 – 30</td><td>5 – 40</td><td>Daily average</td></tr>
<tr><td colspan="4">(1) The lower end of the BAT-AEL range can be achieved when using a wet scrubber; the higher end of the range may be associated with the use of dry sorbent injection.</td></tr>
</table></td><td>Current Emission Limit Values (ELV's) assigned by the EPA to the two stack emissions, are as set out in Schedule B.1 of IE Licence W0232-01 and as contained in Technical Amendment A. These ELV's are higher than BAT-AELs, however, the measured data reported by the site is below that of the BAT-AELs.</td><td></td></tr>
<tr><td>5.1.5.2.3 Emissions of NO_X, N_2O, CO and NH_3
BAT 29.

In order to reduce channelled NO_X emissions to air while limiting the emissions of CO and N_2O from the incineration of waste and the emissions of NH_3 from the use of SNCR and/or SCR, BAT is to use an appropriate combination of the techniques given below.</td><td>Applicable

In addition to the secondary NOx reduction of the SNCR system, the following primary NOx reducing measures is implemented at the Facility:
- Computer fluid dynamic simulation of the grate and furnace section to optimise the injection of combustion air.
- The use of both primary and secondary air injection systems to reduce the excess air in the primary combustion zone, thus reducing the amount of thermal NOx created.</td><td>In place

With respect to the AELs DWtE will comply with those set out in the revised IE Licence.</td></tr>
</table>

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation

	Technique	Description	Applicability
a)	Optimisation of the incineration process	See Section 5.2.1	Generally applicable
b)	Flue-gas recirculation	See Section .2.2	For existing plants, the applicability may be limited due to technical constraints (e.g. pollutant load in the flue-gas, incineration conditions)
c)	Selective non-catalytic reduction (SNCR)	See Section .2.2	Generally applicable
d)	Selective catalytic reduction (SCR)	See Section 2.2	In the case of existing plants, the applicability may be limited by a lack of space
e)	Catalytic filter bags	See Section 2.2	Only applicable to plants fitted with a bag filter
f)	Optimisation of the SNCR/SCR design and operation	Optimisation of the reagent to NO_X ratio over the cross-section of the furnace or duct, of the size of the reagent drops and of the temperature window in which the reagent is injected	Only applicable where SNCR and/or SCR is used for the reduction of NO_X emissions

- The recirculation of some of the flue-gas to control oxygen content and therefore add to NOx control;
- Operation with reduced excess air
- The use of water – cooled grate bars to enable primary air to be added independent of the cooling need of the grate bars.
- Optimise reagent injection points of the SNCR system so as to improve the efficiency of NOX abatement whist minimising the generation of nitrous oxide, ammonia and the consumption of reagent.
- A wet scrubber is used after SNCR, thus unreacted ammonia is absorbed by the scrubbing liquor. The wastewater from wet scrubber is recirculated to the boiler before the flue-gas treatment system.

Conclusions on BAT			Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
g) Wet scrubber	See Section 2.2. Where a wet scrubber is used for acid gas abatement, and in particular with SNCR, unreacted ammonia is absorbed by the scrubbing liquor and, once stripped, can be recycled as SNCR or SCR reagent.	There may be applicability restrictions due to low water availability, e.g. in arid areas	Current Emission Limit Values (ELV's) assigned by the EPA to the two stack emissions, are as set out in Schedule B.1 of IE Licence W0232-01 and as contained in Technical Amendment A. The ELV for oxides of nitrogen is higher than this BAT-AEL. However, the measured data reported by the site is below that of the BAT-AEL. The ELV for carbon monoxide is 50 mg/Nm^{3}i.e. within the BAT AEL range. NH_3 currently is not measured at the Facility (refer to BAT4 text for detail)	

Table 5.4: BAT-associated emission levels (BAT-AELs) for channelled NO_X and CO emissions to air from the incineration of waste and for channelled NH_3 emissions to air from the use of SNCR and/or SCR.

