Chapter	Appendix	Title
5	Appendix 5.1	BAT compliance
	Appendix 5.2	Drawings

Appendix 5.1
BAT compliance

BAT compliance

Introduction

5.1.1. In this appendix, the compliance of the facility with the requirements of the BREF document Waste Incineration (WI) is demonstrated.

5.1.2. In the selection of the design, due consideration has been given to the properties of the waste to be thermally treated, as demonstrated in the Description of alternative processes **(BAT1)**[1].

5.1.3. The Site will be maintained in a generally tidy and clean state, as described in 4.1.2 of the BREF document **(BAT2)**[2]. This will be secured by:

(a) the use of a weighbridge management system to identify and locate/store wastes received.

(b) the prevention of dust emissions from operating equipment will be implemented in the form of a fully enclosed waste reception hall and waste bunker.

(c) effective wastewater management by separating and utilising the wastewater from the flue gas cleaning in the boiler. Discharge of wastewater is thus limited to rain and sanitary water.

(d) effective preventive maintenance by means of an IT-based maintenance control system identifying items requiring maintenance.

(e) Scheduled area cleaning procedures to secure that floors and elevated sections of the process building are kept in a generally tidy and clean state.

5.1.4. Equipment will be maintained in good working order, and maintenance inspections and preventive maintenance will be carried out utilising a dynamic and practical IT-based maintenance control system such as Datastream 7i or similar **(BAT3)**[3].

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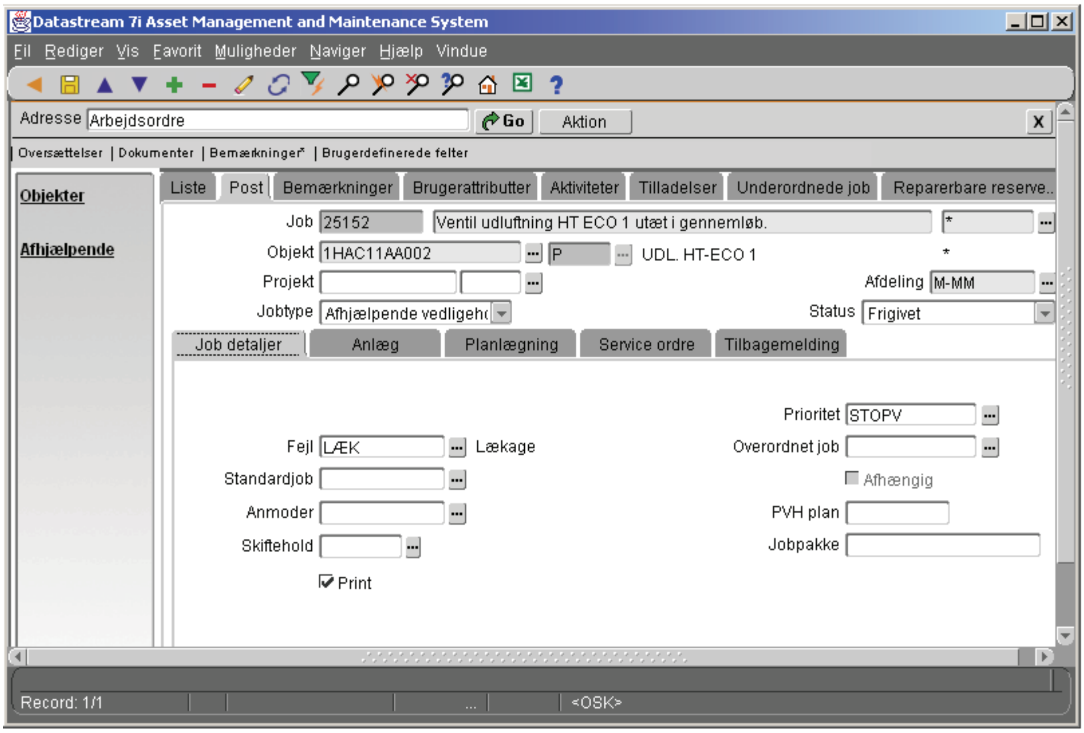
1 The selection of an installation design that is suited to the characteristics of the waste received, as described in 4.1.1, 4.2.1 and 4.2.3

2 the maintenance of the site in a generally tidy and clean state, as described in 4.1.2

3 to maintain all equipment in good working order, and to carry out maintenance inspections and preventive maintenance in order to achieve this

Figure A5.1 IT-based maintenance control system such as Datastream 7i or similar (BAT3)



5.1.5. A quality assurance system will be implemented to establish and maintain quality assurance of the waste input, according to the types of waste that may be received at the Facility **(BAT4)**[4]. Quality assurance will comprise:

(a) Establishing installation input limitations and identifying key risks.

(b) Communication with waste suppliers to improve incoming waste quality control.

(c) Controlling waste feed quality on the incinerator site.

(d) Checking, sampling and testing incoming wastes.

5.1.6. It should be noted that the entities using radioactive materials in the Dublin region such as hospitals and certain industrial companies are limited in quantity, and as these facilities have strict quality control procedures in place for dealing with radioactive waste. Therefore, the risk of waste containing higher levels of radiation is considered to be limited. Therefore no radioactive detection system will be implemented.

5.1.7. The waste will be stored in the waste bunker, which has the following properties **(BAT5)**[5]:

(a) a sealed and resistant surface (section 4.1.4.1 in the BREF document)

(b) a fully covered with roof and side walls

(c) the average storage time in the bunker will not under normal conditions exceed ten days (section 4.1.4.2 in the BREF document)

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[4] to establish and maintain quality controls over the waste input, according to the types of waste that may be received at the installation, as described in:
4.1.3.1 Establishing installation input limitations and identifying key risks, and
4.1.3.2 Communication with waste suppliers to improve incoming waste quality control, and
4.1.3.3 Controlling waste feed quality on the incinerator site, and
4.1.3.4 Checking, sampling and testing incoming wastes, and
4.1.3.5 Detectors for radioactive materials.

[5] the storage of wastes according to a risk assessment of their properties, such that the risk of potentially polluting releases is minimised. In general it is BAT to store waste in areas that have sealed and resistant surfaces, with controlled and separated drainage, as described in 4.1.4.1.

(d) the bunker will have an adequate storage capacity to handle incoming waste in peak periods and to mix waste in the bunker

(e) prior to discharge into the bunker the waste will be categorised at the weighbridge either electronically or manually (section 4.1.4.6 in the BREF document)

(f) part of the combustion air will be taken from the waste bunker, which reduces odour from the waste bunker (section 4.1.4.4 in the BREF document)

(g) part of the secondary air will be taken from the bottom ash extraction area to reduce spreading of components from the bottom ash (section 4.1.4.4 in the BREF document)

(h) drainage from potential areas of contamination (storage/loading/transportation) will be clearly marked (eg colour coded)

(i) a fire resisting wall will be provided between the bunker and the furnace hall. Furthermore, a fire extingusting system comprising fire detection and control systems will be implemented in the bunker (section 4.1.4.7 in the BREF document)

5.1.8. It should be noted that no drainage system is provided in the bunker. The reason for this is that the waste will absorb any water in the bunker. When the waste is incinerated, the water will be released as water vapour in the boiler. Any contamination in the water will thus be caught in the flue gas cleaning system. The implementation of a water drainage system in the bunker will result in considerable additional costs for water treatment, and monitoring will apply without any real environmental benefit. Taking costs and environmental advantages into consideration, a permanent bunker drainage system is deselected.

