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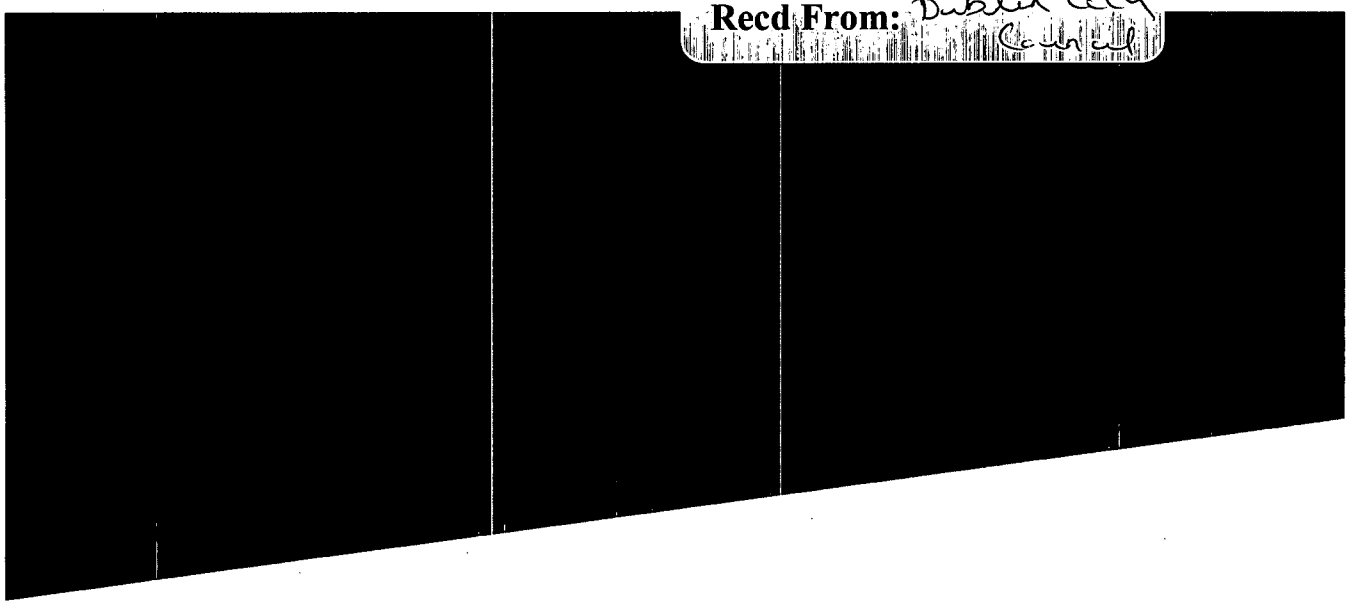

ORAL HEARING INTO THE DUBLIN WASTE TO ENERGY FACILITY

BRIEF OF EVIDENCE

Facility Design

Claus Nørgaard

DONG Energy

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Environmental Protection Agency
14 APR 2008
ORAL HEARING
RECEIVED

Prepared Claus Nørgaard, April 2008
Checked Maria Borne Jensen,
Accepted Claus Nørgaard,
Approved

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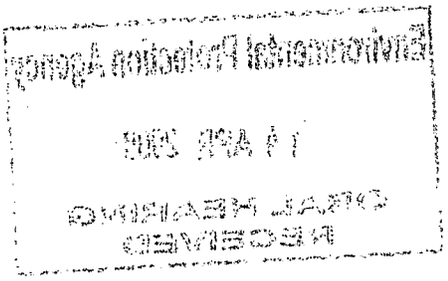

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1. Qualifications and Experience

Name: Claus Nørgaard
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.

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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.

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2. Introduction

DCC entered into a PPP arrangement under a Project Agreement with Dublin Waste to Energy Limited, which is jointly owned by Danish Oil and Natural Gas and Covanta Energy Corporation ("PPP Co") for the design, construction, operation, maintenance and financing of the Project.

The Dublin Waste to Energy facility has been designed based on experience from a number of European 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 a view to compliance with 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 the PPP Co 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 was developed to a level of detail which was 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.

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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.

