# Attachment-4-8-1-Operational-Report

Sub Section 4-8
Application I.D. LA003577

Dublin Waste to Energy Ltd.

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# 1. Introduction

Dublin Waste to Energy Limited (DWtE) is applying to the EPA to review their existing Industrial Emission (IE) Licence (W0232-01) to accommodate an increase in the amount of waste DWtE can accept at their site. DWtE are proposing to increase the permitted maximum annual quantity of waste to be accepted at the DWtE facility from 600,000 tonnes per annum to 690,000 tonnes per annum (an increase of 15%).

As the premise for this IE Licence review is associated only with the increase of 90,000 tonnes (15%) in the annual capacity of the DWtE facility (i.e. no physical amendments to the consented operational facility are necessary to facilitate this capacity increase) it was agreed between DWtE and the EPA during a pre-consultation meeting that the operational report could be limited to a brief site description as environmental conditions on site have not changed since the original licence application.

This operational report is presented under the main headings as outlined in the requirements of the EPA's "*Licence Application Form Guidance: Industrial Emissions (IE), Integrated Pollution Control (IPC) and Waste (Issue 1) (2017)*".

# 2. Description of Plant, Methods and Processes

## 2.1 Overview

The DWtE site is located on the Poolbeg Peninsula in Dublin Bay on the eastern side of Dublin City. Most of the site is located south of Pigeon House Road with a portion extending north of Pigeon House Road. The overall DWtE site is bounded by Dublin Port to the north, Shellybanks Road to the west and Ringsend Wastewater Treatment Plant (WwTP) to the east. A public footpath, roadway and the shoreline of Dublin Bay lie to the south. The nearest European site to the DWtE site is the South Dublin Bay and River Tolka SPA, part of which adjoins the DWtE facility. This part of the SPA comprises a narrow strip of managed grassland, located between the Ringsend WwTP to the north, and the scrubby hill comprising the Irishtown Nature Park to the south.

The facility operates 24 hours a day, 7 days a week, 365 days a year. However, waste deliveries are only accepted Monday to Saturday, 8.00 a.m. to 10.00 p.m. Incinerator residues destined for ships within the Dublin Port Area can be removed from the facility at any time.

A site location map for the DWtE facility is presented in **Drawing 001** of this IEL Application and an area layout plan of the DWtE site is shown in **Drawing 002**.

The main process building has two identical waste-to-energy lines, each with separate boilers and flue gas cleaning. The two lines supply steam to one high-voltage turbine/generator that is connected to the electrical grid. Cooling of the exhaust steam from the turbine takes place in a water-cooled condenser. The net (electrical) power output from the DWtE site is approximately 62-63MW although this could increase to 69 MW once the site can accept the 15% increase in waste volumes.

The facility comprises three building as follows:

- Main process building;
- Cooling water pump house; and
- Security building.

A schematic of the DWtE facility is shown in **Figure 1**:

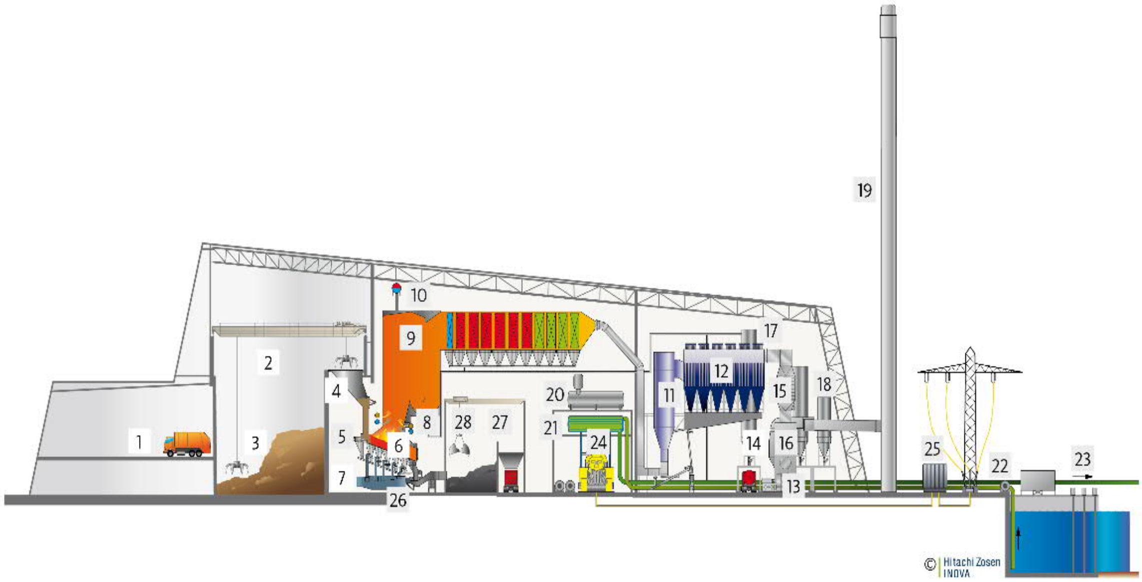


**Figure 1 – Schematic diagram of the waste to energy process.**



1. Tipping hall
2. Waste bunker
3. Waste crane for feeding the boiler grate
4. Waste hopper
5. Ram feeder
6. Hitachi Zosen Inova grate
7. Primary air
8. Secondary air
9. Four-pass boiler
10. Boiler drum
11. SemiDry reactor
12. Fabric filter
13. Induced draft fan
14. Silencer
15. Flue gas heat exchanger
16. Wet scrubber
17. Residue silo
18. Additive silos
19. Stack
20. Feed water tank
21. Water cooled condenser
22. Cooling water pump
23. Fish screen and return system/water intake filter
24. Turbine
25. Transformer
26. Bottom ash extractor
27. Bottom ash bunker
28. Bottom ash crane

When waste arrives at the facility it is logged electronically at the weighbridge. The waste is unloaded at the **Tipping Hall (1)**. The waste reception hall is kept under constant negative pressure to minimise odours/fugitive emissions to the surrounding environs. The waste is stored in the **Waste Bunker (2)**. The bunker capacity was designed to provide for 9,500 tonnes of storage. In order to optimize the combustion process, waste is mixed in the waste bunker prior to thermal treatment. **Two waste cranes (3)** are available to mix and feed the waste into the **feed hopper (4)**. A third grab is on stand-by in case of maintenance or breakdown. From the hopper the waste is pushed into the **ram feeder**

**(5)** and then the **grate (6)** at an appropriate rate. The DWtE facility has two parallel independent waste to energy lines. The actual combustion of waste takes place on the grates. Incinerator bottom ash is deposited into the **bottom ash bunker (27).** The hot gas from the combustion process is fed through the **boiler (9)** in four passes – three vertical and one horizontal. The boiler walls are lined with steel pipes and the heat energy from the gases turn the water in the pipes to steam, which is subsequently fed to the steam turbine. The **steam turbine** drives a **generator** producing electricity (**21, 22, 24 & 25)**. Up to 69 MW of electricity can be generated on site but typically 62-63 MW of electricity are exported. The flue gases then pass through a series of **cleaning processes** (**11, 12, 16, 17 & 18)**, which will reduce the stack emissions to below the level specified by the IE Licence. 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. Bottom ash is discharged from the furnace to a water bath and conveyed to bottom ash bunker (27). Continuous Emission M**onitoring System (CEMS)** is provided to continuously emissions. The monitoring system meets the requirements of Chapter IV of the Industrial Emission (IE) Directive and the IE Licence. All monitoring results are displayed in the control room. The **stacks (19)** are 100m in height.