5.1.9. The average storage time in the bunker will not under normal conditions exceed ten days in order to generally reduce the processing difficulties that may arise **(BAT6)**[6]. So far as it is practicable, waste deliveries will be controlled and managed by communicating with waste suppliers, etc.

5.1.10. The main volume of atmospheric air for the primary combustion will be extracted from the waste bunker and reception hall resulting in a negative pressure in these areas, preventing odour and dust from leaving the waste reception area and creating dust and odour nuisances in the surrounding areas**(BAT7)**[7]. During normal maintenance only one of the two combustion lines will be out of operation leaving the other alternative line fully operational to control the dust and odour by creating the negative pressure in the reception hall and waste bunker

5.1.11. In addition waste storage overload will be avoided through detailed planning of maintenance and communication with waste suppliers, etc.

5.1.12. The Facility will receive non-hazardous waste, mainly mixed municipal waste, and thus segregation techniques will not be routinely applied, as the waste can be mixed in the bunker **(BAT8)**[8]**.** The waste bunker will be equipped with a schredder for reduction of the bulky waste items. Furthermore, it will be possible to remove rejected waste from the bunker using one of the unloading bays.

5.1.13. When the waste arrives at the Facility, it will be catalogued electronically at the weighbridge. The cataloguing takes place either automatically by chip or magnetic card for waste trucks bringing

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[6] to use techniques and procedures to restrict and manage waste storage times, as described in 4.1.4.2, in order to generally reduce the risk of releases from storage of waste/container deterioration, and of processing difficulties that may arise. In general it is BAT to:
- prevent the volumes of wastes stored from becoming too large for the storage provided
- in so far as is practicable, control and manage deliveries by communication with waste suppliers, etc.

[7] to minimise the release of odour (and other potential fugitive releases) from bulk waste storage areas (including tanks and bunkers, but excluding small volume wastes stored in containers) and waste pretreatment areas by passing the extracted atmosphere to the incinerator for combustion (see 4.1.4.4).
In addition it is also considered to be BAT to make provision for the control of odour (and other potential fugitive releases) when the incinerator is not available (e.g. during maintenance) by

a. avoiding waste storage overload, and/or
b. extracting the relevant atmospere via an alternative odour control system

[8] the segregation of the storage of wastes according to a risk assessment of their chemical and physical characteristics to allow safe storage and processing, as described in 4.1.4.5

only a specific sort of waste, eg household waste. If no chip or magnetic card system is in place, the driver will be required to enter a waste catalogue number at the weighbridge **(BAT9)**[9].

5.1.14. The Facility will be equipped with a fire extinguishing system as described in 4.1.4.7 in the BREF document **(BAT10)**[10]**.** The system comprises:

(a) Water canons/sprinkler system in the waste bunker. The system can be operated from the control room.

(b) Manual or automatic fire extinguishing system near the furnace loading area, electrical rooms and in the flue gas cleaning area.

(c) Automatic fire detection and warning systems.

5.1.15. The fire detection and control system implemented will meet the requirements of the Chief Fire Officer of Dublin in order to obtain the Fire Safety Certificate.

5.1.16. The waste bunker will as a minimum have a capacity equivalent to one week's normal throughput of waste and thus be sufficiently large to ensure proper mixing of the waste **(BAT11)**[11].

5.1.17. The bottom ash will be transported off site for pre-treatment prior to end use. As far as practicably and economically viable, ferrous and non-ferrous recyclable metals will be recovered from the bottom ash residues at a location off-site holding the required licences and approvals **(BAT12)**[12].

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[9] the clear labelling of wastes that are stored in containers such that they may continually be identified, as described in 4.1.4.6.

[10] the development of a plan for the prevention, detection and control (described in 4.1.4.7) of fire hazards at the installation, in particular for:
- waste storage and pretreatment areas
- furnace loading areas
- electrical control systems
- bag house filters and static bed filters.

It is generally BAT for the plan implemented to include the use of:
a. automatic fire detection and warning systems, and
b. the use of either a manual or automatic fire intervention and control system, as required according to the risk assessment carried out.

[11] the mixing (eg using bunker crane mixing) or further pretreatment (eg the blending of some liquid and pasty wastes, or the shredding of some solid wastes) of heterogeneous wastes to the degree required to meet the design specifications of the receiving installation (4.1.5.1). When considering the degree of use of mixing/pretreatment it is of particular importance to consider the cross-media effects (eg energy consumption, noise, odour or other releases) of the more extensive pretreatments (eg shredding). Pretreatment is most likely to be a requirement where the installation has been designed for a narrow specification, homogeneous waste.

[12] the use of the techniques described in 4.1.5.5 or 4.6.4 to, as far as practicably and economically viable, remove ferrous and non-ferrous recyclable metals for their recovery either:
a. after incineration from the bottom ash residues, or
b. where the waste is shredded (eg when used for certain combustion systems)
c. from the shredded wastes before the incineration stage

Figure A5.2 From Elsam Odense WtE – Bottom ash with a gravel-like structure

5.1.18. Operators will be able to monitor waste storage areas and loading areas, directly or using television screens or similar **(BAT13)**[13].

5.1.19. The waste feed hoppers will be kept filled with solid waste in order to reduce air ingress into the combustion chamber during loading **(BAT14)**[14].

5.1.20. Computerised Fluid Dynamics (CFD) simulations will be performed of the boiler in order to **(BAT15)**[15]:

(a) optimise furnace and boiler geometry so as to improve combustion performance

(b) optimise combustion air injection so as to improve combustion performance

(c) optimise reagent injection points of the SNCR system so as to improve the efficiency of NO_x abatement whilst minimising the generation of nitrous oxide, ammonia and the consumption of reagent

5.1.21. In strategic areas, the Facility will be equipped with the latest technique such as eg Inconel cladding and online cleaning in order to obtain/achieve maintenance intervals in excess of the standard 12-month maintenance interval **(BAT16)**[16] thus reducing the number of start-ups and shutdowns over the lifetime of the Facility.

5.1.22. 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 **(BAT17**[17] **& Bat 18**[18]**)**.

