



**ORAL HEARING INTO THE
DUBLIN WASTE TO ENERGY
FACILITY**

BRIEF OF EVIDENCE

**The Proposed Development +
Residues and Consumables**

Chapter 5 and 10 of the EIS

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1. Qualifications And Experience

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Qualification: Mechanical Engineer (B.Sc.)
Position: Project Manager

I have been working with the design of power plants since 1998, and in recent years my focus has been on Waste to Energy facilities and project management. I work for DONG Energy and previously worked for Elsam.

I have been involved in activities ranging from feasibility studies, detailed engineering and equipment procurement, contracting and negotiations, supervision and commissioning, research and development to business and project development.

My position in the various projects ranges from project management over technical and strategic consultancy to detailed engineering involving technologies such as waste to energy, biomass, coal, oil and gas.

The waste to energy specific references comprises:

- I/S Amagerforbrænding (425 ktpa, CHP) – front-up engineering of support firing system
- Måbjergværket (155 ktpa, CHP) – optimisation system
- Odense WtE (250 ktpa, CHP) - replacement and upgrade of support firing system
- Nuuk WtE – plant optimisation and feasibility study for a new WtE facility
- Dong Energy Waste-to-Energy performance upgrade programme
- Dublin WtE (600 ktpa) – Conceptual design
- Odense WtE (250 ktpa, CHP) - SNCR system upgrade.
- Jonkoping WtE (160 ktpa, CHP) – contract for shredder system
- Odense WtE (250 ktpa, CHP) - Superheater replacement
- I/S Amagerforbrænding (425 ktpa, CHP) – prefeasibility study
- I/S Vestforbrænding (500 ktpa, CHP) - Inconel evaporator panels at line 5
- Horsens WtE (75 ktpa, CHP) Inconel evaporator panels
- Dong Energy Waste-to-Energy life cycle analysis

As project manager on a number of assignments, I have obtained vital project management and coordination skills. These skills have been further developed through structured programmes of project management courses. I further hold an IPMA level C project manager certificate.

2. Introduction

The Dublin Waste to Energy facility is designed by DONG Energy. The design is based on DONG Energy's experience from a number of waste to energy facilities which among others include:

- Vestforbrændingen WtE, Glostrup, Denmark, 500,000 t/year
- Odense WtE, Odense, Denmark, 250,000 t/year
- Århus WtE, Århus, Denmark, 250,000 t/year
- Jönköping WtE Kraftvärmeverket Torsvik, Jönköping, Sweden, 160,000 t/year
- Måbjerg WtE, Måbjerg, Denmark, 160,000 t/year
- Horsens WtE, Horsens, Denmark, 65,000 t/year

The design of the Dublin Waste to Energy facility was undertaken with due consideration to the emission limits specified in the EU Waste incineration directive and the recommendations in the EU Best Available Technology Reference Document on Waste Incineration.

It is the view of DONG Energy that the selected design delivers the best technology having regard to BAT, as defined:

Directive 96/61/EC (IPPC-Directive) article 2 11.

'best available techniques' shall mean the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole:

- 'techniques' shall include both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned,

- 'available' techniques shall mean those developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced inside the Member State in question, as long as they are reasonably accessible to the operator,

- 'best' shall mean most effective in achieving a high general level of protection of the environment as a whole.

The design of the facility is very similar to what is already in operation in Vestforbrændingen WtE in Glostrup, Denmark (500.000 tonnes/year) and Jönköping WtE in Sweden (160.000 tonnes/year).

The design is developed to a level of detail which is sufficient to allow An Bord Pleanála to make a determination on the application for planning approval, and to allow the EPA consider the waste licence application.

The design for this facility is owned by Dublin City Council and Dublin City Council or a selected Service Provider will, subject to planning approval, be entitled to develop the design further for the purpose of constructing the facility.

3. Summary Of The Proposed Development

The proposed Dublin Waste to Energy facility will be located on the Poolbeg Peninsula in Dublin. Most of the Site is located south of Pigeon House Road. The location of the Site can be seen in Figure 1 below.

