1 INTRODUCTION

This Environmental Impact Assessment (EIS) has been prepared to accompany an application to Meath County Council (MCC) for proposed amendments to an existing planning permission (File Reference Number SA/600050, & PL 17.219721) granted to Indaver Ireland (referred to as Indaver henceforth) for the development of a 70 MW waste-to-energy facility with a maximum annual capacity of 200,000 tonnes at Carranstown, Duleek, Co. Meath. The site location is shown on Figure 1.1.

Indaver Ireland submits this application for an amendment to the existing planning permission as a result of the detailed design developments which have emerged subsequent to the contract award to the main equipment suppliers. It should be noted that the proposed amendment does not seek to alter the annual tonnage currently permitted or the number of staff working at the facility. Because a development such as this must have secured planning permission prior to tendering for the plant in the market, Indaver had to allow a contingency in the building design in advance of the final suppliers being chosen. The allowance of such contingency has meant that, having selected and signed contracts with the suppliers, the building scale can now be reduced.

In terms of all buildings on site, the proposed amendments represent a reduction of approximately 7% in footprint when compared with the existing permission. A synopsis of the amendments proposed is presented in Section 1.1 below.

In February 2006 Indaver lodged a planning application and EIS with Meath County Council (MCC) for the development of the facility. MCC made the decision to grant planning permission on the 25th August 2006. An appeal to amend conditions of the planning decision with An Bord Pleanala (ABP) was submitted in September 2006 and ABP granted approval for the facility in October 2007.

The facility which will process the same quantities and types of material as previously proposed will be located on the same part of the site albeit with a reduced and re-configured building footprint in comparison to the existing permission. The site occupies an area of approximately 10 hectares (25 acres) which was previously used for agricultural purposes. Existing developments within the vicinity of the facility include a cement factory and quarry located to the north of the property. The area of the site for development will be approximately 2 hectares, with the remaining areas of the site to be utilised for landscaping to minimise the visual impact of the facility.

1.1 Proposed Amendments

The amendments to the main process building are discussed in more detail below but can be summarised as follows:

- Reduction in overall length of 45m approximately
- Changes to building widths
- Decrease in tipping hall height by 5m approx

- Increase in bunker roof height by 4m approx
- Increase of main process building height by 1m to incorporate a parapet wall
- Convert underground bottom ash bunker into an overground bottom ash storage and handling building
- Incorporation of turbine building into main process building.

As planning permission is required for these proposed amendments to the building, Indaver has also taken the opportunity to revise the following elements of the existing permission:

- Redesign of gatehouse and staff/visitor parking for increased safety
- Inclusion of an extra floor in office building to incorporate the education centre
- Incorporation of warehouse and workshop into main process building
- Addition of an external fire escape to office building
- Re-location and modification of the air-cooled condenser
- Re-location of pump house and fire water storage tank
- Re-location of 38kV import/export compound including transformer and associated substation building
- Re-location of fuel oil tank and addition of aqueous ammonia storage tank
- Conversion of underground attenuation tank into an attenuation pond
- Modifications to the internal road network to accommodate the above amendments.

1.1.1 Changes to Main Process Building

1.1.1.1 Reduction in building lengths

Due to the final selection of suppliers, the overall building length may be reduced by a total of 45 metres.

The overall reduction of 45m comprises;

- 5m from tipping hall
- 40m from flue gas cleaning section.

These proposed amendments may be seen in attached planning drawing PMG-MEATH-ARC-DWG-000-1703 and in Figure 1.2. The red hatched areas are the existing permitted building and the green hatching represents the changes under the amended application.

1.1.1.2 Changes to building widths

As outlined above, it is proposed to amend the furnace/boiler and flue gas building widths to;

- achieve an optimum layout of the process equipment
- allow for a corridor at ground level on the southern face of the building for guided tours through the facility.

The changes to the building widths can be seen clearly as the coloured green areas on drawing PMG-MEATH-ARC-DWG-000-1703 and in Figure 1.2. The changes to the end elevations in comparison to those currently permitted can be seen in drawings PMG-MEATH-ARC-DWG-010-1717 and PMG-MEATH-ARC-DWG-010-1718 and in Figures 1.3 & 1.4 respectively

1.1.1.3 Changes to building heights

The motivation for the proposed amendments to the main process building heights is as follows;

- Increase in bunker roof height by approximately 4m to allow for maintenance access for the bunker cranes and a 1m parapet wall for roof maintenance and inspections
- Inclusion of a 1m parapet wall to roof of bunker, furnace boiler and flue gas sections to provide edge protection for any maintenance or inspections that will be performed on the roof.
- Increase by approximately 10m to the height of an 11m section of the flue gas cleaning building to allow for the required clearance for maintenance of equipment.
- Decrease in tipping hall roof height by 5m due to a change in the structural design of the roof.

Please refer to drawings PMG-MEATH-ARC-DWG-010-1711 and PMG-MEATH-ARC-DWG-010-1712 and Figures 1.5 & 1.6 respectively for details. The dotted outline on the bottom image of both drawings indicates the existing permitted building superimposed on the proposed revised layout.

1.1.1.4 Conversion of ash bunker to a bottom ash storage and handling building

The motivation for proposing an ash hall in place of an ash bunker is in anticipation of future legislation requiring the recovery of more materials from bottom ash.

The proposed ash hall will be an enclosed building with a contained drainage system. Loading and handling of ash will be performed using a loading shovel and all loading of trucks will be conducted indoors.

This proposed amendment is discussed in detail in section 5.6.11.

1.1.1.5 Changes to Turbine Building location

Because it is proposed to convert the ash bunker to an ash hall as described above, extra space is available within the main process building. It is proposed that this extra space be utilised by housing the turbine and generator in that location. A basement to accommodate the exhaust of the turbine in this location is also proposed. Please refer to drawings PMG-MEATH-ARC-DWG-010-1711 and PMG-MEATH-ARC-DWG-010-1712 and also Figures 1.5 & 1.6 respectively for details.

1.1.2 Proposed additional amendments

1.1.2.1 Re-design of Gatehouse/Weighbridge/Parking area

It is proposed to re-design the gatehouse and weighbridge area to achieve the following goals;

- visitors to the site will not have to cross outgoing traffic from the facility in order to sign in
- to provide a holding area for visitor groups who may arrive at the gatehouse at different times, prior to being brought onto site to the education centre
- reduction in number of parking spaces from 46 to 40, to provide parking spaces for two coaches.

Refer to Drawings PMG-MEATH-ARC-DWG-000-1703 and PMG-MEATH-ARC-DWG-070-1701 and also Figure 1.2 & Figures 1.7 & 1.9 respectively for details of the proposed amendments. It is also proposed to include an additional puraflo domestic effluent treatment plant local to this area. This is discussed in more detail in Section 10.

1.1.2.2 Re-design of office building within main process building

It is proposed that the office building (including the control room) be made 2m wider, an extra floor added and an external fire escape added to achieve the following design objectives;

- provide an appropriately sized education centre for visitors to the site
- provide extra space within the control room to accommodate a visiting group of 20 people at one time
- meet the requirements of the fire officer from Meath Co Co.

As a result of the incorporation of the education centre into the main process building, it is also proposed to locate the warehouse area into the main process building and to omit the stand alone building (warehouse & education centre) proposed in the 2006 application.

1.1.2.3 Changes to air-cooled condenser building

It is proposed to re-locate the air-cooled condenser to accommodate the proposed bottom ash hall. It is also proposed to amend the configuration (from footprint of 24.6m x 24.6m to 41m x 15.6m), based on the preferences of suppliers in the current market. Due to the fact that the air-cooled condenser will not be located on top of the turbine building, this structure would be approximately 6m lower than in the existing permission. It is also proposed to construct a pipebridge to connect the air cooled condenser to the main process building at a level of approximately 12m above ground level.

The proposed changes may be seen in plan on drawing PMG-MEATH-ARC-DWG-000-1703 and in Figure 1.2.

1.1.2.4 Re-location of various items

Pumphouse/Fire water storage tank

It is proposed that the pumphouse and fire water storage be re-located slightly but will remain generally in the same area. This is to accommodate the new road access and levels within the area. This can be seen on drawing PMG-MEATH-ARC-DWG-000-1703 and in Figure 1.2. The footprint of the pumphouse will also be reduced (from 15.2m x 10.2m to) and the overall height will also reduce from 8m to 5.4m. With the proposed amendments, the configuration of the firewater storage tank will be amended from 18m diameter to 16.4m and the height will be increased from 8m to 11.4m approximately.

Relocation and re-design of 38kV compound

It is proposed to re-locate the 38kV compound to accommodate the proposed location of the air-cooled condenser building. It is proposed that the configuration of the compound be changed to reflect the requirements of the ESB. Consequently it is proposed that the location of the associated substation building be changed and its size amended in accordance with the requirements of the ESB. These proposed changes may be seen on drawing PMG-MEATH-ARC-DWG-000-1703 and in Figure 1.2. In summary the footprint has been increased slightly from 8m x 4.4m to 12.4m x 5m. The height has also been increased slightly from 3m to 3.6m.

Conversion of underground attenuation tank to an attenuation pond

It is proposed to revise the size and type of stormwater attenuation system based on the proposed changes and current attenuation calculation methods. This exercise has been carried out in accordance with the requirements of the water services division of Meath Co Co. The monitoring and control of discharges will be the same as the previous application.

Re-location of fuel oil storage tank and addition of aqueous ammonia storage tank

It is proposed to re-locate the 40m^3 fuel oil storage tank near the western site boundary to the south of the air cooled condensers. This will be an above ground horizontal tank and will be connected to the main process building via a pipebridge at approximately 6m above ground level.

It is proposed to locate a 70m^3 aqueous ammonia tank in this area also. The tank will be 3.5 m in diameter and 7m high. It will connect to the main process building via the same pipebridge as above. A loading area will also be provided for the delivery of fuel oil and aqueous ammonia.

Modifications to internal road network

The internal road network will need to be revised to accommodate the proposed changes and the road layout can be seen on drawing PMG-MEATH-ARC-DWG-000-1702 and in Figures 1.8 & 1.9.

1.2 ENVIRONMENTAL IMPACT STATEMENT (EIS) METHODOLOGY

1.2.1 Requirement for an EIS

The requirement for Environmental Impact Assessment (EIA) for certain types and scales of development is set out in the EIA Directives (85/226/EEC, 97/11/EC and 2003/35/EC) and, for current purposes, given effect in Ireland by the Planning and Development Act, 2000 (as amended) and the Planning and Development Regulations, 2001 (as amended). The permitted Waste-to-Energy facility falls into the category defined as;

"Waste disposal installations for the incineration, chemical treatment as defined in Annex IIA to Directive 75/442/EEC under heading D9, of non-hazardous waste with a capacity exceeding 100 tonnes per day."

The amendments now proposed do not, themselves, fall within this category. There is a specific category for such amendments.

Schedule 5, Part 2, Section 13 of the Planning Regulations specifically addresses Changes, Extensions, Development and Testing. This specific section states that an EIS is required for:

> *(a) any Change or extension of development (not being a change or extension referred to in Part 1) which would –*
>
> *(i) result in the development being of a class listed in part 1 or paragraphs 1 to 12 of part 2 of this schedule, **and***
>
> *(ii) results in an increase in size greater than –*
>
> *-25% or*
>
> *-an amount equal to 50% of the appropriate threshold,*
>
> *whichever is the greater*

The proposed amendments will not result in an increase in size of greater than 25% nor will the proposed amendments increase the threshold by an amount equal to 50% of the appropriate threshold. As already stated the volume and type of waste treated will not change due to the proposed changes.

Furthermore, the proposed amendments when assessed in the context of the parent permission represent modifications which do not fundamentally affect the nature and extent of the development already permitted. While, strictly, no EIS is required for the proposed amendments, having consulted with Meath County Council, it was agreed that an EIS be included with the planning application.

This EIS has been prepared in accordance with the following Environmental Protection Agency (EPA) documents "Guidelines on the Information to be contained in Environmental Impact Statements" and "Advice Notes on Current Practice in the Preparation of Environmental Impact Statements", published in 2002 and 2003 respectively.

The waste-to-energy facility will be operated under a waste licence issued by the EPA under the Waste Management Acts, 1996 (as amended).

1.2.2 EIS Methodology

The EIS is presented in the "Direct Format Structure" as set down in the "Guidelines on Information to be Contained in an EIS" produced by the Environmental Protection Agency (March 2002). In general, it follows the framework presented in the EPA Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (September 2003).

1.3 COMPANY BACKGROUND

1.3.1 Indaver NV Company Profile

Indaver NV, is the Flemish parent company of Indaver Ireland. Indaver is a waste management company that specialises in integrated waste management for industries and households. Indaver recycles, treats and disposes of both domestic and industrial waste. Advice on the prevention of waste is an integral part of the Indaver service.

Twenty years ago, the Flemish region of Belgium was in a similar situation to that of Ireland today as regards waste management. While it was still beginning to implement an integrated waste management system, the vast majority of waste was still being disposed of to landfill and there was a very low rate of recycling. Hazardous waste was being exported to other countries for disposal. The Flemish Government, in partnership with local industry, formed Indaver NV in 1985 to provide an integrated waste management strategy for Flanders in order to address the waste crisis.

Today, Flanders, with a population of 6 million, has a recycling rate of over 71%, the highest recycling rate of any region in the world and is self sufficient in the disposal of its residual waste. In addition, Flanders has developed an integrated hazardous waste management system which means the Region no longer exports its hazardous waste to other countries for treatment or disposal. Since its establishment, Indaver has been and continues to be an important contributor to the development of this integrated waste management system.

The Dutch multi utility company, Delta is the majority shareholder of Indaver NV with a 75% shareholding. Flemish Environmental Holding is the holding company of the Government of Flanders and it has a 16% stake in Indaver NV. The remaining shares are held by a number of leading private companies in Flanders. The Indaver group plays a leading role in the implementation of the Flemish Government Waste Policy. The company employs over 800 people and has operations in six European countries. In 2008, Indaver managed approximately 2,250,943 tonnes of hazardous and non-hazardous waste at the company's waste recovery and disposal sites.

1.3.1.1 Indaver's Activities

Indaver NV is involved in a comprehensive range of waste management activities at its various facilities in Flanders, and elsewhere in Europe. A selection of such activities is listed in Table 1.1.

Municipal waste-to-energy facility, Flanders, Belgium

Table 1.1: Indaver NV Waste Management Activities

Site	Facility Description	Facility Tonnage	Total Tonnage
Hazardous Waste Management Facility Antwerp	Solvent Recovery	4,427	446,159
	Physico-chemical Treatment of liquid waste	156,370	
	Waste-to-Energy	105,722	
	Ash Recycling	20,710	

	Landfill	158,930	
Non Hazardous Waste Management Facility Doel	Fluorescent Lamp Recycling	3,132	1,042,449
	Refuse Derived Fuel	27,850	
	Waste-to-Energy	840,829	
	Ash Recovery	98,511	
	Landfill	72,127	
Kallo	Waste Transfer Station	-	3,357
AROC	HCL Recycling Facility	-	145,336
Willebroek Recycling Park	Dry Recyclables (sorting for recycling)	24,520	79,021
	Tyres (Sorting and Recovery)	698	
	Timber	4,033	
	Green Waste	6,928	
	Glass/Carpets	1,303	
	Bulky Waste	20,987	
	Paper/Plastics	20,552	
Grimbergen	Composting Facility	-	77,149
Leuven	Waste-to-Energy	-	11,417

(Source: Indaver NV Sustainability Report 2008)

All the company's facilities are licensed by the regulatory authorities in the region in which they operate. Indaver is striving to have all its facilities accredited to the ISO 9002 Quality Assurance System, the ISO 14001 Environmental Management System and the OHSAS 18001 Health and Safety Standard. Indaver NV was the first waste management company in Flanders (and among the first in Europe), to attain accreditation to the ISO 14001. These certifications are independently audited on a regular basis to ensure company compliance.

An integral part of the above certifications is clear and regular communications with members of the public, customers, suppliers and regulatory authorities. Indaver is committed to permanent and open dialogue regarding environmental matters.