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13 the provision of operators with a means to visually monitor, directly or using television screens or similar, waste storage and loading areas, as described in 4.1.6.1

14 the minimisation of the uncontrolled ingress of air into the combustion chamber via waste loading or other routes, as described in 4.1.6.4

15 the use of flow modelling which may assist in providing information for new plants or existing plants where concerns exist regarding the combustion or FGT performance (as described in 4.2.2), and to provide information in order to:

a. optimise furnace and boiler geometry so as to improve combustion performance, and
b. optimise combustion air injection so as to improve combustion performance, and
c. where SNCR or SCR is used, to optimise reagent injection points so as to improve the efficiency of NO_x abatement whilst minimising the generation of nitrous oxide, ammonia and the consumption of reagent (see general sections on SCR and SNCR in 4.4.4.1 and 4.4.4.2).

16 in order to reduce overall emissions, to adopt operational regimes and implement procedures (eg continuous rather than batch operation, preventative maintenance systems) in order to minimise as far as practicable planned and unplanned shutdown and start-up operations, as described in 4.2.5

17 the identification of a combustion control philosophy, and the use of key combustion criteria and a combustion control system to monitor and maintain these criteria within appropriate boundary conditions, in order to maintain effective combustion performance, as described in 4.2.6. Techniques to consider for combustion control may include the use of infrared cameras (see 4.2.7), or others such as ultra-sound measurement or differential temperature control.

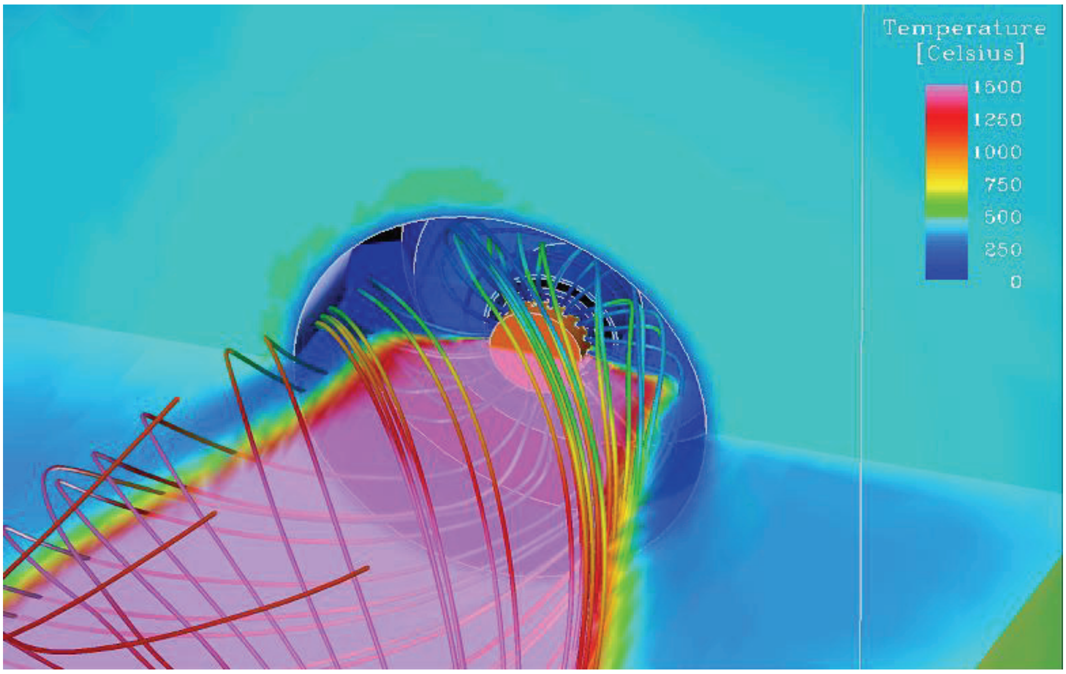
18 The optimisation and control of combustion conditions by a combination of:

5.1.23. The Facility will be operated as specified in Article 6 of Directive 2000/76/EC or as subsequently amended by future legislation. During detailed design it will be evaluated, if other operating conditions can provide for a similar or better level of overall environmental performance **(BAT19)**[19].

5.1.24. In conditions where it may lead to improved performance, the primary combustion air will be preheated using heat recovered within the installation **(BAT20)**[20].

5.1.25. Auxiliary burner(s) for start-up and shutdown and for maintaining the required operational combustion temperatures (according to the waste concerned) will be implemented and operated at all times when unburned waste is in the combustion chamber, if necessary in order to reach the required operational combustion temperatures **(BAT21)**[21].

Figure A5.3 ***Elsam CFD simulation of an auxiliary burner for a waste to energy facility***



5.1.26. The boiler will be equipped with water-cooled panel walls in the grate furnaces and the secondary combustion chambers. The boiler will further be equipped with adequate internal/external insulation that, according to the NCV and corrosiveness of the waste incinerated, provides for **(BAT22)**[22]:

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a. the control of air (oxygen) supply, distribution and temperature, including gas and oxidant mixing
b. the control of combustion temperature level and distribution, and
c. the control of raw gas residence time.

Appropriate techniques for securing these objectives are described in:
4.2.8 Optimisation of air supply stoichiometry
4.2.9 Primary air supply optimisation and distribution
4.2.11 Secondary air injection, optimisation and distribution
4.2.19 Optimisation of time, temperature, turbulence of gases in the combustion zone, and oxygen concentrations
4.2.4 Design to increase turbulence in the secondary combustion chamber

[19] in general it is BAT to use those operating conditions (ie temperatures, residence times and turbulence) as specified in Article 6 of Directive 2000/76/EC. The use of operating conditions in excess of those that are required for efficient destruction of the waste should generally be avoided. The use of other operating conditions may also be BAT – if they provide for a similar or better level of overall environmental performance. For example, where the use of operational temperatures below 1100 °C (as specified for certain hazardous waste in 2000/76/EC) has been demonstrated to provide for a similar or better level of overall environmental performance, the use of such lower temperatures is considered to be BAT.

[20] the preheating of primary combustion air for low calorific value wastes, by using heat recovered within the installation, in conditions where this may lead to improved combustion performance (eg where LCV/high moisture wastes are burned) as described in 4.2.10. In general this technique is not applicable to hazardous waste incinerators.

[21] the use of auxiliary burner(s) for start-up and shutdown and for maintaining the required operational combustion temperatures (according to the waste concerned) at all times when unburned waste is in the combustion chamber, as described in 4.2.20

[22] the use of a combination of heat removal close to the furnace (eg the use of water walls in grate furnaces and/or secondary combustion chambers) and furnace insulation (eg refractory areas or other lined furnace walls) that, according to the NCV and corrosiveness of the waste incinerated, provides for:

(a) adequate heat retention in the furnace

(b) additional heat to be transferred for energy recovery

5.1.27. It is proposed that the individual capacity of the boilers for the Dublin Waste to Energy facility be as large as possible. One of the benefits of a large boiler capacity is that it is better suited to handle variations in waste composition, eg one tonne of plastic fed to a 32 tonne/hour boiler does not cause the same disturbance as one tonne of plastic would in a 4 tonne/hour boiler. This results in a near complete combustion reactions approaching completion and result in low and stable CO and VOC emissions **(BAT23).**[23]

5.1.28. Gasification or pyrolysis will not be used for the Dublin Waste to Energy project. BAT recommendation 24 is thus not relevant.