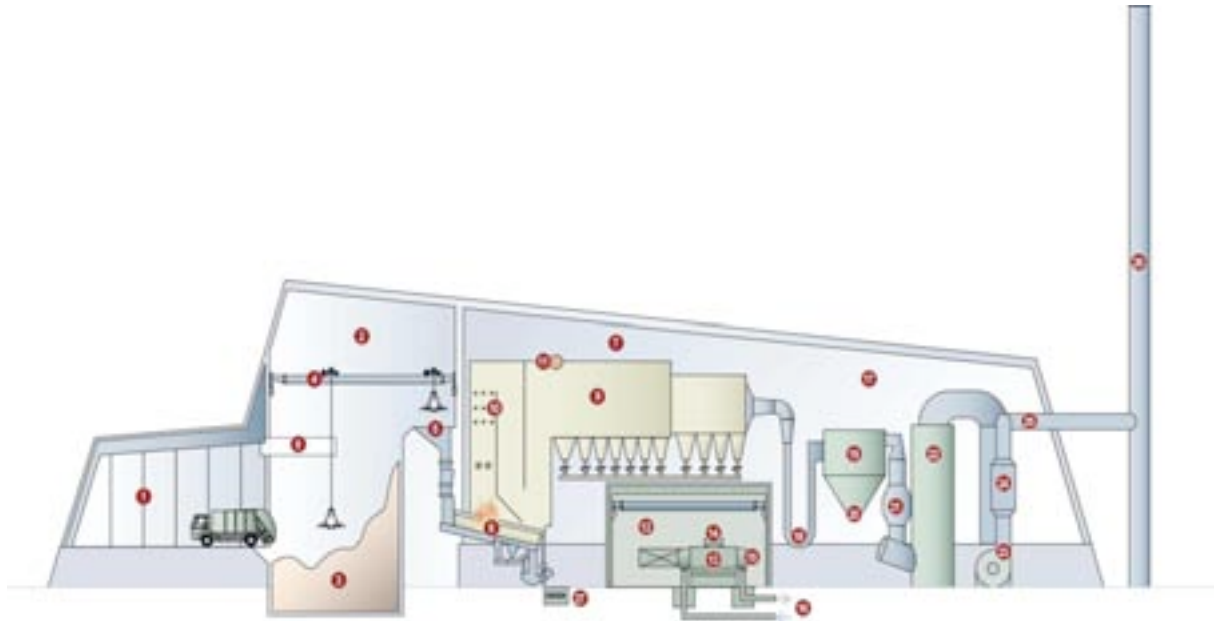


Figure 1

There will be three buildings on the Site:

- (a) the main process building
- (b) the cooling water pump house
- (c) the security building.

The main process building will be approx 200m long by 130m wide by 52m high, at the highest point. A schematic of the waste to energy process is shown in Figure 2 below.



- 1 Waste reception hall
- 2 Waste bunker compartment
- 3 Waste bunker
- 4 Waste crane for feeding the boiler grate
- 5 Waste hopper
- 6 Control room
- 7 Boiler area
- 8 Grate
- 9 Boiler, where the heat energy is transferred from the flue gas to the boiler water
- 10 NO_x reduction by spraying ammonia water into the flue gas
- 11 Boiler drum, where water and steam are separated
- 12 Turbine room
- 13 Steam turbine
- 14 Generator, producing electricity
- 15 Condenser, where the remaining heat energy in the steam is cooled
- 16 Cooling system
- 17 Flue gas treatment area
- 18 Activated carbon and lime are added to the flue gas to bind dioxins and other components
- 19 Fabric filter, where the flue gas treatment residue is removed from the flue gas
- 20 Extraction point for flue gas treatment residues
- 21 Flue gas cooler
- 22 Two-stage wet scrubber for reduction of HCl, SO₂, HF and Hg emissions
- 23 ID fan
- 24 Silencer
- 25 Emission monitoring
- 26 Stack
- 27 Bottom ash for recycling

Figure 2

1: Waste Reception Hall

The waste reception hall will handle up to 50 waste trucks per hour. There will be a series of chutes, ample space for the waste trucks to manoeuvre and an area for inspection of incoming waste. The waste reception hall is kept under constant negative pressure to avoid the leaking of any odours to the surrounding environs.

2 & 3: Waste Bunker Compartment And Waste Bunker

Waste will only be received in the opening hours as specified in the operational licence from the EPA. It is intended that waste will be accepted at the facility between 08.00 and 22.00, six days a week, but incineration will take place 24 hours a day/365 days a year. The waste bunker will be designed to be large enough to ensure that the incinerator can store sufficient waste to allow a continuous feed of fuel outside of waste acceptance hours.