1.3.2 Indaver Ireland

Indaver Ireland, a wholly owned subsidiary of Indaver NV, was established in 1999 to develop waste infrastructure in Ireland. The branch is currently developing two Waste Management Projects – a non-hazardous incineration facility in Carranstown, Duleek, County Meath on which construction commenced in September 2008 and an Industrial waste facility, which includes a hazardous waste incinerator, in Ringaskiddy, County Cork. Information on Indaver's projects can be found on the website www.indaver.ie. Currently, nine staff are employed by Indaver Ireland working directly on the Meath and Cork projects.

Meath Waste Management Facility

On 15th October 2007 Indaver Ireland received planning permission from An Bord Pleanala for a 70MW waste to energy facility with an annual capacity of 200,000 tonnes. Construction commenced on site on 01st September 2008 which will continue until mid 2011.

A waste licence review application is currently under consideration by the Environmental Protection Agency to increase the capacity to 200,000 tonnes per annum as per the volume permitted by the Board in 2007. In parallel with the preparation of this application, Indaver are responding to an Article 12 & 13 Compliance request as part of the review process. This EIS has been designed to address issues raised by the EPA and also to satisfy the requirements of the Planning Authority for the proposed amendments. Hence, the level of detail required for the proposed amendments has been augmented to meet the requirements of both.

Cork Waste Management Facility

In November 2008, Indaver applied for planning permission under the Strategic Infrastructure Act for a hazardous and non-hazardous waste incinerator in Ringaskiddy Co. cork. The facility will process up to 240,000 tonnes per annum of residual waste and produce approximately 22 megawatts of electricity. A hazardous waste transfer station is also part of the development and will have a capacity of 15,000 tonnes per annum. It will accept industrial and household hazardous and non hazardous wastes that require bulking up and safe packaging before treatment on site in the waste-to-energy facility or elsewhere-. An oral hearing was held in between April and June 2009 and a decision is expected by year end.

1.3.2.1 Indaver Ireland Limited

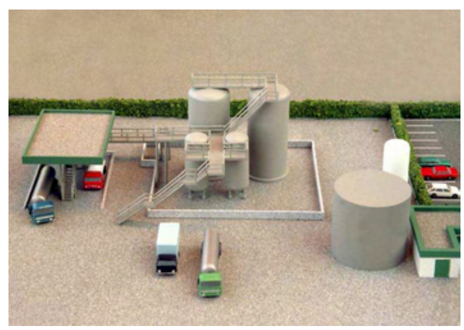
In 1999 Indaver acquired 60% of MinChem Environmental Services Limited, a hazardous waste management company operating in Ireland since 1977. In 2003 Indaver acquired the remaining 40% of MinChem and in 2004 changed the name of the company to Indaver Ireland Limited. Today, Indaver Ireland Limited, with offices in Dun Laoghaire, Dublin Port and Cork, employs approximately 125 people.

Export of Waste

Indaver exports hazardous waste from Ireland to Britain and other European countries for recovery, disposal or treatment as there are limited treatment facilities available in Ireland for these types of waste. Solvents from the pharmaceutical industry, obsolete, or out of specification products, contaminated packaging/clothing and laboratory chemicals are some of the waste streams handled by the company. The company exported over 86,934 tonnes of waste in 2008. Indaver operates an EPA licensed transfer station in Dublin Port for the export of these materials. The facility handled over 27,000 tonnes of material into storage in 2008.

Solvent Blending Facility

Indaver has operated a solvent recovery facility for waste solvents at its Dublin Port Waste Transfer Station since 2006. The facility has the capacity to blend 20,000 tonnes per annum of waste solvents generated by the pharmaceutical and chemical industry. Blended solvents can be used as a fuel in the cement industry.



On-Site Services

Indaver offers a wide range of on-site services to it's customers including, diversion of waste to landfill overseas, export of car-shred for disposal, export of refuse derived fuels to power plants overseas, soil remediation & sludge disposal, site clean-ups, plant decommissioning and other large-scale waste treatment projects.

Total Waste Management

Indaver provides customer with a management service for all their waste generated on-site, including recycling of dry recyclables, disposal of residual waste, recovery / disposal solutions for waste electrical and electronic equipment, sludges and hazardous and non-hazardous industrial waste.

Recycling Centres

Indaver operates Community Recycling Centres in Newcastle West, Mungret and Killmallock on behalf of Limerick County Council. Indaver supports Limerick County Council's aim to promote reuse as a more sustainable way of dealing with some household wastes. An innovative Reuse Centre has recently been launched at the Mungret Recycling Centre. Items brought to the Reuse Centre are placed in an appropriate area from where they may be taken away by others for reuse.

Waste Education

As part of the company's communications programme, Indaver provides a waste education service to industry, other businesses and householders. The company produces guidelines on: waste prevention and minimisation programmes; recycling programmes in the work place and in the home; current waste legislation; and packaging and transportation of hazardous waste.

1.4 CONSULTATION

1.4.1 Pre-Planning Consultation

Indaver Ireland believes in a policy of openness and dialogue between the company and the local community. Indaver has undertaken a consultation campaign on the proposed amendments to the existing permission.

Residents in the local community were met by an Indaver representative and a Newsletter was given to them. The newsletter was also distributed within the local area

Further details outlining the principle changes to the waste-to-energy facility are available on www.indaver.ie/meath1.htm or by calling FreeFone 1800 200646 or writing to Indaver Ireland.

Indaver will make themselves available to meet up with any parties through the planning process.

1.5 PROPOSED ONGOING COMMUNICATIONS

Indaver Ireland believes in a policy of openness and dialogue between the company and the local community. This openess and dialogue has started and Indaver Ireland will maintain this policy of openness throughout the construction phase and the lifetime of the facility. Through Indaver Ireland's website (www.indaver.ie) interested parties can register with Indaver Ireland to obtain regular updates on further developments of the project.

Community Liaison Committee

The community liaison committee as set out in condition 5 of our planning conditions has been initiated and consists of eight members and include representation from Meath County Council, Indaver Ireland, local residents and elected members of Meath County Council. The committee convenes at quarterly intervals and to date three meetings have been held.

The facility will operate under a Waste licence issued by the Environmental Protection Agency (EPA). The facility will be operated to relevant international standards for Environment, Safety and Quality Management Systems, namely ISO 14001 or EMAS for Environment, OHSAS 18001 for Safety and ISO 9002 for Quality. The facility will be subject to inspection by an independent body to verify compliance with these standards. The results of accreditation audits and inspections will be made available to the community liaison committee for discussion at the following scheduled quarterly meeting. In addition the results of independent monitoring inspections and audits carried out by the EPA will also be made available and discussed at the quarterly meetings.

Waste Education Centre

There will be a Waste Education Centre incorporated into the main building of this facility. The Education centre will include a display area outlining household and commercial waste prevention and recycling programmes; updates on the Region’s Waste Management Plan, such as current recycling, waste-to-energy and landfill targets; and how the waste-to-energy facility will operate.

The centre will include a meeting room which will be made available to the community liaison committee.

Information Available to the General Public

Indaver Ireland has an ‘open door’ policy, and it is envisaged that groups, such as local residents and students, may request a tour of the facility when operations commence. Indaver Ireland will be happy to accommodate such groups that may wish to visit the facility.

Access to information regarding the operation of the facility will not be restricted to members of the community liaison committee. It is standard practice for the Environmental Protection Agency to require a licence holder to institute a Communications Programme 'to ensure that members of the public can obtain information concerning the environmental performance of the facility at all reasonable times'.

Correspondence between the company and the EPA and information regarding the environmental performance of the facility will also be accessible at the EPA's offices at Johnstown Castle, Co. Wexford. Indaver's annual environmental report will be distributed locally and will be available on the company website.

Quarterly Newsletter

Indaver publishes a Newsletter on a quarterly basis which provides an update on the development of the project. This Newsletter is posted out to people within the local community and will be distributed also within the local area.

Visitor Centre

During the construction phase of this project there will be a visitor centre located within the contractors' construction village where the public can come to meet the team and obtain information on the development of the project.

1.6 CONTRIBUTORS TO THE EIS

The contributors to the Statement, in alphabetical order by topic, are as follows;

Air Quality	AWN Consulting Ltd
Climate	WYG
Construction	Indaver Ireland
Cultural Heritage	WYG
Ecology	WYG
Human Beings	WYG
Human Health	WYG
Interactions	WYG
Landscape and Visual Appraisal	Mitchell & Associates and ARC Consultants
Material Assets	WYG
Noise	AWN Consulting Ltd
Non-Technical Summary	WYG
Orchestration of Statement	WYG
Project Development and Description	Indaver Ireland
Roads and Traffic	WYG
Soils and Geology	WYG
Water	WYG

1.7 DIFFICULTIES COMPILING SPECIFIED INFORMATION

No difficulties were encountered during the compiling of the EIS.

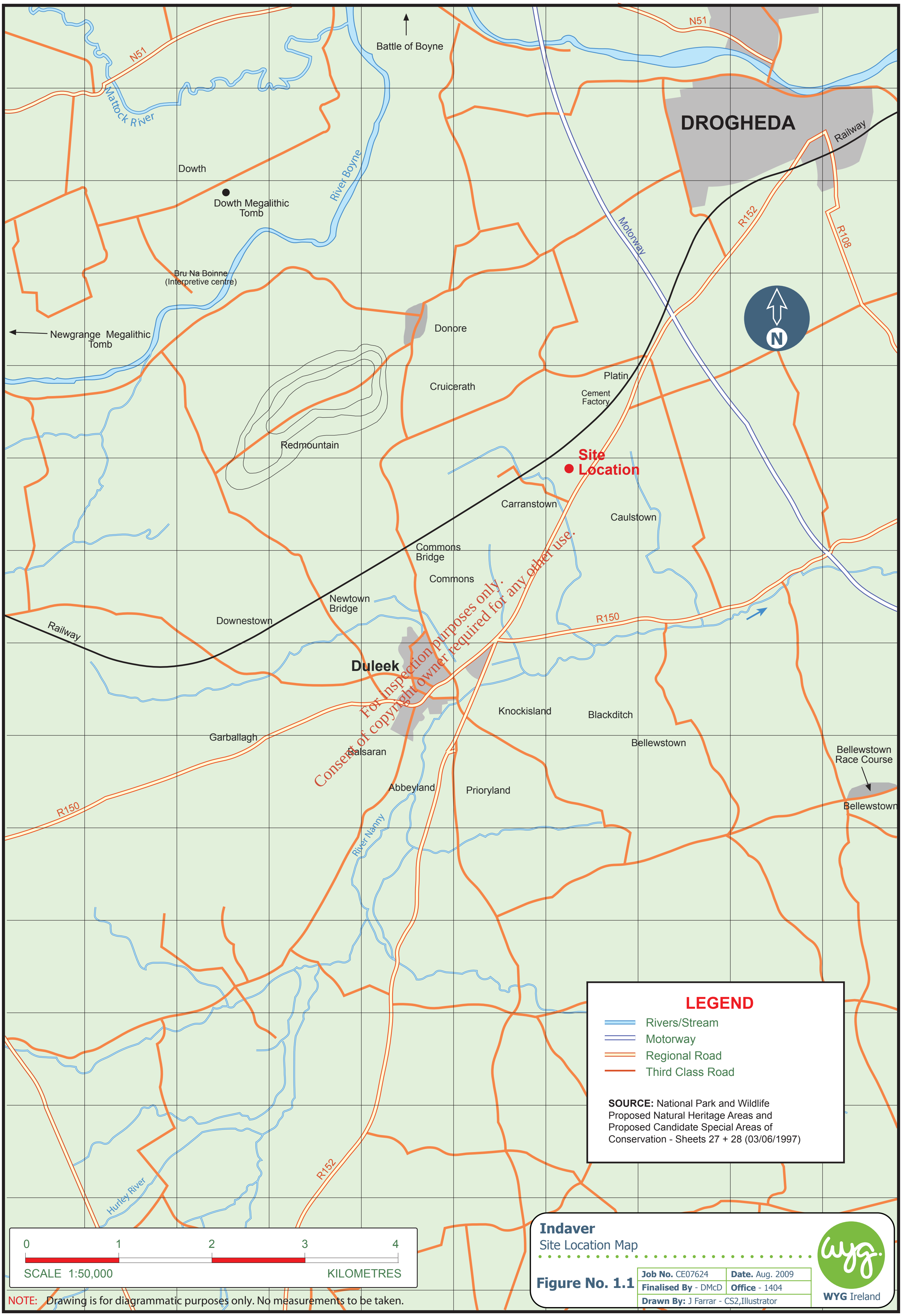
1.8 REFERENCES

Environmental Protection Agency (2002) Guidelines on the Information to be contained in Environmental Impact Statements

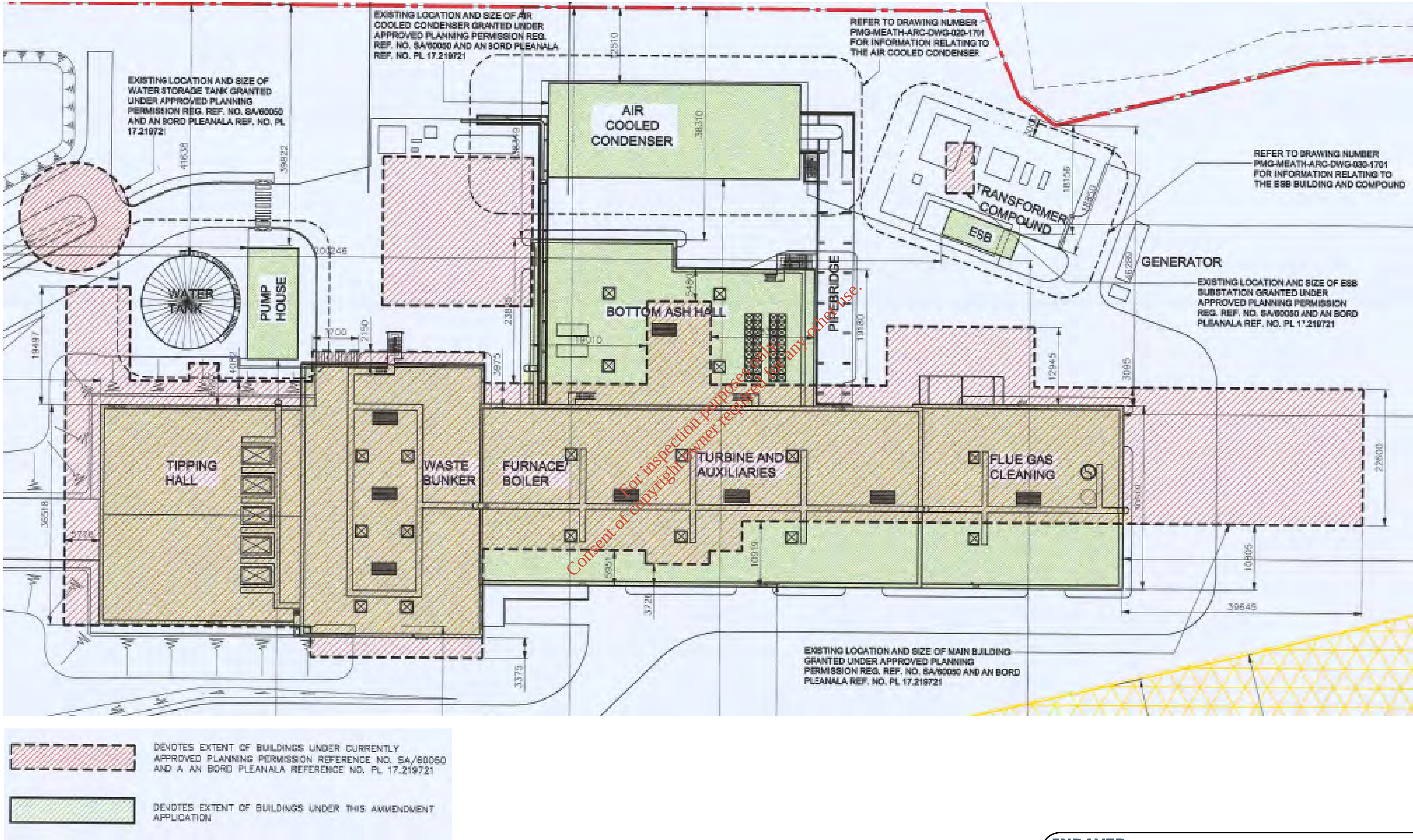
Environmental Protection Agency (2003) Advice Notes on Current Practice in the Preparation of Environmental Impact Statements.