5.1.29. The boiler will be equipped with three empty vertical passes and one horizontal convection pass. This will limit operational problems that may be caused by high-temperature sticky fly ashes, as the boiler design allows gas temperatures to fall to a suitable level before the convective heat exchange bundles **(BAT25)**[25].

5.1.30. The Facility has been designed and optimised to achieve a very high overall energy efficiency and energy recovery, taking into account the techno-economic feasibility and the availability of users for the energy recovered**.** Due to the present limited number of users of district heating in the Dublin area, the Facility is designed to optimise the power output. The design thus results in a net power output of close to 58 MW equivalent to a net power efficiency of approximately 28% **(BAT26)**[26].

5.1.31. The boiler, which will transfer the flue gas energy to the production of steam, will have a thermal conversion efficiency of at least 80%.

5.1.32. As the Facility is not expected to supply district heating in the initial years of operation, BAT recommendation 27 is of limited relevance. Should a district heating scheme come into place, BAT27 will be considered.

5.1.33. 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 **(BAT28)**[28].

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a. adequate heat retention in the furnace (low NCV wastes require higher retention of heat in the furnace)
b. additional heat to be transferred for energy recovery (higher NCV wastes may allow/require heat removal from earlier furnace stages)

The conditions under which the various techniques may be applicable are described in 4.2.22 and 4.3.12.

[23] the use of furnace (including secondary combustion chambers, etc.) dimensions that are large enough to provide for an effective combination of gas residence time and temperature such that combustion reactions may approach completion and result in low and stable CO and VOC emissions, as described in 4.2.23.

[25] in order to avoid operational problems that may be caused by higher temperature sticky fly ashes, to use a boiler design that allows gas temperatures to reduce sufficiently before the convective heat exchange bundles (eg the provision of sufficient empty passes within the furnace/boiler and/or water walls or other techniques that aid cooling), as described in 4.2.23 and 4.3.11. The actual temperature above which fouling is significant is waste type and boiler steam parameter dependent. In general for MSW it is usually 600-750 ºC, lower for HW and higher for SS. Radiative heat exchangers, such as platen type superheaters, may be used at higher flue-gas temperatures than other designs (see 4.3.14).

[26] the overall optimisation of installation energy efficiency and energy recovery, taking into account the techno-economic feasibility (with particular reference to the high corrosivity of the flue gases that results from the incineration of many wastes eg chlorinated wastes), and the availability of users for the energy so recovered, as described in 4.3.1, and in general:

a. to reduce energy losses with flue gases, using a combination of the techniques described in 4.3.2 and 4.3.5
b. the use of a boiler to transfer the flue gas energy for the production of electricity and/or supply of steam/heat with a thermal conversion efficiency of:
   i. for mixed municipal wastes at least 80% (ref. Table 3.46)
   ii. for pretreated municipal wastes (or similar waste) treated in fluidised bed furnaces, 80 to 90%
   iii. for hazardous wastes giving rise to increased boiler corrosion risks (typically from chlorine/sulphur content), above 60 to 70%
   iv. for other wastes, conversion efficiency should generally be increased in the range 60 to 90%
c. for gasification and pyrolysis processes that are combined with a subsequent combustion stage, the use of a boiler with a thermal conversion efficiency of at least 80%, or the use of a gas engine or other electrical generation technology.

[28] the location of new installations so that the use of the heat and/or steam generated in the boiler can be maximised through any combination of:

a. electricity generation with heat or steam supply for use (ie use CHP)
b. the supply of heat or steam for use in district heating distribution networks

The Facility will thus be 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.

5.1.34. The optimum steam parameters for the Dublin Waste to Energy facility of approximately 45 bar/400 °C were selected based on the additional maintenance cost of higher steam parameters compared to the limited value of the additional electricity produced due to the relatively modest power prices in Ireland **(BAT29).**[29] To reduce corrosion, part of the boiler will be protected against corrosion by means of nickel/chromium alloy cladding.

Figure A5.4 Nickel/chromium alloy clad test tubes

5.1.35. The turbine design was selected in order to optimise the power output and thus the electricity supply regime, as no heat supply regime is in place at present **(BAT30).**[30]

5.1.36. The condenser pressure is minimised using cooling water from River Liffey, thus securing a higher electrical efficiency compared to that obtained with air-cooled condensers and/or wet cooling towers **(BAT31)**[31]

5.1.37. The in-house energy demand has been reduced to the widest possible extent taking into consideration the costs and advantages of each design point **(BAT32).**[32] The following design selections are particularly important in this respect:

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c. the supply of process steam for various, mainly industrial, uses (see examples in 4.3.18)
d. the supply of heat or steam for use as the driving force for cooling/air conditioning systems

Selection of a location for a new installation is a complex process involving many local factors (eg waste transport, availability of energy users, etc) which are addressed by the IPPC Directive, Article 9(4). The generation of electricity only may provide the most energy efficient option for the recovery of the energy from the waste in specific cases where local factors prevent heat/steam recovery.

[29] in cases where electricity is generated, the optimisation of steam parameters (subject to user requirements for any heat and steam produced), including consideration of (see 4.3.8):
e. the use of higher steam parameters to increase electrical generation, and
f. the protection of boiler materials using suitably resistant materials (eg cladding or special boiler tube materials)

The optimal parameters for an individual installation are highly dependent upon the corrosivity of the flue gases and hence upon the waste composition.

[30] the selection of a turbine suited to:
a. the electricity and heat supply regime, as described in 4.3.7
b. high electrical efficiency

[31] at new or upgraded installations, where electricity generation is the priority over heat supply, the minimisation of condenser pressure, as described in 4.3.9

[32] the general minimisation of overall installation energy demand, including consideration of the following (see 4.3.6):
a. for the performance level required, the selection of techniques with lower overall energy demand in preference to those with higher energy demand

(a) The flue gas treatment systems are designed and will be ordered in such a way that flue gas reheating is avoided.

(b) The SNCR system is used as an alternative to the more energy-consuming SCR technique.

(c) The use of primary fuels is limited to the consumption of the auxiliary burners.

5.1.38. The possible cooling methods available are:

(a) Convection water cooling using water from River Liffey (BREF 4.3.10.1)

(b) Evaporation water cooling (large concrete towers of up to 100 meters high) (BREF 4.3.10.2)

(c) Air-cooled condensers (BREF 4.3.10.3)

5.1.39. Considering the cross-media impacts of the possible cooling options, convection water cooling using water from River Liffey is selected **(BAT33).**[33]

5.1.40. 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) That 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 increases.

(c) That 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) That the visual impact of convection water cooling is significantly smaller than the visual impact of the two other options.