Parameter	BAT-**AEL (mg/Nm^3)**		**Averaging period**
	New plants	Existing plants	
NO_X	50–120 (1)	50–150 (1)(2)	Daily average
CO	10–50	10–50	
NH_3	2–10 (1)	2–10 (1)(3)	

(1) The lower end of the BAT-AEL range can be achieved when using SCR. The lower end of the BAT-AEL range may not be achievable when incinerating waste with a high nitrogen content (e.g. residues from the production of organic nitrogen compounds).

(2) The higher end of the BAT-AEL range is 180 mg/Nm3 where SCR is not applicable.

<table>
<tr><th>Conclusions on BAT</th><th>Applicability Assessment
(describe how the technique applies or not to your installation)</th><th>State whether it is in place or state schedule for implementation</th></tr>
<tr><td>(3) The lower end of the BAT-AEL range can be achieved when using SCR.
(4) For existing plants fitted with SNCR without wet abatement techniques, the higher end of the BATAEL range is 15 mg/Nm^3</td><td></td><td></td></tr>
<tr><td>5.1.5.2.4 Emissions of organic compounds</td><td></td><td></td></tr>
<tr><td>BAT 30.

In order to reduce channelled emissions to air of organic compounds including PCDD/F and PCBs from the incineration of waste, BAT is to use techniques (a), (b), (c), (d), and one or a combination of techniques (e) to (i) given below.

<table>
<tr><th></th><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>a)</td><td>Optimisation of the incineration process</td><td>See Section 2.1.
Optimisation of incineration parameters to promote the oxidation of organic compounds including PCDD/F and PCBs present in the waste, and to prevent their and their precursors’ (re)formation</td><td>Generally applicable</td></tr>
<tr><td>b)</td><td>Control of waste feed</td><td>Knowledge and control of the combustion characteristics of the waste being fed into the furnace, to ensure optimal and, as far as possible, homogeneous and stable incineration conditions</td><td>Not applicable to clinical waste or to municipal solid waste</td></tr>
</table>
</td><td>Applicable

The reduction of overall PCDD/F emissions to environmental medial is provided by means of:

- Well-controlled combustion secured by means of computer fluid dynamic simulation at the design stage and an advanced combustion control system to aid the removal of PCDD/F.

- Waste types, characteristics are inspected annually. Waste is mixed thoroughly to ensure its homogeneous condition. Waste feed rate is controlled

- The boiler is cleaned using a combination of online and offline boiler cleaning techniques such as mechanical rapping; high or low -pressure water spaying; and periodic manual cleaning.</td><td>In place

With respect to the AELs DWtE will comply with those set out in the revised IE Licence.</td></tr>
</table>

Conclusions on BAT				Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
c)	On-line and off-line boiler cleaning	Efficient cleaning of the boiler bundles to reduce the dust residence time and accumulation in the boiler, thus reducing PCDD/F formation in the boiler. A combination of on-line and off-line boiler cleaning techniques is used.	Generally applicable	- During normal operation, the temperature in three empty passes of the boiler is above 600ºC. When entering the horizontal convection pass, the flue gas is cooled very rapidly due to the large heat convection surfaces. This reduces the dust – laden gas residence time in the temperature zone from 450ºC to 200ºC, in which zone PCDD/F is likely to reform (the de-novo synthesis). - Adsorption by injection of activated carbon at a suitable reagent dose rate, with bag filtration.	
d)	Rapid flue-gas cooling	Rapid cooling of the flue-gas from temperatures above 400 °C to below 250 °C before dust abatement to prevent the de novo synthesis of PCDD/F. This is achieved by appropriate design of the boiler and/or with the use of a quench system. The latter option limits the amount of energy that can be recovered from the flue-gas and is used in particular in the case of incinerating hazardous wastes with a high halogen content.	Generally applicable		
e)	Dry sorbent injection	See Section 2.2. Adsorption by injection of activated carbon or other reagents, generally combined with a bag filter where a reaction layer is created in the filter cake and the solids generated are removed.	Generally applicable		
f)	Fixed- or moving-bed adsorption	See Section 2.2.	The applicability may be limited by the overall pressure drop associated with the FGC system. In the case of existing plants, the applicability		