The European Communities Environmental Impact Assessment (Amendment) Regulations 1999, SI No 93 of 1999

Planning and Development Regulations 2001, S.I. No. 600 of 2001.



NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.



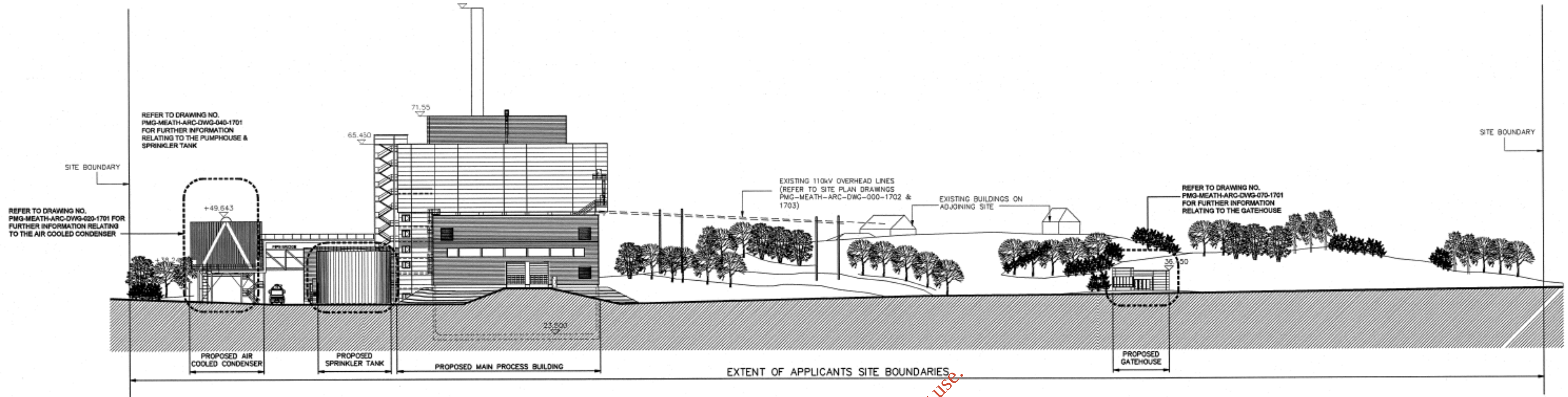
INDAVER
Proposed Amendments Overlayed on Existing Permitted Development

Figure No. 1.2

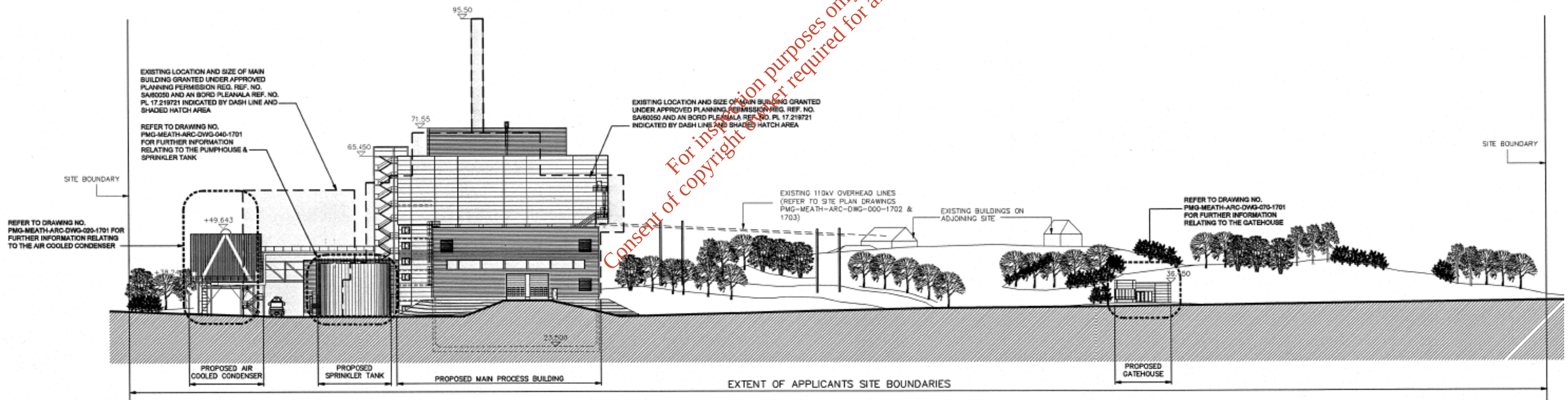
Job No. CE07624	**Date.** Aug 2009
Finalised By-DMcD	**Office** - 1404
Drawn By: Igor Wodyk - CS2,Illustrator	

WYG Ireland

NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.



PROPOSED CONTIGUOUS WEST ELEVATION
SCALE 1:500



PROPOSED CONTIGUOUS WEST ELEVATION (PREVIOUSLY APPROVED LAYOUT INDICATED SHADED WITH A DASHED OUTLINE)
SCALE 1:500

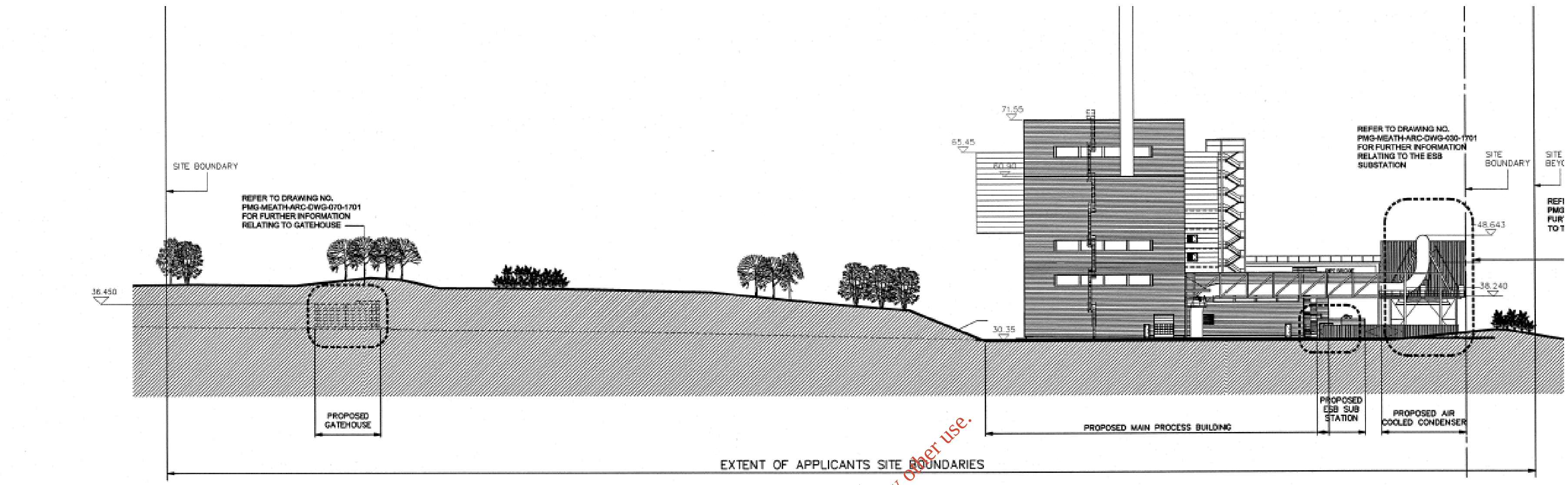
INDAVER
Proposed West Elevation With Existing Permitted Development Outlined With Dashed Line

Figure No. 1.3

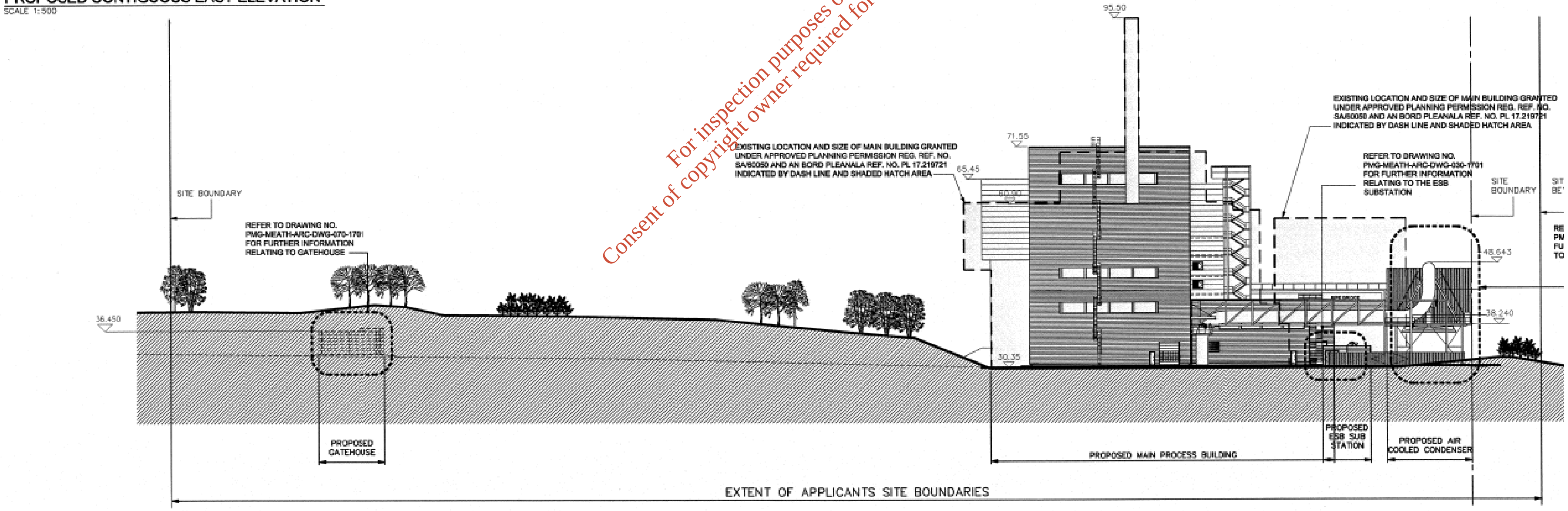
Job No. CE07624	**Date.** Aug 2009
Finalised By-DMcD	**Office** - 1404
Drawn By: Igor Wodyk - CS2,Illustrator	

WYG Ireland

NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.



PROPOSED CONTIGUOUS EAST ELEVATION
SCALE 1:500



PROPOSED CONTIGUOUS EAST ELEVATION (PREVIOUSLY APPROVED LAYOUT INDICATED SHADED WITH A DASHED OUTLINE)
SCALE 1:500

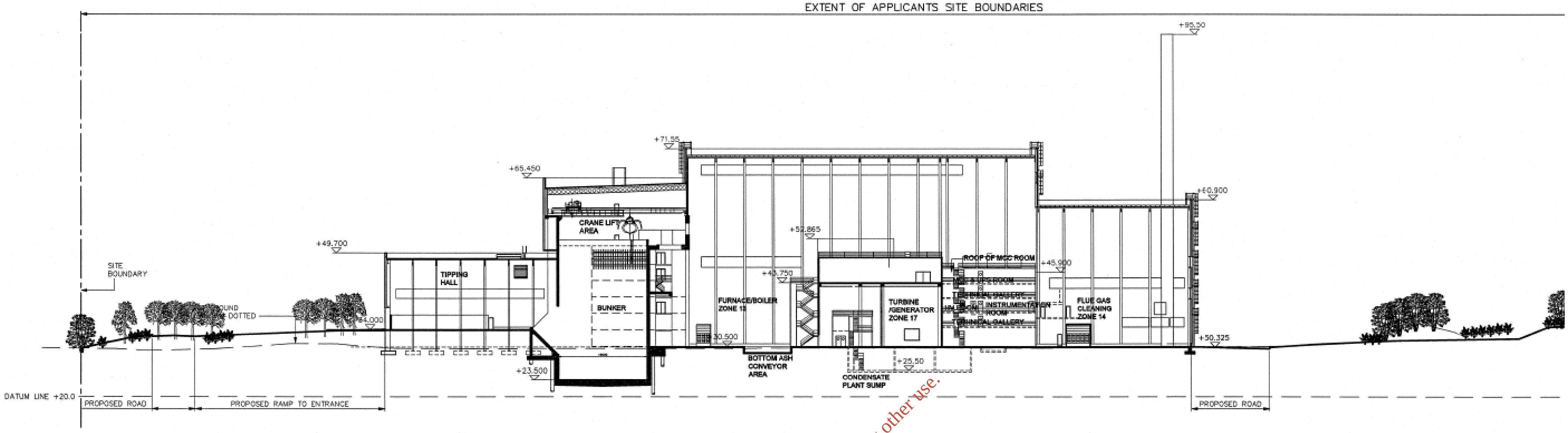
INDAVER
Proposed East Elevation with Existing Permitted Development Outlined with dashed line

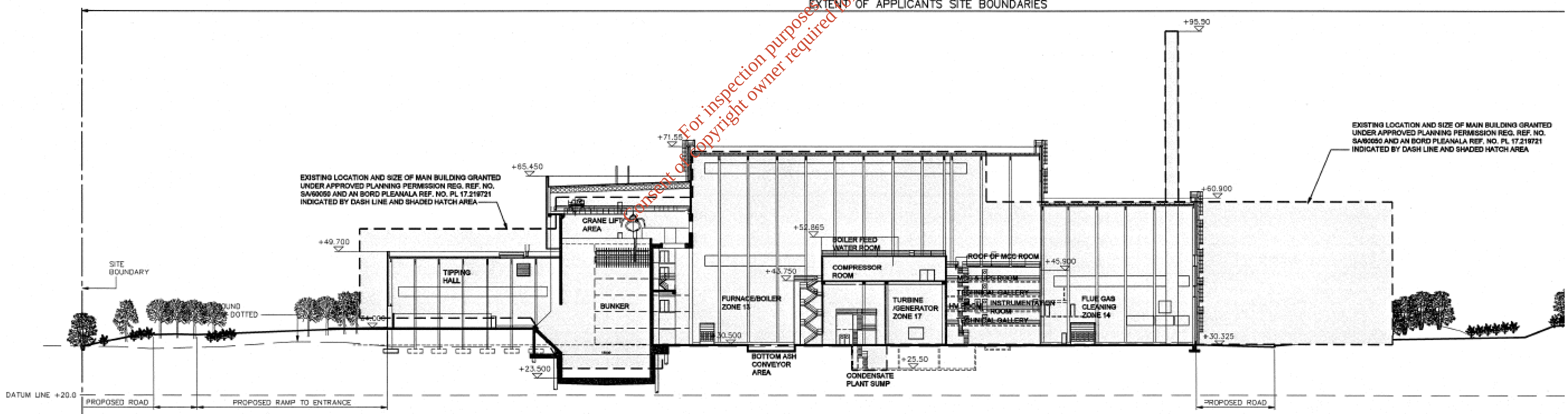
Figure No. 1.4

Job No. CE07624	**Date.** Aug 2009
Finalised By-DMcD	**Office** - 1404
Drawn By: Igor Wodyk - CS2,Illustrator	

WYG Ireland

NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.