5.1.41. The boiler will be cleaned using a combination of online and offline boiler cleaning techniques to reduce dust residence and accumulation in the boiler. The systems to be applied comprise **(BAT34)**[34]:

(a) Mechanical rapping (online)

(b) High or low-pressure water spraying (online)

(c) Periodic manual cleaning (offline)

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b. wherever possible, ordering flue gas treatment systems in such a way that flue gas reheating is avoided (ie those with the highest operational temperature before those with lower operational temperatures)
c. where SCR is used;
   i. to use heat exchangers to heat the SCR inlet flue gas with the flue gas energy at the SCR outlet
   ii. to generally select the SCR system that, for the performance level required (including availability/fouling and reduction efficiency), has the lowest operating temperature
d. where flue gas reheating is necessary, the use of heat exchange systems to minimise flue gas reheating energy demand
e. avoiding the use of primary fuels by using self produced energy in preference to imported sources

[33] 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 4.3.10

[34] the use of a combination of online and offline boiler cleaning techniques to reduce dust residence and accumulation in the boiler, as described in 4.3.19

Figure A5.5 Mechanical rapping device at Elsam's Odense Waste to Energy Facility

5.1.42. Under normal operating conditions, the Facility is generally expected to observe the operational emission levels listed in Table 5.2 of the BREF document for releases to air associated with the use of **(BAT35)**[35]. In this respect the following wording of the preface and the introduction to the BAT chapter in the BREF document should be kept in mind.

(a) "Where emission or consumption levels "associated with best available techniques" are presented, this is to be understood as meaning that those levels represent the environmental performance that could be anticipated as a result of the application, in this sector, of the techniques described, bearing in mind the balance of costs and advantages inherent within the definition of BAT. However, they are neither emission nor consumption limit values and should not be understood as such" and

(b) Note no. 1 to Table 5.2 "The ranges given in this table are the levels of operational performance that may generally be expected as a result of the application of BAT – they are not legally binding emission limit values (ELVs)."

5.1.43. The following (non-exhaustive) list of general factors required will be considered when selecting the flue gas treatment (FGT) systems **(BAT36)**[36]:

(a) type of waste, its composition and variation

(b) type of combustion process, and its size

(c) flue gas flow and temperature

(d) flue gas content, size and rate of fluctuations in composition

(e) target emission limit values

(f) restrictions on discharge of aqueous effluents

[35] the use of an overall flue gas treatment (FGT) system that, when combined with the installation as a whole, generally provides for the operational emission levels listed in Table 5.2 for releases to air associated with the use of BAT.

[36] when selecting the overall FGT system, to take into account:
a. the general factors described in 4.4.1.1 and 4.4.1.3
b. the potential impacts on energy consumption of the installation, as described in section 4.4.1.2
c. the additional overall system compatibility issues that may arise when retrofitting existing installations (see 4.4.1.4)

(g) plume visibility requirements

(h) land and space availability

(i) availability and cost of outlets for residues accumulated/recovered

(j) availability and cost of water and other reagents

(k) energy supply possibilities (eg supply of heat from condensing scrubbers)

(l) availability of subsidies for exported energy

(m) tolerable disposal charge for the incoming waste (both market and political factors exist)

(n) reduction of emissions by primary methods

(o) release of noise

(p) arrange different flue gas cleaning devices with decreasing flue gas temperatures from boiler to stack, if possible.

5.1.44. The design of the FGT system utilises a combination of a semi-dry and a two-stage wet system thus utilising the benefits of each system while reducing the disadvantages. In selecting the FGT system for the Facility, the (non-exhaustive) general selection criteria provided in Table 5.3 of the BREF document have been taken into account **(BAT37)**[37].

5.1.45. In the semi-dry system, with prior injection of lime and activated carbon, the emissions of dust, HCl, HF, SO_2, NO_x, heavy metals, dioxins and furans are reduced. The two-stage wet scrubber system implemented subsequent to the semi-dry system, ensures very low emissions to air of HCl, HF, SO_2, NH_3/NH_4OH, and mercury in gas form (Hg).

5.1.46. The wastewater from the scrubber will be injected into the boiler before the FGT system. This makes it possible to have a system, which does not provide the usual discharge of effluent from the FGT system, but which has the benefits of the wet systems in terms of very low emissions to air of HCl, HF, SO_2, NH_3/NH_4OH, and mercury in gas form (Hg).

5.1.47. The HCl, HF, SO_2, NH_3/NH_4OH, and mercury in gas form (Hg) absorbed by the wet scrubber is returned to the process before the semi-dry system. The final ultimate removal of these components from the process is thus performed by the semi-dry system.

5.1.48. The main benefits of the selected system are:

(a) The absorption of NH_3/NH_4OH in the wet scrubber enables the SNCR system to be operated with a substantial reagent dosage without producing NH_3 emissions to the atmosphere in excess of the emission level associated with best available techniques. This is particularly useful in the event of momentary high raw gas NO_x values, which can then be reduced considerably by the SNCR system, without resulting in significant NH_3 emissions to the atmosphere.

(b) The combination of semi-dry and wet scrubber systems produces less FGT residues than a stand-alone semi-dry system.

(c) The wet scrubber system is particularly efficient in connection with absorption of variations in the emission concentration.

(d) The system does not provide the usual discharge of effluent from the FGT system.

(e) The energy consumption of the system is low compared to the emission levels provided.

[37] when selecting between wet,semi-wet and dry FGT systems, to take into account the (non-exhaustive) general selection criteria given as an example in Table 5.3

5.1.49. To prevent the associated increased electrical consumption of two fabric filters in one FGT line, only one fabric filter is implemented in each of the FGT lines **(BAT38)**[38].

5.1.50. The FGT reagent consumption will be reduced and thus the FGT residue minimised by means of **(BAT39)**[39]:

(a) adjustment and control of the quantity of reagent(s) injected in order to meet the requirements for treatment of the flue gas such that the target final operational emission levels are met

(b) re-circulation of a proportion of the FGT residues collected, as described in 4.4.3.7

5.1.51. In addition to the secondary NO_x reduction of the SNCR system, the following primary (combustion related) NO_x reducing measures will be implemented **(BAT40)**[40]:

(a) CFD simulation of the grate and furnace section to optimise the injection of combustion air.

(b) 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 NO_x created.

(c) Operation with reduced excess air, reducing NO_x formation.

(d) The use of water-cooled grate bars to enable primary air to be added independent of the cooling need of the grate bars.

5.1.52. The reduction of overall PCDD/F emissions to all environmental media will be provided by means of **(BAT41)**[41]:

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[38] 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 (as described in 4.4.2.2 and 4.4.2.3)

[39] the reduction of FGT reagent consumption and of FGT residue production in dry, semi-wet, and intermediate FGT systems by a suitable combination of:

a. adjustment and control of the quantity of reagent(s) injected in order to meet the requirements for the treatment of the flue gas such that the target final operational emission levels are met
b. the use of the signal generated from fast response upstream and/or downstream monitors of raw HCl and/or SO2 levels (or other parameters that may prove useful for this purpose) for the optimisation of FGT reagent dosing rates, as described in 4.4.3.9
c. the re-circulation of a proportion of the FGT residues collected, as described in 4.4.3.7

The applicability and degree of use of the above techniques that represent BAT will vary according to, in particular: the waste characteristics and consequential flue gas nature, the final emission level required, and technical experience from their practical use at the installation.