Conclusions on BAT				Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
			may be limited by a lack of space.		
g)	SCR	See Section 2.2. Where SCR is used for NO_X abatement, the adequate catalyst surface of the SCR system also provides for the partial reduction of the emissions of PCDD/F and PCBs. The technique is generally used in combination with technique (e), (f) or (i).	In the case of existing plants, the applicability may be limited by a lack of space		
h)	Catalytic filter bags	See Section 2.2	Only applicable to plants fitted with a bag filter		
i)	Carbon sorbent in a wet scrubber	PCDD/F and PCBs are adsorbed by carbon sorbent added to the wet scrubber, either in the scrubbing liquor or in the form of impregnated packing elements. The technique is used for the removal of PCDD/F in general, and also to prevent and/or reduce the re-emission of PCDD/F accumulated in the scrubber (the so-called memory effect) occurring especially during shutdown and start-up periods	Only applicable to plants fitted with a wet scrubber.		

Table 5.5: BAT-associated emission levels (BAT-AELs) for channelled emissions to air of TVOC, PCDD/F and dioxin-like PCBs from the incineration of waste

Parameter	Unit	BAT-**AEL**		**Averaging period**
		New plant	Existing plant	

Conclusions on BAT					Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
TVOC	mg/Nm³	<3 – 10	<3 – 10	Daily average	The EPA IE licence limit for TOC is 10 mg/m³ Daily Average. DWtE results are in compliance with this limit. EPA IE license limit for Dioxin & furans (I-TEQ) is 0.1 ng/m³. DWtE results are in compliance with this limit. The DWtE facility does not treat hazardous waste or wastes with the potential to contain polychlorinated biphenyls (PCBs).	
PCDD/F (1)	ng I-TEQ/Nm³	< 0.01–0.04	< 0.01–0.06	Average over the sampling period		
		< 0.01–0.06	< 0.01–0.08	Long-term sampling period (2)		
PCDD/F + dioxin-like PCBs (1)	ng WHO-TEQ/Nm³	< 0.01–0.06	< 0.01–0.08	Average over the sampling period		
		< 0.01–0.08	< 0.01–0.1	Long-term sampling period (2)		
(1) Either the BAT-AEL for PCDD/F or the BAT-AEL for PCDD/F + dioxin-like PCBs applies. (2) The BAT-AEL does not apply if the emission levels are proven to be sufficiently stable.						
5.1.5.2.5 Emissions of mercury						
BAT 31. In order to reduce channelled mercury emissions to air (including mercury emission peaks) from the incineration of waste, BAT is to use one or a combination of the techniques given below.					Applicable The activated carbon injected before the fabric filter reduces the emission of particle bound Hg. In addition the use of low pH in the first stage of the wet scrubber reduces the amount of Hg in the flue gas.	In place With respect to the AELs DWtE will comply with those set out in the revised IE Licence.
Technique		**Description**		**Applicability**		
a)	Wet scrubber (low pH)	See Section .2.2. A wet scrubber operated at a pH value around 1. The mercury removal rate of the technique can be enhanced by adding reagents and/or adsorbents to the scrubbing liquor, e.g.:		There may be applicability restrictions due to low water availability, e.g. in arid areas		

Conclusions on BAT			Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
	• oxidants such as hydrogen peroxide to transform elemental mercury to a water-soluble oxidised form; • sulphur compounds to form stable complexes or salts with mercury; • carbon sorbent to adsorb mercury, including elemental mercury. When designed for a sufficiently high buffer capacity for mercury capture, the technique effectively prevents the occurrence of mercury emission peaks.			
b) Dry sorbent injection	See Section 2.2. Adsorption by injection of activated carbon or other reagents, generally combined with a bag filter where a reaction layer is created in the filter cake and the solids generated are removed.	Generally applicable		
c) Injection of special, highly reactive activated carbon	Injection of highly reactive activated carbon doped with sulphur or other reagents to enhance the reactivity with mercury. Usually, the injection of this special activated carbon is not continuous but only takes place when a mercury peak is detected. For this purpose, the technique can be used in combination with the continuous monitoring of mercury in the raw flue-gas.	May not be applicable to plants dedicated to the incineration of sewage sludge		
d) Boiler bromine addition	Bromide added to the waste or injected into the furnace is converted at high temperatures to elemental bromine, which oxidises elemental	Generally applicable		