VIOUSLY APPROVED LAYOUT INDICATED SHADED WITH A DASHED OUTLINE)

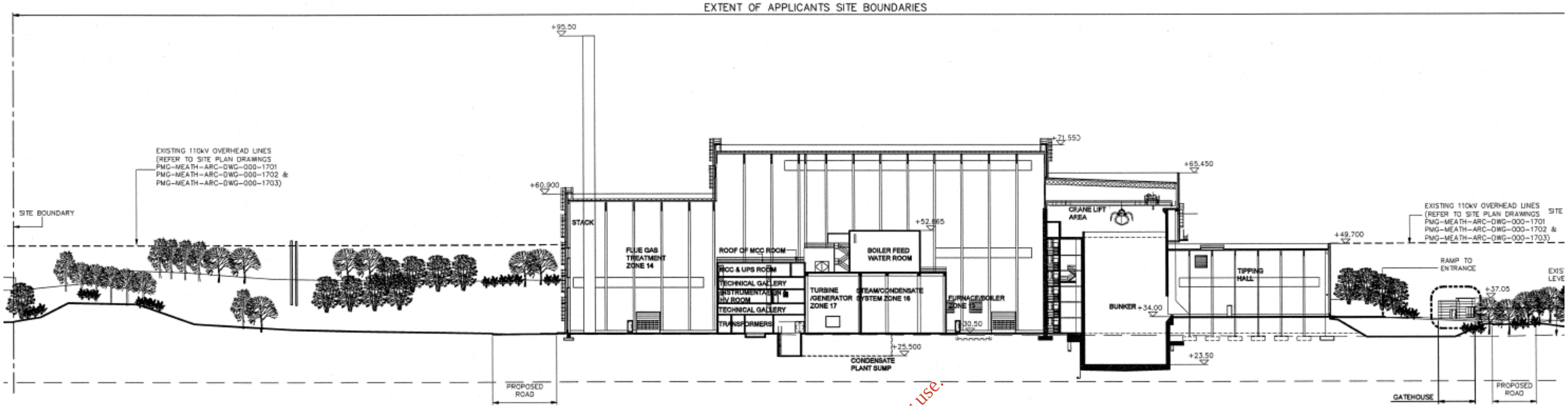
INDAVER
Proposed Section With Existing Permitted Development Outlined With Dashed Line

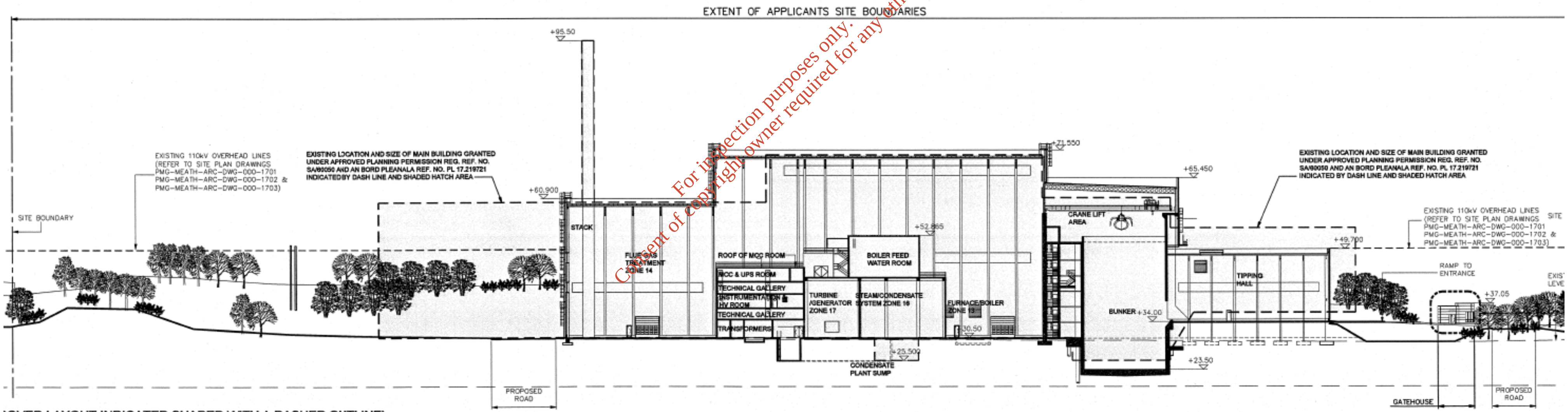
Figure No. 1.5

Job No. CE07624	**Date.** Aug 2009
Finalised By-DMcD	**Office** - 1404
Drawn By: Igor Wodyk - CS2,Illustrator	

WYG Ireland

NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.





ROVED LAYOUT INDICATED SHADED WITH A DASHED OUTLINE)

INDAVER

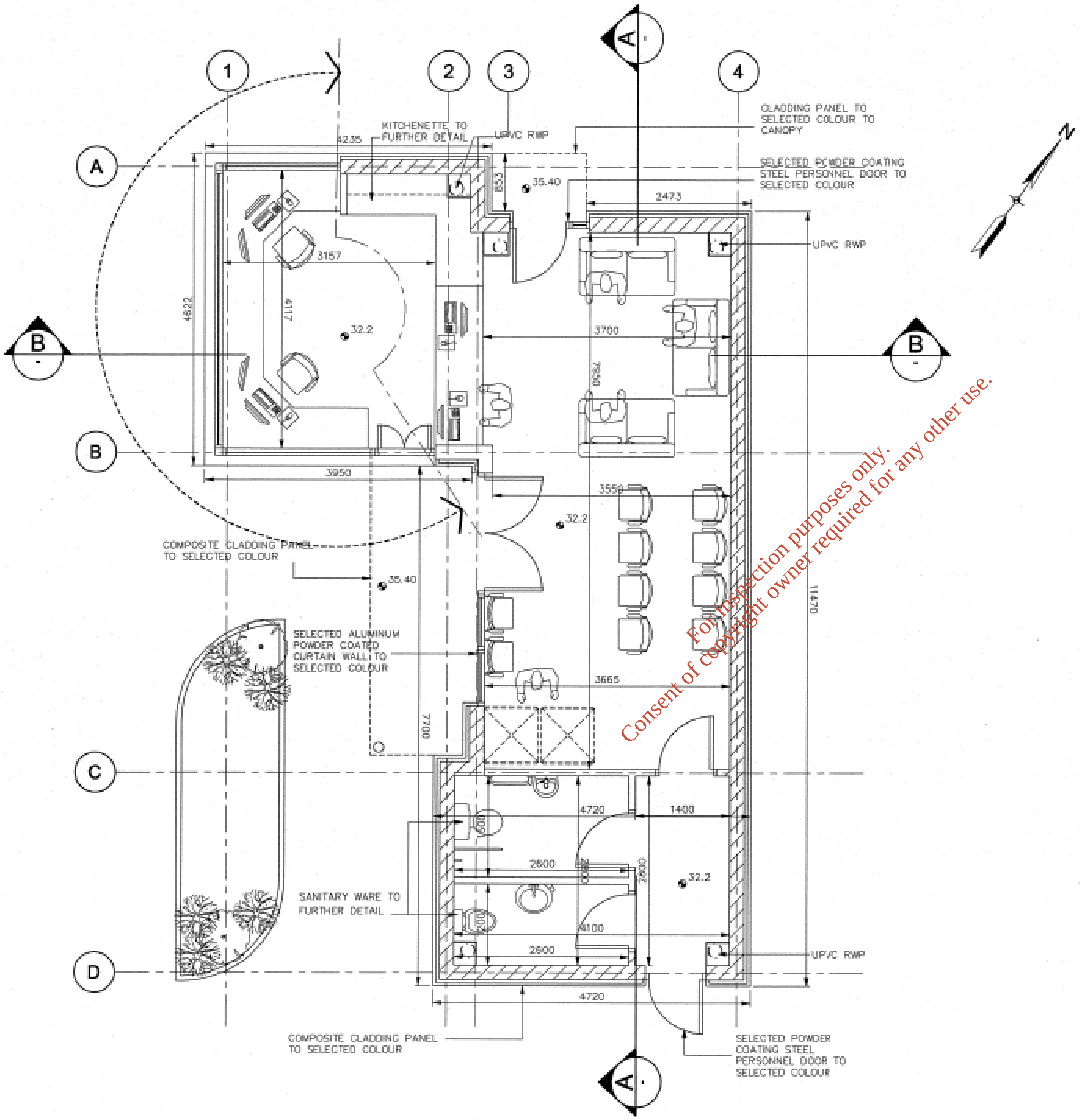
Proposed Section With Existing Permitted Development Outlined With Dashed Line

Figure No. 1.6

Job No. CE07624	**Date.** Aug 2009
Finalised By-DMcD	**Office** - 1404
Drawn By: Igor Wodyk - CS2,Illustrator	

WYG Ireland

NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.



INDAVER

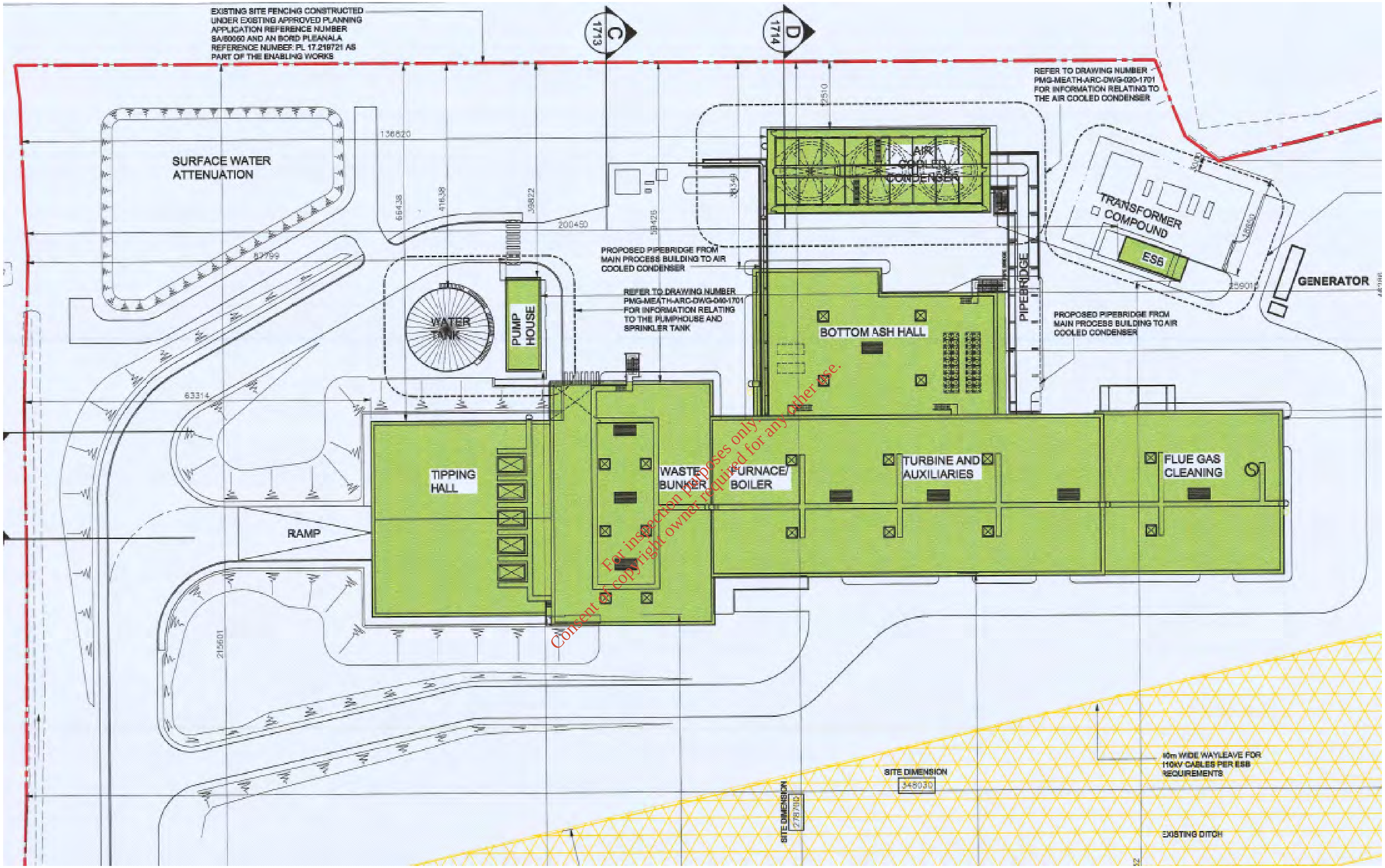
Gatehouse for Site Security

Figure No. 1.7

Job No. CE07624	**Date.** Aug 2009
Finalised By-DMcD	**Office** - 1404
Drawn By: Igor Wodyk - CS2,Illustrator	

WYG Ireland

NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.



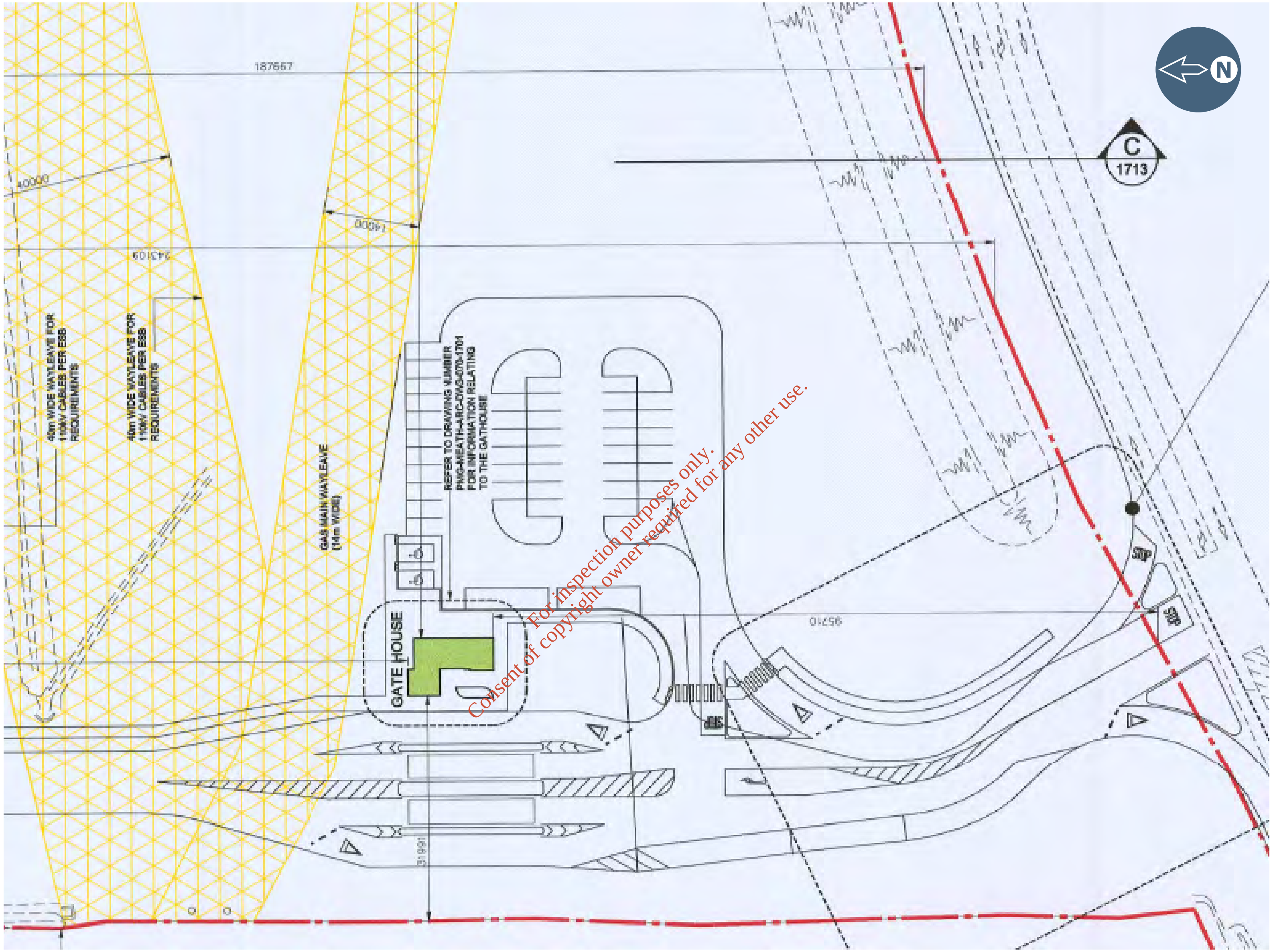
INDAVER
Proposed Amendments to Buildings and Roadways

Figure No. 1.8

Job No. CE07624	**Date.** Aug 2009
Finalised By-DMcD	**Office** - 1404
Drawn By: Igor Wodyk - CS2,Illustrator	

WYG Ireland

NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.