4 & 5: Waste Crane And Hopper

Two waste cranes will mix the waste and feed the waste into the furnace inlet hopper. A third grab will be on standby in case of maintenance or breakdown. From the hopper, the waste will be pushed into the grate at an appropriate rate.

8: Grate

The facility will have two parallel, independent incineration lines. Each line has a capacity of 35 tonnes/hour, ie the capacity of the facility is 70 tonnes/hour. The actual incineration of the waste takes place on the grates. The waste is continuously moved forward at a controlled speed to ensure optimum burnout. The ashes will be deposited in the bottom ash bunker. The grate is water-cooled, and the hot water from this cooling process will be collected and used for pre-heating.

27: Bottom Ash Collection

The bottom ash will be collected and stored on site in a bunker.

9: Boiler

The hot gas from the incineration process will be led through the boiler in four passes – three vertical and one horizontal. The boiler walls will be lined with steel pipes, and the heat energy from the gases turn the water in the pipes into steam, which is subsequently fed to the steam turbine.

12, 13, 14, 15 & 16: Steam Turbine and Electricity Generator

The steam turbine drives a generator producing electricity. Approx 480,000 MWh will be fed to the National Grid annually. This amount of electricity is equal to the demand from approx 50,000 homes. The plant will be designed to allow for a future district heating network, and will have the potential to provide heating to future housing and office developments in the area.

10, 17, 18, 19 & 22: Flue Gas Cleaning

After releasing their heat, the flue gases pass through a series of cleaning processes, which will reduce stack emissions to the level specified by the EPA – in accordance with the Waste Incineration Directive as implemented in Ireland by the European Communities (Incineration of Waste) Regulations 2003. The various processes and systems reduce dust particles, nitrogen oxides (NO_x), heavy metals, dioxins & furans, hydrogen chloride (HCl), sulphur-dioxide (SO₂), Carbon Monoxide (CO) and Hydrogen Fluorides (HF) to the levels for which the plant is licensed. Ammonia is sprayed into the boiler to reduce NO_x and activated carbon to bind dioxins and furans and mercury. In addi-

tion lime is added to reduce the emission of HCl and SO₂. A final scrubbing with water and Sodium Hydroxide (NaOH) takes out the remaining HCl, HF and SO₂.

25: Emission Monitoring

Emission monitoring equipment will be provided to monitor the air pollutants. The monitoring system will meet the requirements of the Waste Incineration Directive, Irish applicable regulations and the Waste Licence. All monitoring results will be displayed in the control room.

Emission monitoring will include the measurement of dioxin emissions from the stack on a fortnightly basis. A monitoring filter will be removed and analysed in an independent laboratory with the subsequent results being representative of dioxin emission concentrations for that period.

26: Stack

The stack will be approximately 100m high. This is approximately half the height of the existing ESB-Poolbeg stacks.

4. Residues

There will be three main solid residues from the Dublin WtE facility:

- a) Bottom ash
- b) Boiler ash
- c) Flue gas treatment residues

Ash Type	Approx % mass input by weight of waste	Tonnes/annum (wet condition)
Bottom Ash	20%	120,000
Boiler Ash	0.5%	3,000
Flue Gas Treatment Residues	4%	24,000
Total		147,000

Table 4.1 Estimated residue quantity and type (based on % mass input by weight)

4.1 Bottom Ash

The residue remaining at the end of the grate after the burnout of the waste is known as bottom ash. The bottom ash will consist of inert material from the combustion process such as silicates, minerals, ferrous and non-ferrous metal pieces, glass compounds and inert siftings.

Bottom ash will account for the bulk of the ash arising from the combustion process. The quantity will depend on the composition and characteristics of the waste. It is estimated that approximately 20% of waste input by weight, will be bottom ash.

4.2 Boiler Ash

Boiler ash will consist of compounds that will be carried over in vapour or particulate form from the combustion chamber, and will accumulate in the first three passes of the boiler. Boiler ash will contain a higher concentration of heavy metals than the bottom ash. The quantity will depend on the composition and characteristics of the waste. It is estimated that about 0.5% by weight of the waste input will be collected as boiler ash. The ash will arise from the regular operation and cleaning of the boiler.