The waste reception area, waste bunker, furnaces, boilers and flue gas treatment lines, turbine hall, residue storage and handling areas are accommodated in the main process building. The service areas including the control room, offices, staff facilities, administration area, workshop and stores are also located in the main process building. The storage areas for residues and process materials are located on the western side of the main building within the building shell. The cooling water pump house is a two-storey building and contains a water treatment system, the main cooling water pumps and the biocide dosing system. A security building is located at the main access point.

The following are the main process elements at the DWtE facility:

a. Waste acceptance;

b. Waste intake and storage;

c. Thermal Processing;

d. Energy recovery process and

e. Flue Gas Cleaning.



These are described in more detail in the following sections.

## 2.2 Waste Acceptance

***Attachment-4-3-5-Waste Acceptance-Procedure*** of the IE Licence review application contains a copy of the site Waste Acceptance Procedure. The DWtE facility accepts household, commercial and non-hazardous industrial waste. A full list of waste (LOW) codes is provided in ***Section 4.3*** of the IE Licence Application on EDEN.

DWtE assesses and approves customers in advance of waste delivery vehicles arriving at the site. When these 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 AMCS weighbridge software system. This information is also 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

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 AMCS 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.

## 2.3 Waste Intake and Storage

### *2.3.1 Unloading of Vehicles*

The wastes are then unloaded in a designated tipping bay of the Tipping Hall where the load is discharged directly to the bunker. Before exiting the Facility, the empty vehicle must be weighted out at the weighbridge using the RFID tag thus completing the transaction. A weighbridge ticket will be printed for the driver to retain for the records of the haulier. The vehicle can then exit the facility.

### *2.3.2 Waste Inspection/ Quarantine*

Inspections of loads by the Tipping Floor Manager occur frequently throughout the day with each waste collector having at least one load inspected. Waste acceptance is determined as per the LoW codes in Section 4.3 of the EDEN IE Licence review application form. If the inspected waste load is deemed acceptable it is loaded into the waste bunker. If the load is deemed unacceptable; it is placed in the quarantine bay area. The related waste contractor is contacted for the immediate removal of the quarantined load off site for proper disposal at an appropriate authorised facility. All quarantined loads are weighed on the weighbridge when exiting the facility.

## 2.4 Thermal Processing



Waste is fed to the combustion chamber via a hopper situated above the waste feeding chute. The waste feeding hopper is kept filled with solid waste in order to prevent air ingress into the combustion chamber. The waste is fed into the furnace by means of a number of feeding rams, which are integrated in the control of the combustion process.

The boilers are natural circulation boilers of the horizontal type with three vertical passes and one horizontal convection pass with evaporator, superheaters and economisers.

The combustion chamber is a fully evaporator-cooled chamber consisting of fully welded, gas proof membrane pipe walls (panels). Primary combustion air is drawn from the waste bunker, thus keeping the waste reception hall and the waste bunker area under negative pressure and preventing the release of odours and dust from these areas. Secondary air is drawn from the top of the boiler house and from the bottom ash storage area.

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 air flow, flue gas oxygen and combustion temperature in order to obtain the best possible operational conditions.

Waste is combusted at a minimum temperature of 850$^{o}$C. The resulting flue gas is maintained at a temperature above 850$^{o}$C for a minimum of 2 seconds.

Each boiler 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, a two-stage wet scrubber, an induced draft fan, a stack, and associated ductwork.

Throughout the facility, compressed air is used in blowers, instrument air and other process requirements. There are 11 compressors on site in total.

## 2.5 Energy Recovery Process

The Facility is currently designed to optimise power output.

Steam from the boiler drum is sent to the turbine and as the steam goes through the multiple stages of the turbine it is collected in the low-pressure header. The electricity produced is exported to the grid, minus whatever is used on-site by the '*house loads*'.

In the future, some of this heat will be exported to the Dublin District Heating Scheme, when the external infrastructure is completed. Heat export pipework and shell and tube heat exchangers are installed and ready for connection at the lower level of the facility. The Dublin District Heating system (DDHS) is currently being developed and is expected to be in operation by c.2021. The DWTE facility will provide the baseload heat output for the DDHS which on its own will supply a heat source for over 50,000 homes. Once this is operational the DWtE facility will have net energy efficiency of over 88%.