INDAVER

Proposed Gatehouse and Internal Road Layout

Figure No. 1.9

Job No. CE07624	**Date.** Aug 2009
Finalised By-DMcD	**Office** - 1404
Drawn By: Igor Wodyk - CS2,Illustrator	

WYG Ireland

NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.

2 BACKGROUND TO THE PROJECT

2.1 INTRODUCTION

In 2006 this section of the EIS contained an assessment of the need for the scheme i.e. how the Waste to Energy facility at Carranstown would meet the thermal treatment requirements of the North East Region as set out in National policy and the specific provisions of the Regional Waste Management Plan. An explanation of the site selection process undertaken was also presented.

As the proposed amendments sought by this application do not result in any change to the nature of the process or the volumes of material handled at the facility, and national policy with regard to incineration remains unchanged, it is not necessary to revisit consideration of the need for the scheme or site selection. The site location at Carranstown is now established. A summary of the principles of the assessment of need for the scheme and site selection process are presented below.

2.2 NEED FOR THE SCHEME

The need for the scheme was established in the planning permission PL17.219721 granted for the facility in October 2007. The reasons and considerations given in the final permission referred to:

- the national waste management policy framework and strategy as set out in Government Policy Statement Taking Stock and Moving Forward (2004)
- the National Development Plan (2007-2013) provisions in regard to waste management
- the National Strategies on Biodegradable Waste (2006) and Climate Change (2007-2012)
- the Waste Management Strategy for the North-East region as set out in the current North-East Regional Waste Management Plan (2007).

At a European level, the position of waste-to-energy in the waste hierarchy has been strengthened since planning permission was granted. This will have to be reflected in the future national policy framework. Existing policy has not otherwise changed. The National Development Plan and Strategies on Biodegradable Waste and Climate Change are still relevant and are the most up to date policies for their relevant areas. These and other policy matters are outlined in more detail in Section 4, Planning and Policy Context.

The Waste Management Strategy for the North-East region (2006), which forecasts waste arisings in the region and uses this to determine the need for thermal treatment, has not been modified and calls for a facility with a maximum capacity of 200,000 tonnes per annum. The proposed amendments to onsite infrastructure do not impact on plant throughput or the type of waste to be processed and therefore do not alter the need for the scheme in the context of this Strategy. The existing permitted capacity is in line with the Waste Management Strategy for the North-East.

For these reasons, the need for the scheme as established in the existing planning permission is still valid at the current and approved capacity of 200,000 tonnes per annum.

2.3 SITE SELECTION

An assessment of alternative locations for the Waste to Energy facility was undertaken as part of the EIS prepared in 2006. The assessment comprised the consideration of a number of site selection criteria, both environmental and technical to determine whether the application site or a number of alternative sites were suitable sites for the development of the facility.

The main steps involved in the process were;

1. Preparation of a centre of gravity model to identify suitable locations to ensure “waste is treated as closely as possible to where it is generated”. A centre of gravity is an analytical model of the volumes of waste arising and the distances of the waste centres to the other centres in the region. The assessment found that the centre of gravity of waste production in the North East Region was within the geographical area around Drogheda, Ardee and Duleek.
2. Detailed consideration of the highest ranked locations from the Centre of Gravity Model for technical and environmental criteria including factors that the applicant company identified as essential to the project. Criteria considered included;

- Central Location close to the Waste Production centre of gravity
- Proximity to energy uses, ideally users of heat,
- Proximity to reasonable road access,
- Appropriate development zoning,
- Availability of cooling water and provision for its disposal
- Availability of sites.

Possible sites at Ardee, Drogheda, Duleek and Carranstown were identified in the original site selection for the facility in 2000 (Reg. Ref. No. 01/5006). As these sites were located within the centre of gravity, they were considered still valid. The previous assessments undertaken were updated in the 2006 EIS to ensure no material changes in the underlying circumstances at each site.

3. The candidate site from Step 2 was considered having regard to criteria for siting Waste to Energy Facilities set out in the World Health Organisation- Site Selection Criteria for the siting of a new Hazardous Waste Management Facility (1993), the Waste Management Plan for the North East Region 1999, the Proposed Replacement Waste Management Plan 2005-2010. The findings from the site selection assessment concluded that the site at Carranstown was a suitable site for the Waste-to-Energy facility.

For the purposes of this application it is considered, given the existing planning permission for the proposed development, that the site location is established. In 2006 it was submitted that the subject site was a suitable location to operate a waste to energy facility and was the best available site to Indaver. In granting planning permission both Meath County Council (in 2006) and the Bord (in 2007) obviously agreed with the concept of waste to energy and that the chosen site was a suitable location to operate such a facility. Because this application is concerned with minor amendments to the existing permission which do not change the type and amount of waste processed or the amount of traffic associated with the existing permission, it is considered that the suitability of the site for this type of facility is unchanged from the final permission granted in October 2007.

3. ALTERNATIVES

As part of the EIA assessment process alternatives are typically considered on the following levels;

- Alternative Locations
- Alternative Thermal Treatment Technologies
- Alternative Waste Management Strategies
- Alternative Energy Recovery and Gas Cleaning Systems
- Alternative Designs

Alternative Locations

Alternative locations for the facility were considered in the 2006 planning application and EIS. At that time it was submitted that the subject site was a suitable location to operate a waste to energy facility and was the best available site to Indaver. In granting planning permission both Meath County Council (in 2006) and the Bord (in 2007) obviously agreed with the concept of waste to energy and that the chosen site was a suitable location to operate such a facility. Because this application is concerned with minor amendments to the existing permission which do not change the type and amount of waste processed or the amount of traffic associated with the existing permission, it is considered that the suitability of the site for this type of facility is unchanged from the final permission granted in October 2007. The site selection process from the 2006 application is summarised in Section 2 of this EIS.

Alternative locations for the development on the site were also considered as part of the 2006 application and it was shown that due to the constraints of the 110 kV power lines dividing the site and the high pressure gas main traversing the site to the east of the power lines, that the most appropriate location for the main process building was west of the power lines. Another deciding factor was the topography of the site and the fact the location identified was the farthest from the main road and at the lowest point on the site, which would mitigate against the visual impact of the facility. The amendments proposed do not seek to alter the location of the main process building on the site.

Alternative Thermal Treatment Technologies

Indaver has planning permission to build a Municipal Solid Waste incinerator on the site with a capacity of 200,000 tonnes per annum. Since the granting of permission in October 2007, Indaver has tendered on the European market for a moving grate furnace and has awarded a contract to a supplier providing exactly this technology. In the context of the proposed amendments contained in this application, which do not propose to change the type of thermal treatment technology, it would not be logical to re-consider alternative thermal treatment technologies.

Alternative Waste Management Strategies

Section 4, planning & Policy context outlines how the existing permitted facility is still in line with all current National, Regional and European policies, strategies and Directives on Waste Management. The proposed amendments are minor in nature and do not impact on or are impacted in any way by these.

However, because a change has been made to the energy efficiency and a part of the gas cleaning systems since the 2006 application, these changes are considered below. The Integrated Pollution Prevention Control Reference Document on the Best Available Techniques for Waste Incineration (also known as BREF Note on waste incineration) has been consulted in relation to these changes.

The BREF document is an aid to determining whether such changes are considered as Best Available Technology (BAT). (See Appendix 3.1 for further information).

3.1 ALTERNATIVE ENERGY RECOVERY & GAS CLEANING SYSTEMS

3.1.1 Heat Recovery

The following heat recovery alternatives were identified in the 2006 EIS:

- no heat recovery
- hot water generation
- steam boiler

Incineration without heat recovery and hot water generation were discounted in the previous EIS and since there has been no change in the philosophy, a steam boiler is still the preferred alternative. Changes to the flue gas cleaning system (see section 3.2.1 below) have enabled a much lower boiler exit temperature of 190℃ from the boiler. This compares to 250℃ identified originally and hence means that further energy can be extracted from the flue gases and is considered BAT. The original steam parameters of a pressure of 40 bar and a temperature of 400℃ have been retained and are still considered BAT.

3.1.2 Dust Removal System

Dust removal can be achieved using a variety of technologies in order to meet the requirements of EC 2000/76 waste incineration directive, such as:

- cyclone
- electrofilter
- baghouse filter

The selection of a baghouse filter has not altered since the previous application and remains the preferred dust removal system.

3.1.3 De-NOx

DeNOx can be achieved by either Selective Catalytic Reduction (SCR) or Selective Non Catalytic Reduction (SNCR). Both technologies are considered BAT.

It is still proposed to use SNCR with ammonia solution injection as it is safer, more flexible and consumes less energy and therefore does not have a negative effect on the overall energy balance of the plant. It has been decided to use a <25% solution of Ammonia in water as this is what has been recommended by the furnace and boiler supplier as the preferred solution.

3.1.4 Dry or Semi Wet Flue Gas Cleaning

The Evaporating Spray Reactor can use a semi-dry or semi-wet absorber. Both are considered BAT.

Flue gases are cooled to approximately 140℃ by the evaporation of injected water and lime. Lime will be added either as a suspension of lime in water (semi-wet system).

The lime reacts with the acids in the flue gas. The spray reactor, with a significant over-stoichiometric use of lime, will ensure acid emissions are within EU emission limits. The spray reactor alone can abate the hydrochloric acid and sulphur dioxide to some 70 % of the EU emission limits; however it is not as efficient in the abatement of peaks of these acids. Therefore, it is proposed that the spray reactor for the facility be operated together with a dry lime injection system to ensure that emissions are well within EU limits. The dry lime injection system replaces the wet scrubbing stage that was identified in the 2006 application. The BREF Notes on waste incineration recommend a recirculation of the partly reacted lime from the baghouse filter, located after the reactor, back to the reactor. This has been incorporated into the design and the residues are recirculated into the flue gas duct prior to the baghouse filter to reduce the amount of fresh lime required and to minimise the residues produced per tonne of waste.

An alternative to semi-wet or semi-dry flue gas cleaning is dry flue gas cleaning (with lime or sodium bicarbonate). Fully dry systems generally require an over consumption of the reactants (lime, sodium bicarbonate) and hence create more residues. Fully dry systems are more suitable for smaller plants. BAT guidelines also suggest that very high stoichiometric rates of lime should be avoided.

The use of a dry lime injection system in conjunction with a semi-wet spray reactor provides flexibility and redundancy for acid gas removal without excessive stoichiometric factors and this has been chosen for the final design. The dry injection replaces the need for a wet stage and has the added benefit that the scrubbing liquid no longer requires evaporation in the spray reactor and hence the flue gas entry temperature to the spray reactor can be lower (down from 250 ℃ to 190 ℃). This in turn means that more heat may be extracted from the flue gases in the boiler and hence more steam and electricity generated as a result. The use of the dry system also means that the water requirement of the process is lower than if a wet stage were used.

The semi-wet stage provides the bulk of removal of acid gases and the hydrated lime is added as required depending on the acid gas loading in the flue gases. In addition the concentration of acid gases is monitored in the flue gas duct between the boiler outlet and spray reactor, giving an early warning of acid gas peaks. This measurement enables the control system to dose the optimal amount of lime in both the semi-wet and dry injection stages. In this way over-use of lime is avoided.

The use of bicarbonate in the dry injection has not been considered for the facility due to the quantity of residue produced. The residue can be recycled and used in the manufacture of salt, however no such recycling market is available in Ireland.

3.1.5 First stage removal of dioxins, trace organics and heavy metals

Options for first stage dioxin removal are:

- the injection of a premix of activated carbon/lignite cokes and lime before the spray reactor
- injection of activated carbon/lignite cokes before the spray reactor
- injection of expanded clay before the spray reactor
- SCR reactor.

Activated carbon or activated lignite cokes can be injected as a premixed blend with hydrated lime. The blend with lime helps to prevent hot spots due to ignition of the activated carbon/lignite cokes at higher temperatures (190°-230℃). However, it is not possi ble to alter the activated carbon or activated lignite cokes /lime ratio when they are dosed together. The benefits of this system are less relevant due to the injection of lime in the evaporating spray tower.

Activated carbon or activated lignite cokes injection before the spray reactor is an efficient dioxin removal system and is considered BAT. However, because the temperature in the flue gases is approximately 190℃, there is a definite risk of fo rming hot spots and hence was not considered.

Expanded clay can be used and is very effective and efficient for dioxin/furan removal. It has the added advantage that it is a mineral based product and hence is unaffected by higher flue gas temperatures and cannot form hot spots in the flue gas duct. Hence the injection of expanded clay was chosen as the most suitable option.

An SCR system is another alternative option. A catalyst bed would be required and the risk of catalyst poisoning/fouling is too high to consider it as an alternative in the earlier stages of the flue gas cleaning system.

3.1.6 Wet flue gas cleaning

Wet systems are more efficient than semi wet or dry systems in the abatement of peaks of acids in flue gases but have the disadvantage that they create a scrubber effluent which must be treated & discharged (process effluent) or evaporated in a semi-wet stage (reducing energy efficiency). Wet systems also require the re-heating of the flue gases prior to discharge to the stack in order to avoid a visible plume. This further reduces the overall energy efficiency of the plant.

As described in 3.1.4 above, the combination of a semi-wet spray absorber and dry lime injection system has been chosen to improve the energy efficiency of the plant, whilst at the same time guaranteeing that any peaks in acid gas concentration can be dealt with.

3.1.7 Second stage removal of dioxins, trace organics and heavy metals

Options for dioxin removal are:

- the injection of a premix of activated carbon/activated lignite cokes and lime before the baghouse filter
- injection of activated carbon/activated lignite cokes before the baghouse filter
- injection of expanded clay before the baghouse filter
- SCR reactor.

Activated carbon or activated lignite cokes can be injected as a premixed blend with hydrated lime. However, it is not possible to alter the activated carbon or activated lignite cokes /lime ratio when they are dosed together. The benefits of this system are less due to the separate injection of dry lime in the duct prior to the baghouse filter.

Activated carbon or activated lignite cokes injection before the baghouse filter is an efficient dioxin removal system and is considered BAT. It is the most favourable option due to its operational simplicity and the fact that a baghouse filter has also been proposed for dust removal from the facility. Activated carbon has also been chosen in preference to lignite cokes, due to better product availability.

Expanded clay injection is efficient for dioxin/furan removal but not as effective as activated carbon in the removal of heavy metals. Hence it was not chosen for the second stage removal also.
An SCR system is another alternative option. However as this was discounted in preference for an SNCR system, it would not be economical to install such a system for dioxin removal only.

3.2 ALTERNATIVE DESIGNS

Three alternative designs were considered for the visual aspect of the facility as shown on the attached Figure 3.1, which included the color scheme for the facility that has already received permission applied to the proposed building layout. This appears as the top image on Figure 3.1. In considering the three options the least preferred option among the design team was the color scheme for the permitted facility. The inclusion of grey colors in the two alternative options were considered to give a more neutral setting and blended in better with the background including the Irish cement facility. Option 2 from Figure 3.1 was the final chosen design and can be seen on Drawing PMG-MEATH-ARC-PRE-010-1701 or on Figure 3.2 below.

Other minor alternatives have been considered as part of the proposed amendments and these are summarised as follows;

3.2.1 Conversion of Bottom Ash Bunker to a Bottom Ash Storage and Handling Building

This alternative was considered to provide more flexibility in the future processing of the bottom ash into a re-usable product, if market conditions are favourable for investment in such an operation. This may include the installation of equipment to screen and grade the bottom ash. This will be solely dependant on whether there is a market available for such a product in the future as one does not exist now.