4.3 Flue Gas treatment Residues

The flue gas treatment residues will consist of a mix of reaction products, excess lime and spent activated carbon which will be collected in the fabric filters. Ash from the fourth pass of the boiler (also known as fly ash) will be included with the flue gas treatment residues. The residues will comprise a complex composition of minerals, organic materials, heavy metals and salts, which are leachable. The quantity will depend on the composition and characteristics of the waste. It is estimated that the flue gas treatment residues will approximately be 4% by weight of the waste input.

4.4 Methodology For Handling Of Residues

4.4.1 Bottom Ash

After the burnout of the waste at the end of the grate, the bottom ash will fall via the bottom ash chute down into the water bath of the wet ash extractor.

The bottom ash will be cooled in the water bath by evaporation. From the water bath, the bottom ash will be discharged onto a belt or a vibrating conveyor. The bottom ash will be transported via the belt conveyor or vibrating conveyor to the bottom ash bunker for temporary storage.

The bottom ash bunker will be covered and will have a capacity to store approximately 10,000 tonnes of bottom ash, which would be equivalent to 30 days normal operation of the Facility. The bottom ash bunker will be constructed of reinforced water proof concrete. The bottom ash will be stored temporarily on-site in the bottom ash bunker until export from the Site.

4.4.2 Boiler Ash

Boiler ash will arise from the operation of the boiler and from the on-line cleaning of the empty passes. The boiler ash from the 2nd and 3rd passes of the boiler will be collected in hoppers installed at the bottom of the passes. It will be possible to discharge the boiler ash to either the bottom ash bunker or the flue gas treatment residues silo, depending on the characteristics of the waste input. During the initial operation of the Facility, the boiler ash will be sampled and analysed to determine its characteristics and the typical levels of contaminants. Until this has been done, all of the boiler ash will be mixed with the flue gas treatment residues for disposal. The level of contaminants will determine whether it will be appropriate to dispose of the boiler ash with the bottom ash or flue gas treatment residues.

4.4.3 Flue Gas Treatment Residues

The flue gas treatment residues retained in the fabric filters will be dislodged into hoppers beneath the fabric filters and will be transported pneumatically to the enclosed flue gas treatment residues silos. The fly ash from the fourth pass of the boiler will be directed to these silos also. There will be two silos located west of the flue gas treatment equipment, each having a gross volume of 350 m³. The silos will be equipped with High Efficiency Particulate Abatement (HEPA) filters to prevent fugitive emissions of flue gas cleaning residues. The residues will be transported off site in sealed containers by licensed/permitted waste contractors in accordance with all applicable regulations.

Figure 4.1 Typical sealed container to transport flue gas treatment residues



4.5 Re-Use/Disposal Of Solid Residues

4.5.1 Bottom Ash

Bottom ash from waste incineration in EU countries is used in situations requiring a stable non-compressible foundation, such as road construction or railway ballast, following treatment in an ash recycling plant. Until the framework for re-use of bottom ash develops in Ireland, the bottom ash will be exported by ship for reuse in the UK or Continental Europe. The bottom ash will be transported by truck from the Facility to a suitable port, e.g., the South Deep Water Berth 46/47 immediately north of the Site, and loaded onto a ship. The loading may take place over a 24 hour period.

The bottom ash will be pre-treated off site prior to re-use. In order to meet the specifications set for its re-use, the bottom ash will be aged, screened and crushed. Magnetic separation of ferrous metals from the bottom ash will be undertaken prior to landfill or re-use. The bottom ash pre-treatment will not be undertaken at the Dublin WtE facility.

4.5.2 Boiler Ash

It is expected, based on experience elsewhere in Europe, that the boiler ash will be non-hazardous. It will either be incorporated with bottom ash or the FGT residues.

4.5.3 Flue Gas Treatment Residues

Flue gas treatment residues will be recovered, e.g., in mainland Europe as backfill material for disused mines, or disposed of in a landfill for hazardous waste. Although it is an objective of the EPA's National Hazardous Waste Management Plan to develop hazardous waste landfill capacity in Ireland, currently there is no such facility here and the flue gas treatment residues will have to be exported. If, during the life-time of the waste to energy plant, a hazardous waste landfill is developed in Ireland, the flue gas treatment residues may be sent there. The FGT residues will be transported in sealed containers, by truck, from the Facility to a suitable container terminal, e.g., the Marine Terminals Limited container terminal to the west of the Site, and loaded onto a ship.