The turbine design optimises the power output and thus the electricity supply regime. The condenser pressure 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 thus results in a net electrical power output of approximately 69 MW.

## 2.6 Flue Gas Cleaning

The flue gas cleaning process comprises an activated carbon and semi-dry lime scrubbing process followed by particle removal in a fabric filter, and a two-stage wet scrubbing process.

The reduction of any reformed dioxins takes place by adding activated carbon to the flue gas prior to the fabric filter, where activated carbon is collected together with fly ash and FGT-residues.

The reduction of NOx from the combustion process will take place in a selective non-catalytic reduction (SNCR) process by injecting ammonia water ($NH_4OH$) into the first pass of the boiler.

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. The baghouses (one (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 result in any reduction in particulate filter efficiency.

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 static 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 and/ or in the quench for the bottom ash discharging from the boilers.



## 2.7 Administrative Areas

Administrative areas consist of welfare facilities, offices and a canteen. The administrative areas have Air Conditioning (AC) in all areas for heating and cooling with local control. Fresh air is provided by Air Handling Units (AHUs) which also extract the stale air.

The lighting is LED throughout. The site has an existing 10kV capacity. There is one emergency generator on site which in the event of a loss of power to the site maintains essential site services. This generator is described in more detail in **Attachment-4-5-1** of this IE Licence review.

## 2.8 Water Supply

Water for sanitary and drinking purposes is supplied by mains water. DWtE have an arrangement with Ringsend Municipal Wastewater Treatment Plant (MWwTP) for the supply of "grey" water from the MWwTP. This water is treated by DWtE via double reverse osmosis and ultra-filtration prior to use by DWtE in the process.

Additional site process water is sourced from the storm water attenuation tank and recycled process waste water.

# 3. Aspects of Unit Operations that can Potentially Cause Emissions to the Environment

## 3.1 Emissions during Normal Operations

During normal day to day site operations the following scheduled emissions take place:

1. A2-1 and A2-2 are the main emission points to air from the DWtE facility. A2-1 and A2-2 correspond to the two stacks associated with each combustion line. Emissions from A2-1 and A2-2 are in accordance with Schedule B.1 of the site IE Licence. Appendix A of this report contains an AECOM report entitled "*Proposed Amendments to Annual Tonnage at Dublin Waste to Energy Facility"* dated February 2019 which discusses air quality impact from the proposed increase in waste acceptance and includes updated air dispersion modelling.

2. Non-contact cooling water (from the site water cooled condenser) is discharged at Emission Point SW-1 as per the requirements of Schedule B.2 of the site IE licence.

3. There is no direct discharge to surface water, of process, sewage or storm water from the DWtE 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 humidification/cooling of the bottom ash outlet.

4. Surface water runoff from building roofs, roads, parking areas etc. is stored in an attenuation tank for re-use in the process. DWtE is connected to the neighbouring Ringsend MWwTP for discharge of sanitary effluent. Any overflow from the surface water attenuation tank also discharges to the MWwTP. Overflow from the attenuation tank is continuously monitored for pH and Total Organic Carbon (TOC) per Schedule C.2.3 of IE Licence. DWtE are applying as part of this IE Licence review to amend the monitoring conditions in Schedule C.2.3. Details of this proposed amendment are contained in **Attachment-7-7-1-Storm water**.

5. Noise emissions from the activity are in compliance with Schedule B.4 and C.6.2 of the site IEL. DWtE are applying as part of this IE Licence review to amend monitoring conditions in Schedule B.4 and C.6.2. Details of this proposed amendment are contained in **Attachment-7-5-Noise.**

6. Short term fugitive emissions may arise from the filling of the diesel tank on site. Diesel is used in site for the emergency generator, the auxiliary burner system and site vehicles. **Attachment 4-8-2** of this IE Licence review application contains details on diesel storage arrangements.