3.2.2 Incorporation of Warehouse and Education Centre into Main Process Building

This alternative design was considered to consolidate activities on the site. The warehouse was a distance from the main process building and meant that staff here were disconnected from their colleagues. The education centre is designed for members of the public visiting the plant and the location identified in the 2006 application and EIS provided a difficulty that groups would have to be checked in to security, moved to the education centre and then moved again if they were to be given a tour of the plant. When moving groups of people up to 20 in size this can be a difficult task. Hence by incorporating the education centre into the accommodation block in the main process building the interaction with site traffic movements is minimised.

3.2.3 Changes to main process building layout

Alternatives equipment layouts were considered as part of the detailed design phase to provide the best use of space within the building, for ease of maintenance of equipment and to provide a safe route for visitors through the plant. The proposed amendment to the building shape and size are the result of that exercise and has resulted in the following positive effects;

- Reduction in overall building length of 45m
- Clear passageway on Eastern side of building for visitor tours of the plant
- Viewing platform at 25m above ground level in the plant to view all process equipment

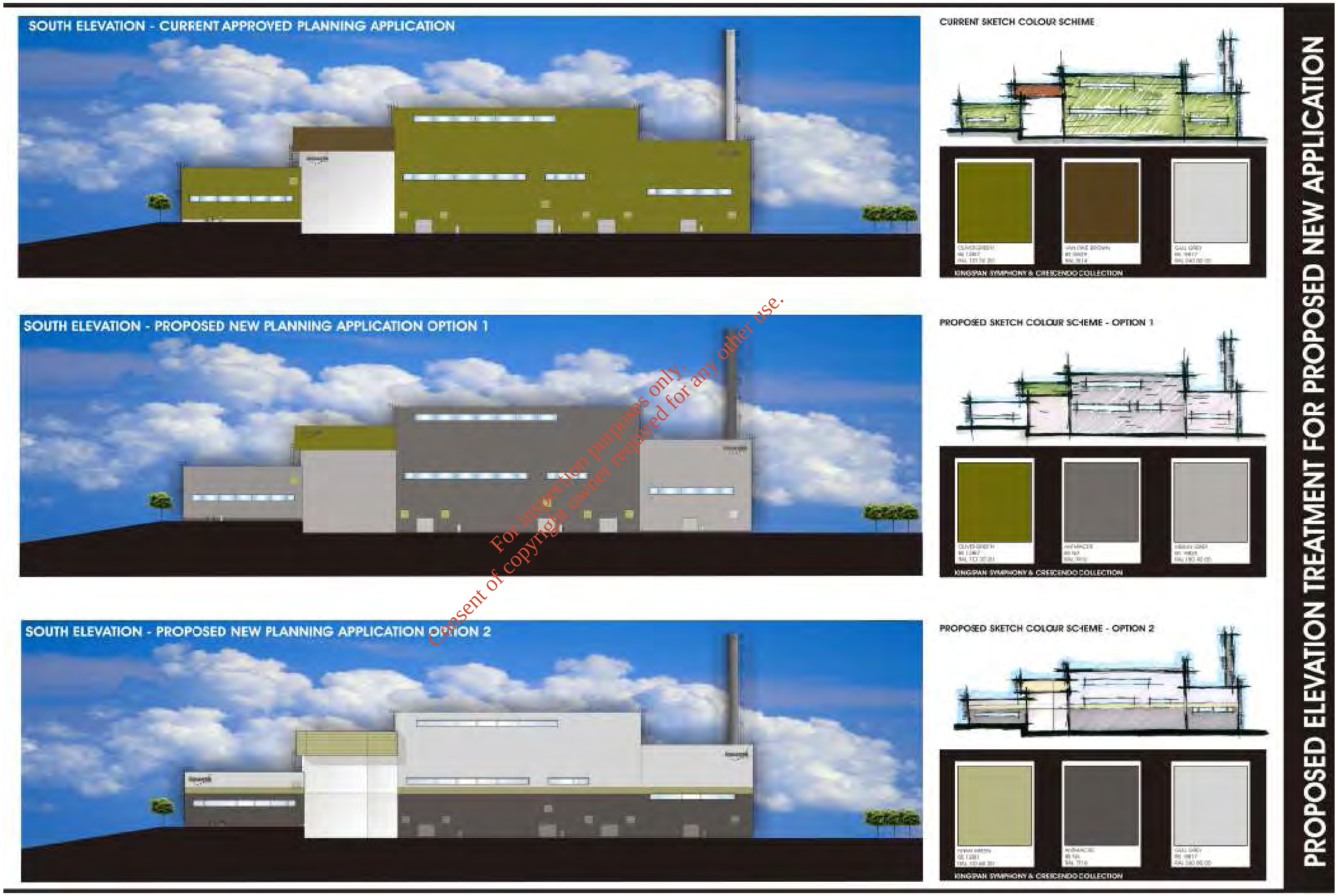


Figure 3.1 Comparison of Permitted Colour Scheme when applied to Proposed Amendments with options

Figure 3.2 Final Colour Scheme selected applied to proposed amendments

3.3 CONCLUSIONS

The facility will allow the North East Region to achieve its policy target for energy recovery identified in the current Regional Waste Management Plan for the region.

Waste-to-Energy plants provide a renewable source of energy and the construction of such a plant is in line with EU and national policy to promote renewable energy sources.

The technology chosen is BAT in line with the BREF Notes on Waste Incineration and will ensure the proposed facility operates well within stringent EU standards for the incineration of waste.

Appendix 3.1

IPPC Reference Document on the Best Available Techniques for Waste Incineration. July 2005

Executive Summary

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Chapter 5: Best Available Techniques

EUROPEAN COMMISSION
DIRECTORATE-GENERAL JRC
JOINT RESEARCH CENTRE
Institute for Prospective Technological Studies (Seville)
Sustainability in Industry, Energy and Transport
European IPPC Bureau

Integrated Pollution Prevention and Control

Reference Document on the Best Available Techniques for Waste Incineration

Dated July 2005

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This document is one of a series of foreseen documents as below (at the time of writing, not all documents have been drafted):

Full title	BREF code
Reference Document on Best Available Techniques for Intensive Rearing of Poultry and Pigs	ILF
Reference Document on the General Principles of Monitoring	MON
Reference Document on Best Available Techniques for the Tanning of Hides and Skins	TAN
Reference Document on Best Available Techniques in the Glass Manufacturing Industry	GLS
Reference Document on Best Available Techniques in the Pulp and Paper Industry	PP
Reference Document on Best Available Techniques on the Production of Iron and Steel	IandS
Reference Document on Best Available Techniques in the Cement and Lime Manufacturing Industries	CL
Reference Document on the Application of Best Available Techniques to Industrial Cooling Systems	CV
Reference Document on Best Available Techniques in the Chlor - Alkali Manufacturing Industry	CAK
Reference Document on Best Available Techniques in the Ferrous Metals Processing Industry	FMP
Reference Document on Best Available Techniques in the Non Ferrous Metals Industries	NFM
Reference Document on Best Available Techniques for the Textiles Industry	TXT
Reference Document on Best Available Techniques for Mineral Oil and Gas Refineries	REF
Reference Document on Best Available Techniques in the Large Volume Organic Chemical Industry	LVOC
Reference Document on Best Available Techniques in the Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector	CWW
Reference Document on Best Available Techniques in the Food, Drink and Milk Industry	FM
Reference Document on Best Available Techniques in the Smitheries and Foundries Industry	SF
Reference Document on Best Available Techniques on Emissions from Storage	ESB
Reference Document on Best Available Techniques on Economics and Cross-Media Effects	ECM
Reference Document on Best Available Techniques for Large Combustion Plants	LCP
Reference Document on Best Available Techniques in the Slaughterhouses and Animal By-products Industries	SA
Reference Document on Best Available Techniques for Management of Tailings and Waste-Rock in Mining Activities	MTWR
Reference Document on Best Available Techniques for the Surface Treatment of Metals	STM
Reference Document on Best Available Techniques for the Waste Treatments Industries	WT
Reference Document on Best Available Techniques for the Manufacture of Large Volume Inorganic Chemicals (Ammonia, Acids and Fertilisers)	LVIC-AAF
Reference Document on Best Available Techniques for Waste Incineration	WI
Reference Document on Best Available Techniques for Manufacture of Polymers	POL
Reference Document on Energy Efficiency Techniques	ENE
Reference Document on Best Available Techniques for the Manufacture of Organic Fine Chemicals	OFC
Reference Document on Best Available Techniques for the Manufacture of Speciality Inorganic Chemicals	SIC
Reference Document on Best Available Techniques for Surface Treatment Using Solvents	STS
Reference Document on Best Available Techniques for the Manufacture of Large Volume Inorganic Chemicals (Solids and Others)	LVIC-S
Reference Document on Best Available Techniques in Ceramic Manufacturing Industry	CER

EXECUTIVE SUMMARY

The BAT (Best Available Techniques) Reference Document (BREF) entitled Waste Incineration (WI) reflects an information exchange carried out under Article 16(2) of Council Directive 96/61/EC (IPPC Directive). This executive summary describes the main findings, a summary of the principal BAT conclusions and the associated consumption and emission levels. It should be read in conjunction with the preface, which explains this document's objectives; how it is intended to be used and legal terms. It can be read and understood as a standalone document but, as a summary, it does not present all the complexities of this full document. It is therefore not intended as a substitute for this full document as a tool in BAT decision making.

Scope of this document

The scope of this document is based on Sections 5.1 and 5.2 of Annex 1 of the IPPC Directive 96/61/EC, in so far as they deal with incineration of waste. The scope chosen for the work was not restricted by the installation size limitations in the IPPC Directive, nor by the definitions of waste, recovery or disposal included therein. The selected scope therefore intended to provide a pragmatic view across the incineration sector as a whole, with a particular focus upon those installation and waste types that are most common. The scope of the Waste Incineration Directive was also a factor taken into account when deciding on the scope of the BREF document. The final contents of the BREF reflect the information that was submitted during the information exchange by the TWG.

The document deals only with the dedicated incineration of waste and not with other situations where waste is thermally treated, e.g. co-incineration processes such as cement kilns and large combustion plants.

Although incineration provides the main focus of the document, it also includes some information on waste pyrolysis and gasification systems.

This BREF document does not:

- deal with decisions concerning the selection of incineration as a waste treatment option
- compare waste incineration with other waste treatment options.

Waste Incineration (WI)

Incineration is used as a treatment for a very wide range of wastes. Incineration itself is commonly only one part of a complex waste treatment system that altogether, provides for the overall management of the broad range of wastes that arise in society.

The incineration sector has undergone rapid technological development over the last 10 to 15 years. Much of this change has been driven by legislation specific to the industry and this has, in particular, reduced emissions to air from individual installations. Continual process development is ongoing, with the sector now developing techniques which limit costs, whilst maintaining or improving environmental performance.

The objective of waste incineration, in common with most waste treatments, is to treat waste so as to reduce its volume and hazard, whilst capturing (and thus concentrating) or destroying potentially harmful substances. Incineration processes can also provide a means to enable recovery of the energy, mineral and/or chemical content from waste.

Basically, waste incineration is the oxidation of the combustible materials contained in the waste. Waste is generally a highly heterogeneous material, consisting essentially of organic substances, minerals, metals and water. During incineration, flue-gases are created that will contain the majority of the available fuel energy as heat. The organic substances in the waste will burn when they have reached the necessary ignition temperature and come into contact with oxygen. The actual combustion process takes place in the gas phase in fractions of seconds and simultaneously releases energy. Where the calorific value of the waste and oxygen supply is sufficient, this can lead to a thermal chain reaction and self-supporting combustion, i.e. there is no need for the addition of other fuels.

Although approaches vary greatly, the incineration sector may approximately be divided into the following main sub-sectors:

i. Mixed municipal waste incineration – treating typically mixed and largely untreated household and domestic wastes but may sometimes including certain industrial and commercial wastes (industrial and commercial wastes are also separately incinerated in dedicated industrial or commercial non-hazardous waste incinerators).

ii. Pretreated municipal or other pretreated waste incineration – installations that treat wastes that have been selectively collected, pretreated, or prepared in some way, such that the characteristics of the waste differ from mixed waste. Specifically prepared refuse derived fuel incinerators fall in this sub-sector

iii. Hazardous waste incineration - this includes incineration on industrial sites and incineration at merchant plants (that usually receive a very wide variety of wastes)

iv. Sewage sludge incineration – in some locations sewage sludges are incinerated separately from other wastes in dedicated installations, in others such waste is combined with other wastes (e.g. municipal wastes) for its incineration

v. Clinical waste incineration – dedicated installations for the treatment of clinical wastes, typically those arising at hospitals and other healthcare institutions, exist as centralised facilities or on the site of individual hospital etc. In some cases certain clinical wastes are treated in other installations, for example with mixed municipal or hazardous wastes.

Data in this document shows that, at the time of its compilation:

- Around 20 - 25 % of the municipal solid waste (MSW) produced in the EU-15 is treated by incineration (total MSW production is close to 200 million tonnes per year)
- The percentage of MSW treated by incineration in individual Member States of the EU-15 varies from 0 % to 62 %
- The total number of MSW installations in the EU-15 is over 400
- Annual MSW incineration capacity in individual European countries varies from 0 kg to over 550 kg per capita
- In Europe the average MSW incinerator capacity is just under 200000 tonnes per year.
- The average throughput capacity of the MSWI installations in each MS also varies. The smallest plant size average seen is 60000 tonnes per year and the largest close to 500000 tonnes per year
- Around 12 % of the hazardous waste produced in EU-15 is incinerated (total production close to 22 million tonnes per year).

Expansion of the MSW incineration sector is anticipated in Europe over the next 10 – 15 years as alternatives are sought for the management of wastes diverted from landfill by the Landfill Directive and both existing and new Member States examine and implement their waste management strategies in the light of this legislation.

Key environmental issues

Waste and its management are a significant environmental issue. The thermal treatment of waste may therefore be seen as a response to the environmental threats posed by poorly or unmanaged waste streams. The target of thermal treatment is to provide for an overall reduction in the environmental impact that might otherwise arise from the waste. However, in the course of the operation of incineration installations, emissions and consumptions arise, whose existence or magnitude is influenced by the installation design and operation.

The potential impacts of waste incineration installations themselves fall into the following main categories:

- overall process emissions to air and water (including odour)
- overall process residue production
- process noise and vibration
- energy consumption and production
- raw material (reagent) consumption
- fugitive emissions – mainly from waste storage
- reduction of the storage/handling/processing risks of hazardous wastes.

Other impacts beyond the scope of this BREF document (but which can significantly impact upon the overall environmental impact of the whole chain of waste management) arise from the following operations:

- transport of incoming waste and outgoing residues
- extensive waste pretreatment (e.g. preparation of waste derived fuels).

The application and enforcement of modern emission standards, and the use of modern pollution control technologies, has reduced emissions to air to levels at which pollution risks from waste incinerators are now generally considered to be very low. The continued and effective use of such techniques to control emissions to air represents a key environmental issue.

Other than its role in ensuring effective treatment of otherwise potentially polluting unmanaged wastes, many waste incineration installations have a particular role as an energy-from-waste recovery process. Where policies have been implemented to increase the ability of, (most commonly municipal) waste incineration installations to recover the energy value of the waste, this increases the exploitation of this positive environmental contribution. A significant environmental opportunity for the industry is therefore to increase its potential as an energy supplier.

Applied processes and techniques

Chapter 2 of this document provides a description of the processes and techniques that are applied in the waste incineration industry. It focuses upon the most commonly applied thermal treatment of incineration, but also includes information on gasification and pyrolysis. The following main activities and areas are described to varying degrees of detail:

- incoming waste reception
- storage of waste and raw materials
- pretreatment of waste (mainly on-site treatments and blending operations)
- loading of waste into the furnace
- techniques applied at the thermal treatment stage (furnace design etc.)
- the energy recovery stage (e.g. boiler and energy supply options)
- flue-gas cleaning techniques (grouped by substance)
- flue-gas cleaning residue management
- emissions monitoring and control
- waste water control and treatment (e.g. from site drainage, flue-gas treatment, storage)
- ash/bottom ash management and treatment (arising from the combustion stage).