[40] the use of primary (combustion related) NO_x reduction measures to reduce NO_x production, together with either SCR (4.4.4.1) or SNCR (4.4.4.2), according to the efficiency of flue gas reduction required. In general SCR is considered BAT where higher NO_x reduction efficiencies are required (ie raw flue gas NO_x levels are high) and where low final flue gas emission concentrations of NO_x are desired.
One MS reported that technical difficulties have been experienced in some cases when retrofitting SNCR abatement systems to existing small MSW incineration installations, and that the cost effectiveness (ie NO_x reduction per unit cost) of NO_x abatement (eg SNCR) is lower at small MSWIs (ie those MSWIs of a capacity <6 tonnes of waste/hour).

[41] for the reduction of overall PCDD/F emissions to all environmental media, the use of:

a. techniques for improving knowledge of and control of the waste, including in particular its combustion characteristics, using a suitable selection of techniques described in 4.1, and
b. primary (combustion related) techniques (summarised in 4.4.5.1) to destroy PCDD/F in the waste and possible PCDD/F precursors, and
c. the use of installation designs and operational controls that avoid those conditions (see 4.4.5.2) that may give rise to PCDD/F reformation or generation, in particular to avoid the abatement of dust in the temperature range of 250-400 °C. Some additional reduction of de-novo synthesis is reported
d. where the dust abatement operational temperature has been further lowered from 250 to below 200 °C, and
e. the use of a suitable combination of one or more of the following additional PCDD/F abatement measures:
    i. adsorption by the injection of activated carbon or other reagents at a suitable reagent dose rate, with bag filtration, as described in 4.4.5.6, or
    ii. adsorption using fixed beds with a suitable adsorbent replenishment rate, as described in 4.4.5.7, or
    iii. multi-layer SCR, adequately sized to provide for PCDD/F control, as described in 4.4.5.3, or
    iv. the use of catalytic bag filters (but only where other provision is made for effective metallic and elemental Hg control), as described in 4.4.5.4

(a) Well-controlled combustion secured by means of CFD simulation (BAT15) at the design stage, and an advanced combustion control system (BAT17&18) to aid the reduction of PCDD/F and its precursors.

(b) During normal operation, the temperature in the three empty passes of the boiler will be above 600 °C. 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 450 to 200 °C, in which zone PCDD/F is likely to reform (the de-novo synthesis).

(c) Adsorption by injection of activated carbon or other reagents at a suitable reagent dose rate, with bag filtration.

5.1.53. The glass fibre structure of the two-stage wet scrubber may absorb PCDD/F if exposed to: PCDD/F. The absorbed PCDD/F may then subsequently be released, causing an increased PCDD/F emission. This is known as the “memory effect”. The memory effect mainly occurs if the injection of activated carbon for some reason fails during combustion of waste. In order to prevent the build-up of any memory effect, flow monitoring of the activated carbon dosage will be implemented in the overall SCADA system **(BAT42)**[42].

5.1.54. Re-burning of FGT residues is not applied for the Dublin Waste to Energy project. BAT recommendation 43 is thus not relevant.

5.1.55. The use of low pH in the first stage of the wet scrubber reduces the amount of gas form HG in the flue gas. In addition, the activated carbon injected before the fabric filter will reduce the emission of particle bound Hg (**BAT44[44] + BAT45[45])**.

5.1.56. A rainwater collection system will be implemented. From this system, rainwater will be led to a technical water tank. From this tank the water will be used within the process, eg in the bottom ash extraction system and the flue gas cleaning system **(BAT46)**[46].

5.1.57. Separate systems will be implemented for drainage, treatment and discharge of rainwater that falls on the Site, including roof water, so that it does not mix with potentially or actually contaminated wastewater streams **(BAT47)**[47].

5.1.58. Wet scrubber effluent will be re-circulated within the scrubber system, and the electrical conductivity (mS/cm) of the re-circulated water will be used as a control measure, so as to reduce scrubber water consumption by replacing scrubber feed water **(BAT48)**[48].

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42 where wet scrubbers are used, to carry out an assessment of PCDD/F build up (memory effects) in the scrubber and adopt suitable measures to deal with this build-up and prevent scrubber breakthrough releases. Particular consideration should be given to the possibility of memory effects during shut-down and start-up periods.

44 for the control of Hg emissions where wet scrubbers are applied as the only or main effective means of total Hg emission control:
a. the use of a low pH first stage with the addition of specific reagents for ionic Hg removal (as described in 4.4.6.1, 4.4.6.6 and 4.4.6.5), in combination with the following additional measures for the abatement of metallic (elemental) Hg, as required in order to reduce final air emissions to within the BAT emission ranges given for total Hg
b. activated carbon injection, as described in 4.4.6.2, or
c. activated carbon or coke filters, as described in 4.4.6.7

45 for the control of Hg emissions where semi-wet and dry FGT systems are applied, the use of activated carbon or other effective adsorptive reagents for the adsorption of PCDD/F and Hg, as described in 4.4.6.2, with the reagent dose rate controlled so that final air emissions are within the BAT emission ranges given for Hg

46 the general optimisation of the re-circulation and re-use of wastewater arising on the site within the installation, as described in 4.5.8, including for example, if of sufficient quality, the use of boiler drain water as a water supply for the wet scrubber in order to reduce scrubber water consumption by replacing scrubber feed-water (see 4.5.6)

47 the use of separate systems for the drainage, treatment and discharge of rainwater that falls on the site, including roof water, so that it does not mix with potentially or actually contaminated wastewater streams, as described in 4.5.9. Some such wastewater streams may require only little or no treatment prior to their discharge, depending on contamination risk and local discharge factors

48 where wet flue-gas treatment is used:
a. the use of on-site physico/chemical treatment of the scrubber effluents prior to their discharge from the site, as described in 4.5.11, and thereby to achieve, at the point of discharge from the effluent treatment plant (ETP), emission levels generally within the operational emission level ranges associated with BAT that are identified in Table 5.4
b. the separate treatment of the acid and alkaline wastewater streams arising from the scrubber stages, as described in 4.5.13, when there are particular drivers for the additional reduction of releases to water that result, and/or where HCl and/or gypsum recovery is to be carried out

5.1.59. Sections of BAT 48 are not applicable, as the Facility will not release wastewater from the FGT system or produce gypsum. Thus a traditional wastewater treatment system for FGT wastewater will not be implemented.

5.1.60. It should be noted that no sulphide (eg M-trimercaptotriazine) or ammonia stripping is implemented, as the costs of this particular facility are considerable compared to the advantages obtained.