Conclusions on BAT			Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
	mercury to the water-soluble and highly adsorbable HgBr2. The technique is used in combination with a downstream abatement technique such as a wet scrubber or an activated carbon injection system. Usually, the injection of bromide is not continuous but only takes place when a mercury peak is detected. For this purpose, the technique can be used in combination with the continuous monitoring of mercury in the raw flue-gas			
e) Fixed- or moving-bed adsorption	See Section 2.2. When designed for a sufficiently high adsorption capacity, the technique effectively prevents the occurrence of mercury emission peaks.	The applicability may be limited by the overall pressure drop associated with the FGC system. In the case of existing plants, the applicability may be limited by a lack of space.		

Table 5.6: BAT-associated emission levels (BAT-AELs) for channelled mercury emissions to air from the incineration of waste:

Parameter	BAT-**AEL (**µg/Nm³**)** (1)		**Averaging period**
	New plant	Existing plant	
	< 5–20(2)	< 5–20(2)	Daily average over the sampling period

The IE license ELV for Hg is 0.05 mg/m^3 (or 50 µg/m^3). DWtE are in compliance with this ELV.

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
Hg 1-10 1-10 Long-term sampling period (1) Either the BAT-AEL for daily average or average over the sampling period, or the BAT-AEL for long-term sampling period, applies. The BAT-AEL for long-term sampling may apply in the case of plants incinerating waste with a proven low and stable mercury content (e.g. mono-streams of waste of a controlled composition). (2) The lower end of the BAT-AEL ranges may be achieved when: • incinerating wastes with a proven low and stable mercury content (e.g. mono-streams of waste of a controlled composition), or • using specific techniques to prevent or reduce the occurrence of mercury peak emissions while incinerating non-hazardous waste. The higher end of the BAT-AEL ranges may be associated with the use of dry sorbent injection. As an indication, the half-hourly average mercury emission levels will generally be: • < 15–40 µg/Nm³ for existing plants; • < 15–35 µg/Nm³ for new plants		
5.1.6 Emissions to water		
BAT 32. In order to prevent the contamination of uncontaminated water, to reduce emissions to water, and to increase resource efficiency, BAT is to segregate waste water streams and to treat them separately, depending on their characteristics. Description Waste water streams (e.g. surface run-off water, cooling water, waste water from flue-gas treatment and from bottom ash treatment, drainage water	Applicable All process waste waters (e.g. boiler blow down, boiler water treatment reject water, scrubber water) are collected for recycling in the Flue Gas Treatment System or used for humidification/cooling of the bottom ash outlet.	In place

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
collected from the waste reception, handling and storage areas (see BAT 12 (a)) are segregated to be treated separately based on their characteristics and on the combination of treatment techniques required. Uncontaminated water streams are segregated from waste water streams that require treatment. When recovering hydrochloric acid and/or gypsum from the scrubber's effluent, the waste waters arising from the different stages (acidic and alkaline) of the wet scrubbing system are treated separately. Applicability Generally applicable to new plants. Applicable to existing plants within the constraints associated with the configuration of the water collection system.	Surface water runoff from building roofs, roads, parking areas etc. is stored in an attenuation tank for re-use in the process. Overflow from the attenuation tank discharges to the neighbouring Ringsend Municipal Wastewater Treatment Facility (MWwTP). This is done via a pump system which is manually operated	
BAT 33. In order to reduce water usage and to prevent or reduce the generation of waste water from the incineration plant, BAT is to use one or a combination of the techniques given below. **Technique** / **Description** / **Applicability** a) Waste-water-free FGC techniques / Use of FGC techniques that do not generate waste water (e.g. dry sorbent injection or semi-wet absorber, see Section .2.2) / May not be applicable to the incineration of hazardous waste with a high halogen content	Applicable The Facility has two stage wet scrubbers but there is no discharge of process wastewater from the Facility. Process wastewater is collected for recycling in the flue gas treatment system or used for humidification/cooling of the bottom ash outlet. Surface water runoff from building roofs, roads, parking areas etc. is stored in an attenuation tank for re-use in the process.	In place