Where techniques are specific to certain types of wastes, relevant sections are subdivided according to waste type.

Consumptions and emissions

The emissions, and material and energy consumptions, that arise from waste incineration installations are described in Chapter 3. Available data are presented on installation emissions to air and water, noise, and residues. Information on raw material consumptions is also provided, along with a section that focuses upon energy consumption and output. Most of the data are whole installation data arising from industrial surveys. Some information about the techniques applied in order to achieve these emission levels is also included.

Although some European installations have yet to be upgraded, the industry is generally achieving operational levels that meet or improve upon the air emission limit values set in Directive 2000/76/EC.

In circumstances where CHP or heat (as heat or steam) can be supplied, it is possible for very large percentages of the energy value of the waste (approx. 80 % in some cases) to be recovered.

Techniques to consider in the determination of BAT

Each technique described in Chapter 4 includes the available relevant information, on: the consumption and emission levels achievable using the technique; some idea of the costs and the cross-media issues associated with the technique, and; information on the extent to which the technique is applicable to the range of installations requiring IPPC permits - for example new, existing, large or small installations, and to various waste types. Management systems, process-integrated techniques and end-of-pipe measures are included.

The techniques that are included are those that are considered to have the potential to achieve, or contribute to, a high level of environmental protection in the waste incineration industry. The final BAT, as agreed by the TWG, is not covered in Chapter 4, but in Chapter 5. The inclusion of a technique in Chapter 4, but not in Chapter 5 should not be taken as an indication that the technique is not and cannot be BAT - the rationale for excluding the technique from Chapter 5 could, for example, be that the TWG felt that the technique not sufficiently widely applicable for it to be described as *BAT in general*. Furthermore, because it is not possible to be exhaustive and because the situation is dynamic, Chapter 4 cannot be considered to be entirely comprehensive. Other techniques may also provide for levels of performance that meet or exceed the BAT criteria later established in Chapter 5, and when applied locally those techniques may provide particular advantages in the situation in which they are used.

The techniques included are grouped in approximately the order in which they would appear in the majority of waste incineration installations. The table below gives the title of the chapter subsections and indicates the grouping to which the techniques are listed.

Chapter 4 section number	Title of section
4.1	General practices applied before thermal treatment
4.2	Thermal processing
4.3	Energy recovery
4.4	Flue-gas treatment
4.5	Process water treatment and control
4.6	Treatment techniques for solid residues
4.7	Noise
4.8	Environmental management tools
4.9	Good practice for public awareness and communication

Table: Organisation chart for the information in Chapter 4

Chapter 4 concentrates on techniques that provide particular advantages at each of the main stages generally seen in waste incineration installations. Dividing the techniques in this way does however mean that, although mentioned in some cases, the important aspect of the overall integration of all of the techniques in an installation (sometimes referred to in the BREF as their "inter-process compatibility") is something which requires careful consideration when reading the individual sections of Chapter 4. The subsections on *operational data* and *applicability* are generally where such matters are given consideration. Overall compatibility was also been given further consideration when finally deriving the BAT conclusions in Chapter 5.

Chapter 4 does not generally describe in detail those techniques that, whilst they provide, or contribute to, a high level of environmental performance, are so common that their use may already be considered as standard. An example of this is that, because the applicability of the main combustor designs to the main waste streams is relatively well established, the techniques considered at this stage concentrate mainly on:

a) the general issue of ensuring the combustion system selected is properly matched to the wastes fed to it, and
b) on some aspects relating to improving combustion performance e.g. waste preparation, air supply control, etc.

BAT for the incineration of waste

The BAT chapter (Chapter 5) identifies those techniques that the TWG considered to be BAT in a general sense, based on the information in Chapter 4, taking into account the Article 2(11) definition of best available techniques and the considerations listed in Annex IV of the Directive.

The BAT chapter does not set or propose emission limit values but suggests the operational consumption and emission values that are associated with the use of BAT. The introduction to Chapter 5 included in this BREF is specifically extended to clarify certain issues that were considered to be of particular relevance to the waste incineration industry, including the links between the Waste Incineration Directive (WID) and IPPC. These additional specific issues include:

- the difference between WID emission limit values and BAT performance
- the relationship between BAT and site selection
- how to understand and use the BAT described in Chapter 5.

The following paragraphs summarise the key BAT conclusions but **reference must be made to the BAT chapter itself to be comprehensive**. The generic BAT are intended to apply to the whole sector (i.e. waste incineration, waste gasification and waste pyrolysis of whatever type of waste). Other BAT are given that apply to sub-sectors dealing primarily with specific waste streams. It is therefore anticipated that a specific installation would apply a combination of the generic and waste specific BAT, and that installations treating mixtures of waste, or wastes not specifically mentioned, would apply the generic BAT plus a suitable selection of the waste specific BAT. Further comment on the combining of the BAT is included in the introduction to Chapter 5.

Generic BAT

A fundamental BAT stresses the importance of the selecting an installation design that is suited to the characteristics of the waste received at the installation in terms of both its physical and chemical characteristics. This BAT is fundamental to ensuring the installation may treat the waste received with a minimum of process disturbances – which themselves may give rise to additional environmental impacts. To this end there is also a BAT about the minimisation of planned and unplanned shutdowns.

BAT includes establishing and maintaining quality controls over the waste input. This aims to ensure that the waste characteristics remain suited to the design of the receiving installation. Such quality control procedures are compatible with the application of an environmental management system, which is also considered BAT.

There are several BAT regarding the conditions and management of the storage of incoming wastes prior to their treatment, so that this does not give rise to pollution and odour releases. Some specific techniques and conditions of storage are noted. A risk based approach that takes into account the properties of the waste concerned is considered BAT.

Consideration of the demonstrated ability of some installation designs to very efficiently treat highly heterogeneous wastes (e.g. mixed MSW), and the risks and cross-media effects associated with pretreatment, results in a conclusion that it is BAT to pretreat incoming wastes to the degree required to meet the design specification for the receiving installation, noting that to treat wastes beyond this requires balanced consideration of (possibly limited) benefits, operational factors and cross-media effects.

The design and operation of the combustion stage is identified as an important primary pollution prevention aspect, and therefore of great relevance to achieving the aims of the IPPC Directive. It is noted in the BAT chapter that flow modelling at the design stage may assist in ensuring that certain key design decisions are well informed. In operation, it is considered BAT to use various techniques (e.g. control of air supply and distribution) to control combustion. The BAT regarding the selection of a design that suits the waste received is of particular relevance here.

In general the use of the combustion operating conditions specified in Article 6 of Directive 2000/76/EC (WID) are considered to be compatible with BAT. However the TWG noted, that the use of conditions in excess of these (e.g. higher temperatures) could result in an overall deterioration in environmental performance, and that there were several examples of hazardous waste installations that had demonstrated an overall improvement in environmental performance when using lower operational temperatures than the 1100 °C specified in WID for certain hazardous wastes. The general BAT conclusion was that the combustion conditions (e.g. temperature) should be sufficient to achieve the destruction of the waste but, in order to limit potential cross-media impacts, generally not significantly in excess of those conditions. The provision of auxiliary burner(s) for achieving and maintaining operational conditions is considered to be BAT when waste is being burned.

When gasification or pyrolysis is used, in order to prevent the generation of waste by disposal of the reaction products of these techniques, it is BAT either, to recover the energy value from the products using a combustion stage, or to supply them for use. The BAT associated emission levels for releases to air from the combustion stage of such installations are the same as those established for incineration installations.

The recovery of the energy value of the waste is a key environmental issue for the sector, presenting an area where the sector may make a significant positive contribution. Several BAT cover this aspect, dealing with:

- specific techniques that are considered to be BAT
- the heat transfer efficiencies expected of boilers
- the use of CHP, district heating, industrial steam supply and electricity production
- the recovery efficiencies that may be anticipated.

With CHP and steam/heat supply generally offering the greatest opportunity for increasing energy recovery rates, policies affecting the availability of suitable customers for steam/heat generally play a far greater role in determining the efficiency achievable at an installation than the detail of its design. For mainly policy and economic reasons, electricity generation and supply is often the energy recovery option selected at individual installations. Options for CHP, district heating and industrial steam supply are only well exploited in a few European Member States – generally those that have high heat prices and/or that have adopted particular policies. The supply of energy for the operation of cooling systems and desalination plants is something that is done, but is in general poorly exploited – such an option may be of particular interest in warmer climate zones, and in general expands the options for the supply of waste derived energy.

The flue-gas treatments applied at waste incineration installations have been developed over many years in order to meet stringent regulatory standards and are now highly technically advanced. Their design and operation are critical to ensure that all emissions to air are well controlled. The BAT that are included:

- cover the process of selection of FGT systems
- describe several specific techniques which are considered to be BAT
- describe the performance levels that are anticipated from the application of BAT.

The performance ranges agreed by the wider TWG resulted in some split views. These were mainly from one Member State and the Environmental NGO, who believed that lower emission values than the ranges agreed by the remainder of the TWG could also be considered to be BAT.

The BAT regarding waste water control include:

- the in-process recirculation of certain effluents
- the separation of drainage for certain effluents
- the use of on-site effluent treatment for wet scrubber effluents
- BAT associated performance levels for emissions from scrubber effluent treatment
- the use of specific techniques.

The performance ranges agreed by the wider TWG resulted in some split views from one Member State and the Environmental NGO, who believed that lower emission values than the ranges given could also be considered to be BAT.

BAT regarding residue management include:

- a bottom ash burnout TOC level of below 3 %, with typical values falling between 1 and 2 %
- a list of techniques, which when suitably combined may attain these burnout levels
- the separate management of bottom ash from fly ash and a requirement to assess each stream produced
- the extraction of ferrous and non-ferrous metals from ash for their recovery (where present in ash to sufficient degree to make this viable)
- the treatment of bottom ashes and other residues using certain techniques - to the extent required for them to meet the acceptance criteria at the receiving recovery or disposal site.

In addition to these generic BAT, more specific BAT are identified for those sub-sectors of the industry treating mainly the following wastes:

- municipal wastes
- pretreated or selected municipal wastes
- hazardous wastes
- sewage sludge
- clinical waste.

The specific BAT provide, where it has been possible, more detailed BAT conclusions. These conclusions deal with the following waste stream specific issues:

- in-coming waste management, storage and pretreatment
- combustion techniques
- energy recovery performance.

Emerging techniques

The section on emerging techniques is not comprehensive. A number of the techniques supplied by the TWG and included in earlier drafts of this document were transferred into this section. In the majority of cases the techniques included have only been demonstrated on a pilot or trial scale.

The degree of demonstration (as measured by overall throughput and operational hours) of pyrolysis and gasification on the main European waste streams is low compared with incineration and operational difficulties are reported at some installations. However, both gasification and pyrolysis are applied in the sector and therefore, according to the BREF definition, cannot be considered to be *emerging techniques*. For this reason the information concerning these techniques is included in Chapter 4.

Concluding remarks

Information exchange
This BREF is based on several hundred sources of information, and over 7000 consultation comments supplied by a very large working group. Some of the information was overlapping and therefore, not all of the documents supplied are referenced in the BREF. Both industry and Member States supplied important information. Data quality was generally good, particularly for emissions to air, allowing valid comparisons to be made in some cases. This was not however uniformly the case, and data regarding costs was difficult to compare owing to inconsistencies in data compilation and reporting. The consumption and emissions data given are predominantly for whole installations or groups of techniques, rather than individual ones. This has lead to some important BAT conclusions being expressed as quantitative overall performance targets, with certain technical options presented that when suitably combined, may give rise to that performance.

Level of consensus
There was a very good general level of consensus. There was full agreement, and no split views, in relation to the technique related BAT. There was also generally good consensus upon the quantitative BAT, although the operational emission levels associated with the use of BAT did give rise to some split views, with one Member State and the Environmental NGO recording split views in relation to many of the BAT associated emission levels for releases to both air and water.

Recommendations for future work and R&D projects

The information exchange and its result, i.e. this BREF, provide a step forward in achieving the integrated prevention and control of pollution from waste incineration. Further work could continue the process by providing:

- information regarding the techniques used to, and costs of, upgrading existing installations – such information may be derived from experience of implementing WID in Member States and might usefully be compared with the costs/performance at new installations
- the more detailed cost information that is required to undertake a more precise assessment of variations in technique affordability with plant size and waste type
- information regarding smaller installations – very little information was provided regarding small installations
- information regarding installations that treat industrial non-hazardous wastes and the impact on installations of treating mixtures of wastes e.g. sewage sludge or clinical waste with MSW
- a more detailed evaluation of the impact on pollution prevention of detailed combustion design features e.g. grate design
- further information on emerging techniques.
- ammonia consumption and emission (mainly to air and water) levels for different FGT systems (mainly wet, semi-wet and dry) and their relative NO_X reduction efficiency
- the impact of the dust removal temperature range upon PCDD/F releases to air and residues
- further experiences with continuous emissions monitoring for Hg (to air and water).

Other important recommendations for further work beyond the scope of this BREF but arising from the information exchange are:

- the need for consideration of the overall impact of competition for waste treatment, in particular competition from industries co-incinerating wastes – a study of such might usefully include consideration of: relative reliability of, and risks to, the supply of the total waste management service; overall emissions and energy recovery according to various degrees of diversion, and; consider and identify key risk factors e.g. waste fuel quality assurance.
- it may be useful to assess the impact on adopted waste strategies (i.e. the balance of technologies used on a national scale), and on achieved thermal treatment installation efficiencies, of the degree of integration of energy and waste management policy in EU Member States (and other countries). Such studies may identify how policy on energy and waste interact and give examples, both positive and negative.
- the need to understand in more detail of the impact of absolute and relative energy prices (for electricity and heat) upon the typically achieved energy efficiency of installations, and the role and impact of subsidies and taxation schemes
- the identification of the typical barriers to developing new installations and the approaches that have proved successful
- the development of suitable standards for the use of bottom ash – such standards have proved helpful in improving markets for the use of bottom ash
- the costs and benefits of further reducing emissions from the waste incineration industry when compared to reductions at other industrial and anthropogenic sources of pollution.

The EC is launching and supporting, through its RTD programmes, a series of projects dealing with clean technologies, emerging effluent treatment and recycling technologies and management strategies. Potentially these projects could provide a useful contribution to future BREF reviews. Readers are therefore invited to inform the EIPPCB of any research results which are relevant to the scope of this document (see also the preface of this document).

5 BEST AVAILABLE TECHNIQUES

General Introduction to the BAT chapter

In understanding this chapter and its contents, the attention of the reader is drawn back to the preface of this document and in particular the fifth section of the preface: "How to understand and use this document". The techniques and associated emission and/or consumption levels, or ranges of levels, presented in this chapter have been assessed through an iterative process involving the following steps:

- identification of the key environmental issues for Waste Incineration
- examination of the techniques most relevant to address those key issues
- identification of the best environmental performance levels, on the basis of the available data in the European Union and worldwide
- examination of the conditions under which these performance levels were achieved; such as costs, cross-media effects, and the main driving forces involved in implementation of these techniques
- selection of the Best Available Techniques (BAT) and the associated emission and/or consumption levels for this sector in a general sense all according to Article 2(11) and Annex IV of the Directive.

Expert judgement by the European IPPC Bureau and the relevant Technical Working Group (TWG) has played a key role in each of these steps and in the way in which the information is presented here.

On the basis of this assessment, techniques, and as far as possible emission and consumption levels associated with the use of BAT, are presented in this chapter that are considered to be appropriate to the sector as a whole and in many cases reflect current performance of some installations within the sector. 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. In some cases it may be technically possible to achieve better emission or consumption levels but due to the costs involved or cross-media considerations, they are not considered to be appropriate as BAT for the sector as a whole. However, such levels may be considered to be justified in more specific cases where there are special driving forces.

The emission and consumption levels associated with the use of BAT have to be seen together with any specified reference conditions (e.g. averaging periods).