5.1.61. The TOC value in the bottom ash will be below 3 wt %. The TOC value will typically be between 1 and 2 wt %, which will be ensured by **(BAT49)**[49]:

(a) a combination of furnace design, furnace operation and waste throughput rate that provides sufficient agitation and residence time of the waste in the furnace at sufficiently high temperatures, including any ash burn-out areas

(b) applying furnace designs that, as far as possible, physically retain the waste within the combustion chamber (eg narrow grate bar spacings).

(c) using techniques for mixing and pre-treatment of the waste, as described under BAT 11 above.

(d) optimising and controlling combustion conditions, including air (oxygen) supply and distribution, as described in BATS 17+18 above.

5.1.62. The Facility will be designed and erected with the possibility to discharge boiler ash from the 2nd, 3rd and 4th pass to either the bottom ash system or the FGT system. Depending on the composition of waste in the Dublin area, the boiler ash may prove to be either non-hazardous or hazardous in nature. During the initial operation of the Facility the boiler ash will be mixed with the APC residues until the levels of contaminants in the boiler ash have been established. Based on sampling of the boiler ash it will be assessed whether separation or mixing with bottom ash is appropriate **(BAT50)**[50].

5.1.63. If the boiler ash proves to be suitable for mixing with the bottom ash this will reduce the amount of hazardous FGT residue (as this will not contain boiler ash).

5.1.64. It should be noted that no pre-dusting stage for boiler ash will be implemented in the design, as a considerable part of the boiler ash will be collected in the 2nd, 3rd and 4th passes. If this boiler ash proves to be suitable for mixing with bottom ash, it will be separated from the APC residue.

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c. the re-circulation of wet scrubber effluent within the scrubber system, and the use of the electrical conductivity (mS/cm) of the re-circulated water as a control measure, so as to reduce scrubber water consumption by replacing scrubber feed-water, as described in 4.5.4
d. the provision of storage/buffering capacity for scrubber effluents, to provide for a more stable wastewater treatment process, as described in 4.5.10
e. the use of sulphides (eg M-trimercaptotriazine) or other Hg binders to reduce Hg (and other heavy metals) in the final effluent, as described in 4.5.11
f. when SNCR is used with wet scrubbing the ammonia levels in the effluent discharge may be reduced using ammonia stripping, as described in 4.5.12, and the recovered ammonia re-circulated for use as a NO_x reduction reagent

49 the use of a suitable combination of the techniques and principles described in 4.6.1 for improving waste burnout to the extent that is required so as to achieve a TOC value in the ash residues of below 3 wt % and typically between 1 and 2 wt %, including in particular:
a. the use of a combination of furnace design (see combustion technology selection in 4.2.1), furnace operation (see 4.2.17) and waste throughput rate (see 4.2.18) that provides sufficient agitation and residence time of the waste in the furnace at sufficiently high temperatures, including any ash burn-out areas
b. the use of furnace designs that, as far as possible, physically retain the waste within the combustion chamber (eg narrow grate bar spacings for grates, rotary or static kilns for appreciably liquid wastes) to allow its combustion. The return of early grate riddlings to the combustion chamber for re-burn may provide a means to improve overall burnout where they contribute significantly to the deterioration of burnout (see 4.2.21)
c. the use of techniques for mixing and pretreatment of the waste, as described in BAT 11, according to the type(s) of waste received at the installation
d. the optimisation and control of combustion conditions, including air (oxygen) supply and distribution, as described in BAT 18

50 the separate management of bottom ash from fly ash and other FGT residues, so as to avoid contamination of the bottom ash and thereby improve the potential for bottom ash recovery, as described in 4.6.2. Boiler ash may exhibit similar or very different levels of contamination to that seen in bottom ash (according to local operational, design and waste specific factors) – it is therefore also BAT to assess the levels of contaminants in the boiler ash, and to assess whether separation or mixing with bottom ash is appropriate. It is BAT to assess each separate solid waste stream that arises for its potential for recovery either alone or in combination.

However, if the bottom ash is hazardous, it will be mixed with the FGT residue, as it serves little purpose to separate them **(BAT51)**[51].

5.1.65. The ferrous and non-ferrous metals from bottom ash will, as far as practicably and economically viable, be separated from the bottom ash off-site **(BAT52)**[52].

5.1.66. To the extent required in order to meet the requirements for its use or the specifications of the receiving treatment or disposal site, bottom ash will be aged, screened and crushed off-site **(BAT53)**[53].

5.1.67. FGT residue will be treated off-site to the extent required in order to meet the acceptance criteria of the waste disposal option selected **(BAT54)**[54].

5.1.68. It should be noted that no additional treatment of the FGT residue, such as cement solidification, vitrification and melting, acid extraction and similar will be implemented, as this is not economically and technically viable, taking into consideration the costs involved and the advantages gained.

5.1.69. The following noise reduction measures will be implemented to meet local noise requirements **(BAT55)**[55]:

(a) The main entrance for waste trucks will be located close to the ramp to avoid unnecessary truck movements on the Site leading to increased noise emanating from the Site.

(b) Furthermore, 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 such as eg the residential Sandymount and Ringsend area.

(c) An enclosed waste reception hall significantly reduces the noise from unloading of waste.

(d) All process equipment is located inside the building.

(e) The Facility is designed with seawater cooling which provides lower noise emissions than for example air-cooled condensers and/or wet cooling towers.

5.1.70. The selected operator Elsam is aware of the benefits of having an efficient Environmental Management System. As such, the Elsam Group has obtained and maintains an ISO 14001 certificate for the Environmental Management Systems implemented within the Elsam Group.

5.1.71. Under the general Environmental Management System of Elsam the following facility-specific Environmental Management Programme will be implemented for the Facility **(BAT56)**[56] Traffic regulating measures

(a) Traffic regulating measures

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51 where a pre-dedusting stage (see 4.6.3 and 4.4.2.1) is in use, an assessment of the composition of the fly ash so collected should be carried out to assess whether it may be recovered, either directly or after treatment, rather than disposed of

52 the separation of remaining ferrous and non-ferrous metals from bottom ash (see 4.6.4), as far as practicably and economically viable, for their recovery

53 the treatment of bottom ash (either on or off site), by a suitable combination of:
a. dry bottom ash treatment with or without ageing, as described in 4.6.6 and 4.6.7, or
b. wet bottom ash treatment, with or without ageing, as described in 4.6.6 and 4.6.8, or
c. thermal treatment, as described in 4.6.9 (for separate treatment) and 4.6.10 (for in-process thermal treatment) or
d. screening and crushing (see 4.6.5)
to the extent that is required to meet the specifications set for its use or at the receiving treatment or disposal site eg to achieve a leaching level for metals and salts that is in compliance with the local environmental conditions at the place of use.