Conclusions on BAT			Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
b) Injection of waste water from FGC	Waste water from FGC is injected into the hotter parts of the FGC system)	Only applicable to the incineration of municipal solid waste		
c) Water reuse/recycling	Residual aqueous streams are reused or recycled. The degree of reuse/recycling is limited by the quality requirements of the process to which the water is directed.	Generally applicable		
d) Dry bottom ash handling	Dry, hot bottom ash falls from the grate onto a transport system and is cooled down by ambient air. No water is used in the process.	Only applicable to grate furnaces. There may be technical restrictions that prevent retrofitting to existing incineration plants.		
BAT 34. In order to reduce emissions to water from FGC and/or from the storage and treatment of slags and bottom ashes, BAT is to use an appropriate combination of the techniques given below, and to use secondary techniques as close as possible to the source in order to avoid dilution. **Technique** — **Typical pollutants targeted** Primary techniques			Not applicable No waste water is discharged from the site. FGC, slags and bottom ashes are not treated onsite, however, the incineration process and the FGC system are optimised to reduce organic compounds in the flue gas (refer to BAT 29, 30).	Not applicable

Conclusions on BAT		Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
a) Optimisation of the incineration process (see BAT 14) and/or of the FGC system (e.g. SNCR/SCR, see BAT 29 (f))	Organic compounds including PCDD/F, ammonia/ammonium		
Secondary techniques [1]			
Preliminary and primary treatment			
b) Equalisation	All pollutants		
c) Neutralisation	Acids, alkalis		
d) Physical separation, e.g. screens, sieves, grit separators, primary settlement tanks	Gross solids, suspended solids		
Physico-chemical treatment			
e) Adsorption on activated carbon	Organic compounds including PCDD/F, mercury		
f) Precipitation	Dissolved metals/metalloids, sulphate		
g) Oxidation	Sulphide, sulphite, organic compounds		
h) Ion exchange	Dissolved metals/metalloids		
i) Stripping	Purgeable pollutants (e.g. ammonia/ammonium)		
j) Reverse osmosis	Ammonia/ammonium, metals/metalloids, sulphate, chloride, organic compounds		
Final solids removal			
k) Coagulation and flocculation			

Conclusions on BAT					Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
l) Sedimentation m) Filtration n) Flotation		Suspended solids, particulate-bound metals/metalloids				
(1) The descriptions of the techniques are given in Section 2.3.						

Table 5.7: BAT-AELs for direct emissions to a receiving water body

Parameter		Process	Unit	BAT-AEL(1)
Total suspended solids (TSS)		FGC Bottom ash treatment	mg/l	10 – 30
Total organic carbon (TOC)		FGC Bottom ash treatment		15 – 40
Metals and metalloids	As	FGC		0.01 – 0.05
	Cd	FGC		0.005 – 0.03
	Cr	FGC		0.01 – 0.1
	Cu	FGC		0.03 – 0.15
	Hg	FGC		0.001 – 0.01
	Ni	FGC		0.03 – 0.15

Conclusions on BAT					Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
	Pb	FGC Bottom ash treatment		0.02 – 0.06		
	Sb	FGC		0.02–0.9		
	Tl	FGC		0.005 – 0.03		
	Zn	FGC		0.01 – 0.5		
Ammonium-nitrogen (NH_4-N)		Bottom ash treatment		10 – 30		
Sulphate (SO_4^{2-})		Bottom ash treatment		400 – 1,000		
PCDD/F		FGC	ng I-TEQ/l	0.01 – 0.05		
1) The averaging periods are defined in the General considerations						
The associated monitoring is in BAT 6.						
BAT-AELs for indirect emissions to a receiving water body						
Parameter		Process	Unit	BAT-AEL(1) **(daily average)**		
	As	FGC		0.01 – 0.05		
	Cd	FGC		0.005 – 0.03		
	Cr	FGC		0.01 – 0.1		
	Cu	FGC		0.03 – 0.15		