The method of disposal or reuse/recycling of residues will be subject to the approval of the EPA under the conditions of the Waste Licence and any facilities to be used for disposal or recycling will be appropriately licensed.

5. Consideration of Issues raised in Observations to An Bord Pleanála

The main relevant submission in relation to the technical design of the facility is addressed below.

5.1 BAT Technology

The design as developed is in line with the recommendations in EU's BREF document on waste incineration, as outlined in Appendix 5.1 of the EIS.

5.2 Application Of A Single Baghouse Filter

The design with a single baghouse filter per waste line is selected because it prevents the associated increased electrical consumption of two fabric filters in one FGT line. The application of a single filter is furthermore in line with the recommendations of the BREF document (BAT38).

BAT38 "to prevent the associated increased electrical consumption, to generally (ie unless there is a specific local driver) avoid the use of two bag filters in one FGT line."

5.3 Ammonia Stripping

Ammonia stripping is not implemented, as the ammonia slip from the SNCR system is very limited when operating at EU emission limits. Should emission requirements for NO_x below 50% of the present limit be introduced, ammonia stripping can be implemented subsequently.

5.4 Single Turbine Design

In relation to the single turbine design, the facility is operational for thermal treatment of waste even if the turbine/generator is out for service, as the steam can be bypassed to the condenser. In any event, the waste is not stored in the waste feed hopper but in the bunker with a capacity for more than two weeks of equivalent plant capacity. The risk of bypass is thus estimated to be very limited.

5.5 Potable Water Supply To The Facility

The design of the facility correctly requires up to 250.000 m³ of potable water a year. It is the intention to reduce the amount by using grey water from the sewage treatment facility.

The supply of this amount of potable water might require reinforcement of the water network, which is not unusual for a project of this size. Our belief that this supply is readily possible is based on discussions with Dublin City Council's water department.

5.6 Routing Of Cable To The 110kv Ringsend Substation

The intended routing of the 110kV underground cable to the Ringsend substation along the proposed South Bank Road is a result of discussions with ESB Networks about the possible routes.

5.7 Odour Release During Outage of Both Lines

It is intended that service be performed on one line at a time, thus maintaining one line in operation. In this way the negative pressure is maintained.

In the event that both lines are out, the enclosed structure around the waste bunker is sufficient in itself to prevent odour release at the site boundary. Based on the experience of DONG Energy, facilities with enclosed reception halls do not produce odours outside the site, not even during outage of the combined facility.

5.8 Selection Of Cooling Water System

Three possible cooling methods were considered for the facility. These are:

- Once through water cooling using seawater from the River Liffey or Dublin Bay (BREF 4.3.10.1)
- Water cooling by evaporation, using large concrete towers of up to 100 metres height (BREF 4.3.10.2)
- Air-cooled condensers (BREF 4.3.10.3)

Considering the cross-media impacts of the possible cooling options, once through water cooling using water from River Liffey is selected. This is consistent with the recommendations in the EU BREF document (BAT33) which states.

“where cooling systems are required, the selection of the steam condenser cooling system technical option that is best suited to the local environmental conditions, taking particular account of potential cross-media impacts, as described in 4.3.100” (BAT33)

The main considerations in this respect have been:

- a) The close proximity to River Liffey and Dublin Harbour makes the optimum cooling method by means of once through water cooling possible.
- b) Once through water cooling provides the lowest condenser pressure of the three options, and thus the highest electrical energy generation possible by improving the vacuum in accordance with BAT31 is increased.
- c) Water cooling provides the lowest possible noise impact. Both evaporation water cooling and air-cooled condensers have high noise levels (BREF 4.3.10).
- d) The visual impact of convection water cooling is significantly smaller than the visual impact of the two other options.

6. Conclusions

The design complies with BAT and the facility will comply with the stringent emission limit values in the Waste Incineration Directive. In summary, the design of the Dublin WtE facility these three issues should be remembered:

1. The design reflects the very essence of BAT technology.
2. The size of the facility allows an attractive design, due to the economics of scale
3. The design comprises proven technology, which is already operating successfully elsewhere.

7. Appendices

1. Presentation – The proposed development
2. Presentation – Cooling water system
3. Presentation – Residues and consumables