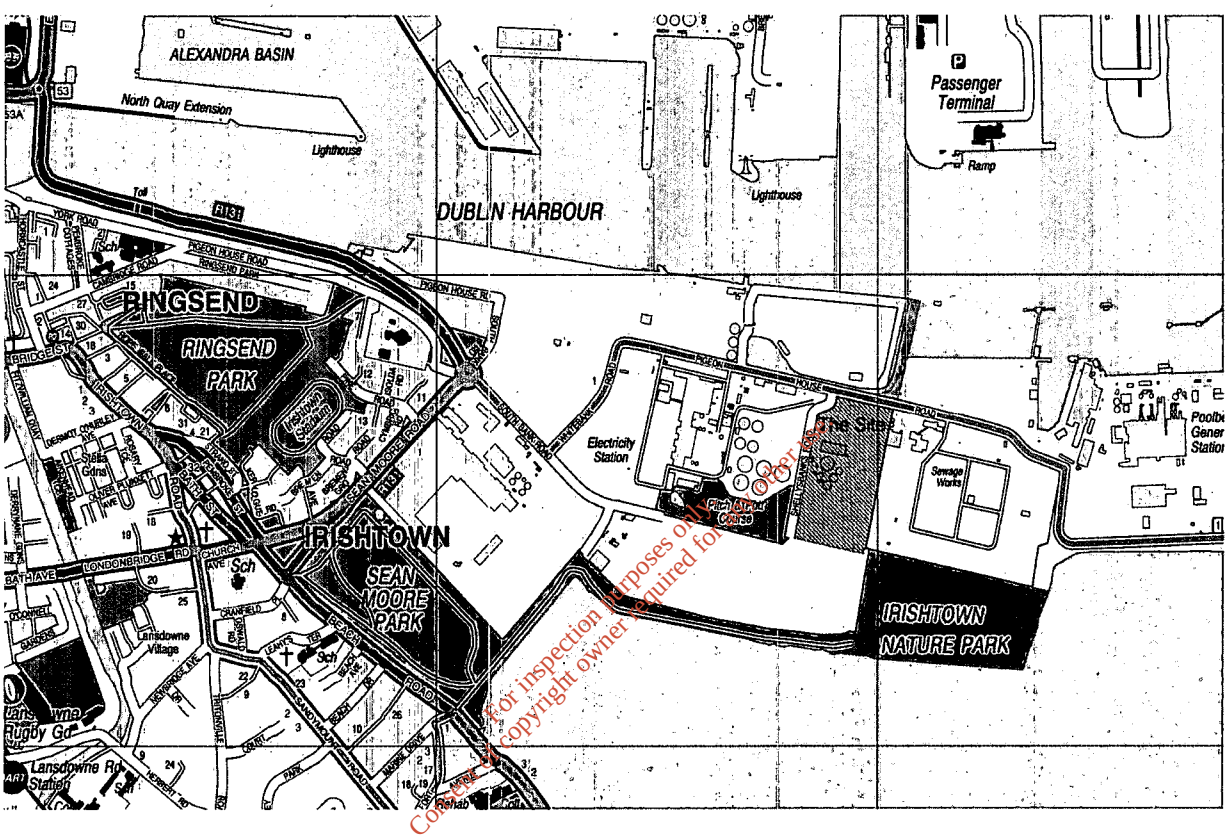

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Figure 1

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.

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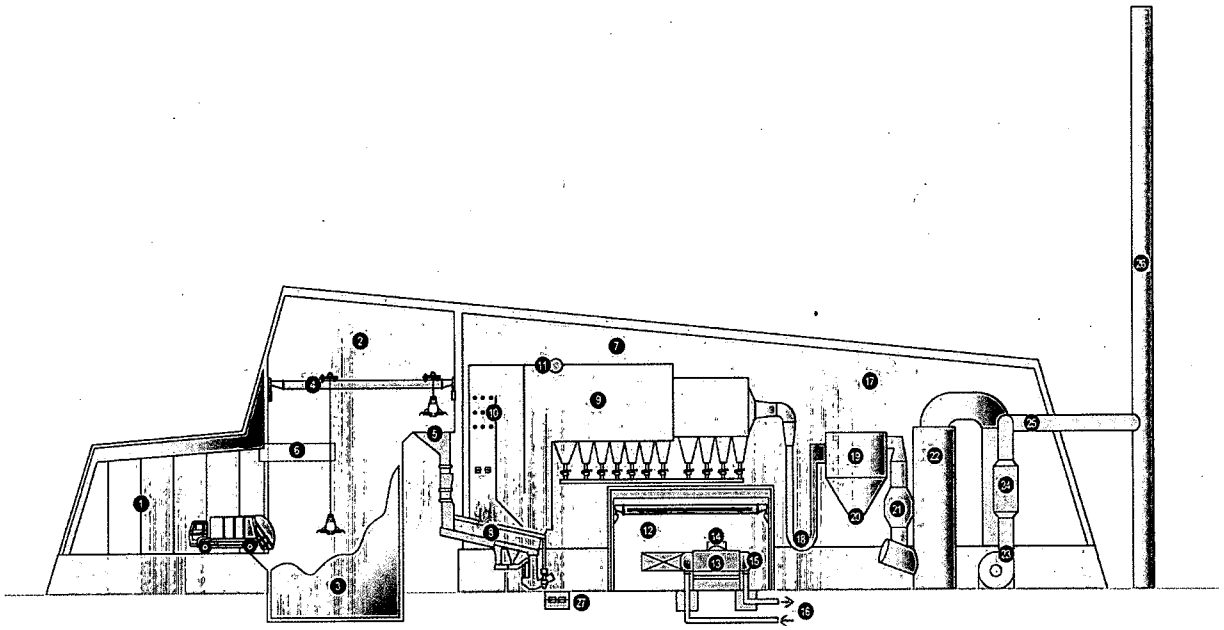

1 Waste reception hall
2 Waste bunker compartment
3 Waste bunker
4 Waste crane for feeding the boiler grate
5 Waste hopper
6 Control room
7 Boiler area
8 Grate
9 Boiler, where the heat energy is transferred from the flue gas to the boiler water
10 NO_x reduction by spraying ammonia water into the flue 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, SO_2, HF and Hg emissions
23 ID fan
24 Silencer
25 Emission monitoring
26 Stack
27 Bottom ash for recycling

Figure 2

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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, i.e. 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.

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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 (NOx), heavy metals, dioxins & furans, hydrogen chloride (HCl), sulphur-dioxide (SO_2), Carbon Monoxide (CO) and Hydrogen Fluorides (HF) to the levels for which the plant is licensed.

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Ammonia is sprayed into the boiler to reduce NOx and activated carbon to bind dioxins and furans and mercury. In addition lime is added to reduce the emission of HCl and SO_2. A final scrubbing with water and Sodium Hydroxide (NaOH) takes out the remaining HCl, HF and SO_2.

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, applicable Irish 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 height will be 100m in accordance with the EPA Proposed Decision on the waste licence. This is approximately half the height of the existing ESB-Poolbeg stacks.

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Appendices

1. Presentation -- The proposed development
2. Presentation -- Thermal efficiency

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