Conclusions on BAT					Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
Metals and metalloids	Hg	FGC	mg/l	0.001 – 0.01		
	Ni	FGC		0.03 – 0.15		
	Pb	FGC Bottom ash treatment		0.02 – 0.06		
	Sb	FGC		0.02–0.9		
	Tl	FGC		0.005 – 0.03		
	Zn	FGC		0.01 – 0.5		
PCDD/F		FGC	ng I-TEQ/l	0.01 – 0.05		
(1) The BAT-AELs may not apply if the downstream waste water treatment plant is designed and equipped appropriately to abate the pollutants concerned, provided this does not lead to a higher level of pollution in the environment.						
The associated monitoring is in BAT 6.						
5.1.7 Material efficiency						
BAT 35. In order to increase resource efficiency, BAT is to handle and treat bottom ashes separately from FGC residues.					Applicable Bottom ash and FGC residues are handled and treated separately.	In place

<table>
<tr><th>Conclusions on BAT</th><th>Applicability Assessment
(describe how the technique applies or not to your installation)</th><th>State whether it is in place or state schedule for implementation</th></tr>
<tr>
<td>BAT 36.

In order to increase resource efficiency for the treatment of slags and bottom ashes, BAT is to use an appropriate combination of the techniques given below based on a risk assessment depending on the hazardous properties of the slags and bottom ashes.

<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>a) Screening and sieving</td><td>Oscillating screens, vibrating screens and rotary screens are used for an initial classification of the bottom ashes by size before further treatment</td><td>Generally applicable</td></tr>
<tr><td>b) Crushing</td><td>Mechanical treatment operations intended to prepare materials for the recovery of metals or for the subsequent use of those materials, e.g. in road and earthworks construction.</td><td>Generally applicable</td></tr>
<tr><td>c) Aeraulic separation</td><td>Aeraulic separation is used to sort the light, unburnt fractions commingled in the bottom ashes by blowing off light fragments.
A vibrating table is used to transport the bottom ashes to a chute, where the material falls through an air stream that blows uncombusted light materials, such as wood, paper or plastic, onto a removal belt or into a container, so that they can be returned to incineration.</td><td>Generally applicable</td></tr>
</table>
</td>
<td>Not applicable

Ash is not treated on site, it is exported for recovery. Incinerator Bottom ash (IBA), boiler ash and Air Pollution Control Residues (APCR) are generated during the waste to energy process.

In summary, IBA constitutes the largest percentage of solid waste products resulting from the combustion process. After burnout of the waste at the end of the grate, the IBA falls down the bottom ash chute into the water bath of the wet ash extractor. The IBA is cooled in the water bath by evaporation. From the water bath, the IBA removed by the bottom ash extractor is discharged onto a conveyor to the bottom ash bunker for temporary storage. The IBA consists of non-hazardous and inert materials from the combustion process such as glass, metal, earth and other fractions. It is stored in a separate bottom ash bunker with sealed surfaces. The bottom ash bunker is located adjacent to the boiler area on the west side of the site. The bottom ash bunker has a capacity of 10,000 tonnes. Included in the bottom ash bunker are grate siftings which comprise fine ash that falls through the grate bars of the furnace. These grate siftings are collected in hoppers under the grate and are transferred by conveyor belt to the bottom ash bunker. IBA is</td>
<td>Not applicable</td>
</tr>
</table>