7. Short term emissions to atmosphere will arise from the routine testing of the site generator. This test takes place approximately once a month.



All processes, cleaning, loading, unloading and consumables storage are internal and as the building is under negative pressure, any fugitive releases will become part of the combustion air. Therefore, the site does not routinely release fugitive emissions.

## 3.2 Emissions during a malfunction

In the event of a loss of power to the site (as outlined in the Emergency Response Plan (procedure reference 3.6 DWTE_ERP_007 Utility Failure and CEMS Shut Down) the site emergency generator will maintain essential site services. Emissions from the generator during such an event would comprise short term emissions of nitrogen oxides (NOx), oxides of sulphur (SOx), carbon monoxide (CO) and particulate matter (PM10). A loss of mains power to the site would result in the manual shut-off valve of the overflow discharge from the site attenuation tank to the Ringsend MWwTP remaining closed.

# 4. Descriptions of Abatement Systems

## 4.1 Flue Gas Treatment

Section 2.6 of this report describes in detail the Flue Gas Treatment System.

## 4.2 Wastewater Treatment

The DWtE facility does not generate process wastewater for disposal.

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.

The Facility is equipped with a rainwater collection system enabling collection and reuse of rainwater in the process. The rainwater is led to the site attenuation tank and from this tank the water is used within the process, e.g. in the bottom ash extraction system and the flue gas cleaning system. Wet scrubber effluent is re-circulated within the scrubber system.

In the bunker, the waste absorbs any water, therefore no drainage system is provided in the bunker. When the waste is combusted, the water will be released as water vapour in the boiler. Any contamination in the water is thus treated in the flue gas cleaning system.

Sanitary effluent and overflow from the attenuation tank are discharged to the neighbouring Ringsend MWwTP.

# 5. Storage Conditions

## 5.1 Material Storage Areas

Storage of materials takes place within the main process building. **Attachment-4-6-2** of this IE Licence review application contains a list of all materials used at the DWtE facility. In accordance with Condition 3.12 of site's IE Licence, storage of materials only takes place in designated areas in suitable tanks/receptacles. All bunds are integrity tested every five years in accordance with the requirements of the IE Licence. Details of such testing are reported annually to the EPA and detailed test records are maintained on site. **Attachment 4-8-2** of this IE Licence review application contains details on the storage arrangements of specific materials stored on-site.

## 5.2 Waste Storage

Incinerator Bottom ash (IBA), boiler ash and Air Pollution Control Residues (APCR) are generated during the waste to energy process. Details on quantities and final destinations for these waste streams are provided in **Attachment 8-1** of this IE Licence Review.

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 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 transported off site in closed containers for recovery which currently takes place in Norway and in a salt mine in Germany.

# 6. Site Drainage

Separate drainage systems are provided for sanitary drainage and storm water drainage from roofs, roads and parking areas. Sanitary effluent is discharged to the adjacent Ringsend MWwTP. Storm water drainage is collected and stored in a 725m$^3$ underground attenuation tank and reused in the facility process, where possible. Overflow from the attenuation tank is discharged to the Ringsend MWwTP. The overflow from the attenuation tank is monitored for pH and TOC on a continuous basis as per the requirements of Schedule C.2.3 of the IE Licence. As part of this IE Licence review and as detailed in **Attachment-7-7-1-Storm water,** DWtE are requesting a change to this monitoring regime. There are two Class 1 oil/petrol interceptors on the storm water drainage system upstream of the attenuation tank. The Class I oil/petrol Interceptors have high-level alarms which can be read in the control room.

# 7. Main Alternatives

Alternatives to the activities undertaken at DWtE are either landfill or export of waste neither of which are in accordance with the Waste Hierarchy principals. Therefore, the consideration of alternatives is not considered relevant for this IE Licence review application.

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