54 the treatment of FGT residues (on or off site) to the extent required to meet the acceptance requirements for the waste management option selected for them, including consideration of the use of the FGT residue treatment techniques described in 4.6.11

55 the implementation of noise reduction measures to meet local noise requirements
(techniques are described in 4.7 and 3.6)

56 apply environmental management. A number of environmental management techniques are determined as BAT. The scope (eg level of detail) and nature of the EMS (eg standardised or non-standardised) will generally be related to the nature, scale and complexity of the installation, and the range of environmental impacts it may have.
BAT is to implement and adhere to an Environmental Management System (EMS).

(b) Cleaning of roads

(c) Noise and vibrations

(d) Air emissions, including dust and odours

(e) Temporary lowering of groundwater table

(f) Dealing with disconnected installations

(g) Control of pollution to soil

(h) Control of pollution to surface water and groundwater

(i) Chemicals and dangerous substances

(j) Handling of solid waste

(k) Site Reinstatement Plan

5.1.72. The incoming waste for thermal treatment will be stored in the waste bunker, which will be made of reinforced concrete, thus having a sealed surface. No wastewater drainage system is provided within the waste bunker, as any liquids will be absorbed by the waste in the bunker. When the waste is combusted, the liquid from the bunker forms part of the thermal treatment process and the subsequent flue gas treatment. A wastewater collection system in the waste bunker will only collect a wastewater fraction, which will require specific treatment **(BAT57)**[57].

5.1.73. The bottom ash consisting of inert materials from the combustion process such as glass, metal, earth and other fractions is stored in a separate bottom ash bunker with sealed surfaces.

5.1.74. The FGT residues will be stored in one or more steel tanks designed for this specific purpose. The steel tanks have sealed surfaces.

5.1.75. Waste will not be stockpiled on the Site for later combustion outside the waste bunker. The waste bunker on Site will thus be prepared for such storage and the waste will be stored in such a manner that risks of odour, vermin, litter, fire and leaching are effectively controlled. **(BAT58)**[58].

5.1.76. The waste will be pre-treated in order to improve its homogeneity (ie its combustion characteristics and burn-out) to the extent to which it is beneficial for the combustion. This pre-treatment comprises **(BAT59)**[60]:

(a) mixing in the bunker

(b) shredding or crushing of bulky wastes, eg furniture, that are to be incinerated

5.1.77. The main combustion grate sections will be water cooled, which will allow for optimisation of primary air to the combustion without regard to the cooling requirements of these sections **(BAT60)**[61]**.**

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[57] the storage of all waste, (with the exception of wastes specifically prepared for storage or bulk items with low pollution potential eg furniture), on sealed surfaces with controlled drainage inside covered and walled buildings

[58] when waste is stockpiled (typically for later incineration) it should generally be baled (see 4.1.4.3) or otherwise prepared for such storage so that it may be stored in such a manner that risks of odour, vermin, litter, fire and leaching are effectively controlled.

[59] when waste is stockpiled (typically for later incineration) it should generally be baled (see 4.1.4.3) or otherwise prepared for such storage so that it may be stored in such a manner that risks of odour, vermin, litter, fire and leaching are effectively controlled.

[60] to pretreat the waste, in order to improve its homogeneity and therefore combustion characteristics and burnout, by:
a. mixing in the bunker (see 4.1.5.1), and
b. the use of shredding or crushing for bulky wastes eg furniture (see 4.1.5.2) that are to be incinerated,
to the extent that is beneficial according to the combustion system used. In general grates and rotary kilns (where used) require lower levels of pretreatment (eg waste mixing with bulky waste crushing) whereas fluidised bed systems require greater waste selection and pretreatment, usually including full shredding of the MSW.

[61] the use of a grate design that incorporates sufficient cooling of the grate such that it permits the variation of the primary air supply for the main purpose of combustion control, rather than for the cooling of the grate itself. Air-cooled grates with well-distributed air

5.1.78. The Site selected is in close proximity to a potential future district-heating scheme. The design of the Facility makes it possible for the Facility to export energy in the range of 1.9 MWh/tonne of waste once and if the district-heating scheme is fully developed **(BAT61)**[62].

5.1.79. The Facility will as an annual average generate in excess of 0.65 MWh electricity/tonne waste received **(BAT62)**[63]. The Facility has however been designed with built-in provisions for steam/district heating supply. If the steam/district heating option are implemented the electricity/tonne waste received will decrease slightly.

5.1.80. The installation electrical demand (excluding pre-treatment or residue treatment) will generally be below 0.15 MWh/tonne of waste processed as an annual average **(BAT63)** [64].

5.1.81. The Facility will have built in provisions for the combustion of sewage sludge from the Ringsend Waste Water Treatment Works. The Facility is not mainly dedicated to the incineration of sewage sludge, and thus BAT76 is not relevant.

5.1.82. The Facility will be designed and operated in such a way that additional combustion support fuels are not generally required for thermal treatment of sewage sludge (BAT77). This will be secured by means of feeding the sewage sludge into the waste feed hopper creating a proper mixture with the solid waste from the bunker.

5.1.83. The remaining BAT recommendations, BAT64-BAT82, do not apply to the Facility, as these recommendations apply to pre-treated or selected municipal waste incineration or hazardous waste incineration, sewage sludge incineration and clinical waste incineration.

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cooling flow are generally suitable for wastes of average NCV of up to approx 18 MJ/kg. Higher NCV wastes may require water (or other liquid) cooling in order to prevent the need for excessive primary air levels (ie levels that result in a greater air supply than the optimum for combustion control) to control grate temperature and length/position of fire on the grate (see section 4.2.14)

62 the location of new installations so that the use of CHP and/or the heat and/or steam utilisation can be maximised, so as to generally exceed an overall total energy export level of 1.9 MWh/tonne of MSW (ref. Table 3.42), based on an average NCV of 2.9 MWh/tonne (ref. Table 2.11)

63 in situations where less than 1.9 MWh/tonne of MSW (based on an average NCV of 2.9 MWh/tonne) can be exported, the greater of:
a. the generation of an annual average of 0.4-0.65 MWh electricity/tonne of MSW (based on an average NCV of 2.9 MWh/tonne (ref. Table 2.11) processed (ref. Table 3.40), with additional heat/steam supply as far as practicable in the local circumstances, or
b. the generation of at least the same amount of electricity from the waste as the annual average electricity demand of the entire installation, including (where used) on-site waste pretreatment and on-site residue treatment operations (ref. Table 3.48)

64 to reduce average installation electrical demand (excluding pretreatment or residue treatment) to be generally below 0.15 MWh/tonne of MSW processed (ref. Table 3.47 and section 4.3.6) based on an average NCV of 2.9 MWh/tonne of MSW (ref. Table 2.11)

65 to reduce average installation electrical demand (excluding pretreatment or residue treatment) to be generally below 0.15 MWh/tonne of MSW processed (ref. Table 3.47 and section 4.3.6) based on an average NCV of 2.9 MWh/tonne of MSW (ref. Table 2.11)