Conclusions on BAT			Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
d) Recovery of ferrous and non-ferrous metals	Different techniques are used, including: • magnetic separation for ferrous metals • eddy current separation for non-ferrous metals • induction all-metal separation	Generally applicable	transported in covered trucks to Dublin Port located on the other side of Pigeon House Road for transfer to ship and subsequent delivery to a recovery facility. At present the approved recovery facility in the Netherlands recovers the metal (ferrous and non-ferrous) from the IBA. The remaining IBA material is used as aggregate in road building, embankments, road barriers and concrete pads for solar parks. It is intended to carry out this activity, through a 3rd party, in Ireland once the prerequisite licences and approvals are granted. Air Pollution Control Residues (APCR) containing fly ash, calcium-based salts, lime and activated carbon which is retained in the fabric filters in the air pollution control system is collected in hoppers located beneath the fabric filters. 90% of this material is recirculated back into the air pollution control system to maximise the reuse of the reagents and enhance the performance of the system. The remaining APCR collected in the hoppers is continuously discharged via a screw conveyor to two fully enclosed steel tanks (silos) located west of the flue gas cleaning area. The silos have sealed surfaces and a gross volume of 700m^3. The silos are equipped with High Efficiency Particulate Abatement (HEPA) filers. The APCR is	
e) Ageing	The ageing process stabilises the mineral fraction of the bottom ashes by uptake of atmospheric CO2 (carbonation), draining of excess water and oxidation. Bottom ashes, after the recovery of metals, are stored in the open air or in covered buildings for several weeks, generally on an impermeable floor allowing for drainage and run-off water to be collected for treatment. The stockpiles may be wetted to optimise the moisture content to favour the leaching of salts and the carbonation process. The wetting of bottom ashes also helps prevent dust emissions.	Generally applicable		
f) Washing	The washing of bottom ashes enables the production of a material for recycling with minimal leachability of soluble substances (e.g. salts)	Generally applicable		

<table>
<tr><th>Conclusions on BAT</th><th>Applicability Assessment
(describe how the technique applies or not to your installation)</th><th>State whether it is in place or state schedule for implementation</th></tr>
<tr><td></td><td>transported off site in closed containers for recovery which currently takes place in Norway and in a salt mine in Germany.</td><td></td></tr>
<tr><td>5.1.8 Noise</td><td></td><td></td></tr>
<tr><td>BAT 37.

In order to prevent or, where that is not practicable, to reduce noise emissions, BAT is to use one or a combination of the techniques given below.

<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>a) Appropriate location of equipment and buildings</td><td>Noise levels can be reduced by increasing the distance between the emitter and the receiver and by using buildings as noise screens</td><td>In the case of existing plants, the relocation of equipment may be restricted by a lack of space or by excessive costs</td></tr>
<tr><td>b) Operational measures</td><td>These include:
• improved inspection and maintenance of equipment
• closing of doors and windows of enclosed areas, if possible
• operation of equipment by experienced staff
• avoidance of noisy activities at night, if possible</td><td>Generally applicable</td></tr>
</table>
</td><td>Applicable

The following noise reduction measures are implemented to meet the local noise requirements:
- The main entrance for waste trucks is located close to the ramp to avoid unnecessary truck movement on the Facility leading to increased noise emanating from the Facility.
- The main entrance gate is located in such a position that the building structure of the Facility itself functions as a baffle wall reducing noise emissions to noise sensitive locations.
- An enclosed waste reception hall significantly reduces the noise from unloading of waste.
- All process equipment is located inside the building.
- The Facility is designed with seawater cooling which provides lower noise emissions than for example air cooled condensers and/or wet cooling towers.</td><td>In place</td></tr>
</table>

Conclusions on BAT			Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
	• provisions for noise control during maintenance activities			
c) Low-noise equipment	This includes low-noise compressors, pumps and fans	Generally applicable when existing equipment is replaced or new equipment is installed		
d) Noise attenuation	Noise propagation can be reduced by inserting obstacles between the emitter and the receiver. Appropriate obstacles include protection walls, embankments and buildings.	In the case of existing plants, the insertion of obstacles may be restricted by a lack of space		
e) Noise-control equipment/ infrastructure	This includes: • noise-reducers • equipment insulation • enclosure of noisy equipment • soundproofing of buildings	In the case of existing plants, the applicability may be limited by a lack of space		