The concept of "levels associated with BAT" described above is to be distinguished from the term "achievable level" used elsewhere in this document. Where a level is described as "achievable" using a particular technique or combination of techniques, this should be understood to mean that the level may be expected to be achieved over a substantial period of time in a well maintained and operated installation or process using those techniques, although the particular circumstances (e.g. technical conditions, costs, cross-media impacts) that gave rise to the achieved level may mean that these levels are not generally considered to be BAT.

Where available, data concerning costs have been given together with the description of the techniques presented in the previous chapters. These give a rough indication about the magnitude of costs involved. However, the actual cost of applying a technique will depend strongly on the specific situation regarding, for example, taxes, fees, and the technical characteristics of the installation concerned. It is not possible to evaluate such site-specific factors fully in this document. In the absence of data concerning costs, conclusions on economic viability of techniques are drawn from observations on existing installations.

It is intended that the general BAT in this chapter are a reference point against which to judge the current performance of an existing installation or to judge a proposal for a new installation. In this way they will assist in the determination of appropriate "BAT-based" conditions for the installation or in the establishment of general binding rules under Article 9(8). It is foreseen that new installations can be designed to perform at or even better than the general BAT levels presented here, and that existing installations could move towards the general BAT levels or do better, subject to the technical and economic applicability of the techniques in each case.

While the BAT reference documents do not set legally binding standards, they are meant to give information for the guidance of industry, Member States and the public on achievable emission and consumption levels when using specified techniques. The appropriate limit values for any specific case will need to be determined taking into account the objectives of the IPPC Directive and the local considerations.

Additional introductory issues specifically developed for this BREF

The relationship between Emission Limit Values and BAT performance:

Many European incineration plants have been the subject of specific regulations concerning their emissions to air – in some cases for many years. Regulations have included the application of emission limit values (ELVs) for some substances when released to air. The most recent European legislation is Directive 2000/76/EC, which includes a range of operational conditions and ELVs applicable to the majority of situations where waste is burned in industrial installations.

When interpreting the emission and performance levels associated with the use of BAT as reported in this chapter it is essential that the reader understands the following:

- emission and performance levels associated with the use of BAT are not the same as ELVs
- across the EU25, where this is a matter for national or local competence, ELVs are set and enforced in different ways
- the emission and performance levels given here are the operational performance levels that would normally be anticipated from the application of BAT
- compliance with the ELVs set in permits and legislation naturally results in operational levels below those ELVs
- it is important to note that, at a particular installation, lowering an emission level within the BAT range presented here may not represent the best overall solution considering costs and cross-media effects. Additionally, antagonism may exist between them i.e. lowering one may increase another. For these reasons, it is not anticipated that an installation would operate with all parameters at the lowest levels in the BAT ranges.

The ELVs that appear in the various regulations applicable to incineration have been used in equipment supply contracts as minimum performance guarantee levels for plant suppliers, to be achieved under the most adverse of operating conditions. This then leads to a situation where in actual operation, some incineration installations show operational emissions that are significantly below the ELVs (see in particular Section 3.2). It is, therefore, important to appreciate the difference between the operational performance levels that are given as BAT in this chapter, and the higher ELVs that have given rise to this level of performance.

In a hypothetical example, if the ELV for HCl is set at 10 mg/Nm^3, a supplier of a particular technology may, as part of their equipment supply contract, choose to provide a performance guarantee in the region of 7 - 8 mg/ Nm^3. In such a situation the plant might then typically operate at 1 - 5 mg/ Nm^3 with some transient variations above this.

An actual example of an ELV and reported emission results for dust at a MSWI in one MS is (data year 2001):

- ELV given in the permit was: 15 mg/Nm³ (½hr average)
- range of actual measured values: 0 - 12.6 mg/Nm³ (½hr average)
- monthly mean values (based on all measured ½hr average values): 0.4 - 1.8 mg/Nm³
- yearly mean value (based on all measured ½hr average values): 0.8 mg/Nm³.

It can be seen that the averaged emission values are closer to the lower level of the measured range and far below the ELV set in this example case. It should however be noted that it cannot be automatically assumed that similar relationships between ELVs and actual results will exist in other cases or other industrial sectors.

For some substances and some technologies reducing an ELV may result in difficulties in guaranteeing the lower emission level. This can then drive the adoption of a different technique for the control of that substance and require revision of the overall design of the installation.

Reducing ELVs to air on their own, without consideration of the overall integrated performance of the installation, can, whilst improving performance in one respect, give rise to an overall reduction in performance and/or significant cost impacts. This is generally supported for this sector by the results of European health impact assessment studies - which, on the basis of current evidence and modern emissions performance, suggest that the local impacts of incinerator emissions to air are either negligible or not detectable. [64, TWGComments, 2003]

The emission and performance levels associated with the use of BAT as given in this chapter are, where appropriate, given with the reference conditions under which they apply, for example the relevant monitoring and sampling periods. For emissions to air the release concentrations stated are standardised at 11 % Oxygen, dry gas, 273K and 101.3kPa.

Combining the BAT on waste incineration listed in this chapter:

When considering the BAT described here for waste incineration, it is important to consider that the optimal solution for a particular incineration installation as a whole, varies according to local conditions. A checklist for the best local solution is not what the BAT listed here provides, as this would require the consideration of local conditions to a degree that cannot be carried out in a document dealing with BAT in general. Hence, the simple combination of the individual elements described here as BAT in general, without consideration of local conditions is not likely to give the optimised local solution in relation to the environment as a whole.
[74, TWGComments, 2004]

The relationship between BAT and site selection for waste incineration installations:

This document does not itself deal with criteria for the selection of suitable sites for waste incineration plants, but it is the case that for some of the BAT to be fulfilled, special site conditions are required. However, the choice of a site itself will typically require consideration of many other important criteria e.g. site availability, waste transport to the installation etc.

For example, in a particular local circumstance it may only be possible to build either:
a) an installation with very high rates of energy recovery in a location that then requires long waste transport distances, or
b) one with reduced energy recovery that then reduces the waste transport

Such advantages and disadvantages themselves are often considered together in a balanced way when the location is being selected. The result may then be that, owing to the location selected, some of the BAT included here are simply unavailable at the installation level.

Understanding the application of the BAT described in this chapter:

This BREF deals with wastes of different types (e.g. HW, MSW, sludge) which exhibit a very wide range of characteristics between and even within the different classes e.g. particulate size, calorific value, water and ash content, type and concentration of pollutants. Therefore when considering the BAT presented in this chapter the applicability of the techniques described in Chapter 4 must always be checked for a specific plant. Article 9 (4) of the Directive takes this into account saying that permit conditions shall be based on BAT "*without prescribing the use of any technique or specific technology, but taking into account the technical characteristics of the installation concerned, its geographical location and the local environmental conditions.*"

The BAT that are listed in this chapter include generic BAT (see 5.1) and specific BAT (see 5.2, 5.3, 5.4, 5.5 and 5.6) for certain waste types. The generic BAT are those that are considered to be generally applicable to all types of waste incineration installations. The waste type specific BAT are those that are considered to be generally BAT for installations dealing mainly or wholly with certain types of waste (i.e. dedicated installations). At installations that are receiving more than one waste type a combination of the specific BAT may represent BAT, however no assessment of when and to what degree they should be applied is made here and a local judgement will be required.

Overall BAT for a specific case	
Generic BAT plus	**Specific BAT for waste type**
as described in 5.1	Municipal waste incineration – section 5.2
	Pretreated or selected municipal waste (including municipal refuse derived fuels) – section 5.3
	Hazardous waste incineration) – section 5.4
	Sewage sludge incineration) – section 5.5
	Clinical waste incineration) – section 5.6

Table 5.1: How to combine the BAT described for a specific case

Because it is not possible to be exhaustive and because of the dynamic nature of industry, and the momentary nature of this document, it is possible that there may be additional techniques not described in this chapter but which meet or exceed the BAT criteria established here.

5.1 Generic BAT for all waste incineration

The generic BAT in this section are additional to those listed later in this chapter for individual sub-sectors of the incineration industry.

It is considered that in general for each waste incineration installation, the combination of the BAT listed here (section 5.1), together with the waste type specific BAT listed in sections 5.2 to 5.6 represent a starting point for the process of determining appropriate local techniques and conditions. The practical aim is therefore the local optimisation in the circumstances of the installation, taking account of this BAT guidance, and other local factors.

For waste incineration, the local factors to be taken into account may, amongst others, generally include:

- local environmental drivers e.g. background environmental quality may influence the required local performance in respect of releases from the installation, or availability of certain resources
- the particular nature of the waste(s) that arise locally and the impact of the waste management infrastructure upon the type and nature of waste arriving at the installation
- the cost and technical possibility of implementing a particular technique in relation to its potential advantages – this is of particular relevance when considering the performance of existing installations
- the availability, degree of utilisation and price of options for the recovery/disposal of residues produced at the installation
- the availability and price received for recovered energy
- local economic/market/political factors that may influence the tolerability of the higher gate fees that may accompany the addition of certain technological options.

Therefore, in combination with the additional waste stream specific BAT listed in later sections of this chapter, in order to provide for levels of performance that are generally compatible with BAT, in general BAT for waste incineration is considered to be:

1. the selection of an installation design that is suited to the characteristics of the waste received, as described in 4.1.1 and 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 preventative maintenance in order to achieve this

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 released 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.

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 atmosphere 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

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 (e.g. using bunker crane mixing) or further pretreatment (e.g. 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 (e.g. energy consumption, noise, odour or other releases) of the more extensive pretreatments (e.g. 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 (e.g. when used for certain combustion systems) from the shredded wastes before the incineration stage.

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 (such 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 at 4.4.4.1 and 4.4.4.2).

16. in order to reduce overall emissions, to adopt operational regimes and implement procedures (e.g. 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:
   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 (i.e. temperatures, residence times and turbulence) as specified in Article 6 of Directive 2000/76. 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 of below the 1100 °C (as specified for certain hazardous waste in 2000/76/EC) have 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 (e.g. where low 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 shut-down 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 (e.g. the use of water walls in grate furnaces and/or secondary combustion chambers) and furnace insulation (e.g. 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 (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

24. When gasification or pyrolysis is used, in order to avoid the generation of waste, it is BAT to:
   a. combine the gasification or pyrolysis stage with a subsequent combustion stage with energy recovery and flue-gas treatment that provides for operational emission levels to air within the BAT associated emission ranges specified in this BAT chapter, and/ or
   b. recover or supply for use of the substances (solid, liquid or gaseous) that are not combusted

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 (e.g. 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 °C, lower for HW and higher for SS. Radiative heat exchangers, such as platten type super heaters, 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 e.g. 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 waste 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

27. to secure where practicable, long-term base-load heat/steam supply contracts to large heat/steam users (see 4.3.1) so that a more regular demand for the recovered energy exists and therefore a larger proportion of the energy value of the incinerated waste may be used

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 (i.e. use CHP)
   b. the supply of heat or steam for use in district heating distribution networks
   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 (e.g. waste transport, availability of energy users, etc) which are addressed by 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):
   a. the use of higher steam parameters to increase electrical generation, and
   b. the protection of boiler materials using suitably resistant materials (e.g. claddings 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 upgrading 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
   b. wherever possible, ordering flue-gas treatment systems in such a way that flue-gas reheating is avoided (i.e. 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 lower 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 on-line and off-line boiler cleaning techniques to reduce dust residence and accumulation in the boiler, as described in 4.3.19

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.

Table 5.2: Operational emission level ranges associated with the use of BAT (see notes below) for releases to air (in mg/Nm^3 or as stated)

Substance(s)	Non-continuous samples	½ hour average	24 hour average	Comments
Total dust		1 – 20 (see split view 2)	1 – 5	In general the use of fabric filters give the lower levels within these emission ranges. Effective maintenance of dust control systems is very important. Energy use can increase as lower emission averages are sought. Controlling dust levels generally reduces metal emissions too.
Hydrogen chloride (HCl)		1 – 50	1 – 8	Waste control, blending and mixing can reduce fluctuations in raw gas concentrations that can lead to elevated short-term emissions. Wet FGT systems generally have the highest absorption capacity and deliver the lowest emission levels for these substances, but are generally more expensive. See Table 5.3 for consideration of criteria for selection between the main FGT systems, including cross-media impacts.
Hydrogen fluoride (HF)		<2 (see split view 2)	<1	
Sulphur dioxide (SO_2)		1 – 150 (see split view 2)	1 – 40 (see split view 2)	
Nitrogen monoxide (NO) and nitrogen dioxide (NO_2), expressed as nitrogen dioxide for installations using SCR		40 – 300 (see split view 2)	40 – 100 (see split view 2)	Waste and combustion control techniques coupled with SCR generally result in operation within these emission ranges. The use of SCR imposes an additional energy demand and costs. In general at larger installations the use of SCR results in less significant additional cost per tonne of waste treated. High N waste may result in increased raw gas NO_X concentrations.
Nitrogen monoxide (NO) and nitrogen dioxide (NO_2) expressed as nitrogen dioxide for installations not using SCR		30 – 350	120 – 180	Waste and combustion control techniques with SNCR generally result in operation within these emission ranges. 24 hour averages below this range generally require SCR although levels below 70mg/Nm^3 have been achieved using SNCR e.g. where raw NO_X is low and/or at high reagent dose rates) Where high SNCR reagent dosing rates are used, the resulting NH_3 slip can be controlled using wet FGT with appropriate measures to deal with the resultant ammoniacal waste water. High N waste may result in increased raw gas NO_X concentrations. (See also note 8 below in respect of small installations).
Gaseous and vaporous organic substances, expressed as TOC		1 – 20	1 – 10	Techniques that improve combustion conditions reduce emissions of these substances. Emission concentrations are generally not influenced greatly by FGT. CO levels may be higher during start-up and shut down, and with new boilers that have not yet established their normal operational fouling level
Carbon monoxide (CO)		5 – 100	5 – 30	
Mercury and its compounds (as Hg)	<0.05 (see split view 2)	0.001 – 0.03	0.001 – 0.02	Adsorption using carbon based reagents is generally required to achieve these emission levels with many wastes - as metallic Hg is more difficult to control than ionic Hg. The precise abatement performance and technique required will depend on the levels and distribution of Hg in the waste. Some waste streams have very highly variable Hg concentrations – waste pretreatment may be required in such cases to prevent peak overloading of FGC system capacity. Continuous monitoring of Hg is not required by Directive 2000/76/EC but has been carried out in some MSs
Total cadmium and thallium (and their compounds expressed as the metals)	0.005 - 0.05 (see split view 2)			See comments for Hg. The lower volatility of these metals than Hg means that dust and other metal control methods are more effective at controlling these substances than Hg.
Σ other metals	0.005 - 0.5			Techniques that control dust levels generally also control these metals
Dioxins and furans (ng TEQ/Nm^3)	0.01 – 0.1 (see split view 2)			Combustion techniques destroy PCDD/F in the waste. Specific design and temperature controls reduce *de-novo* synthesis. In addition to such measures, abatement techniques using carbon based absorbents reduce final emissions to within this emission range. Increased dosing rates for carbon absorbent may give emissions to air as low as 0.001 but result in increased consumption and residues.

Substances not included in Directive 2000/76/EC on waste incineration:				
Ammonia (NH_3)	<10	1 – 10	<10 (see split view 1)	Effective control of NO_X abatement systems, including reagent dosing contributes to reducing NH_3 emissions. Wet scrubbers absorb NH_3 and transfer it to the waste water stream.
Benz(a)pyrene	For these substances there was insufficient data to draw a firm BAT conclusion on emission levels. However, the data provided in Chapter 3 indicates that their emission levels are generally low. PCBs, PAHs and benz(a)pyrene can be controlled using the techniques applied for PCDD/F. N_2O levels are determined by combustion technique and optimisation, and SNCR optimisation where urea is used.			Techniques that control PCDD/F also control Benz(a)pyrene, PCBs and PAHs
PCBs				
PAHs				
Nitrous oxide (N_2O)				Effective oxidative combustion and control of NO_X abatement systems contribute to reducing N_2O emissions. The higher levels may be seen with fluidised beds operated at lower temperatures e.g. below ~900 °C

NOTES:
1. 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)
2. ∑ other metals = sum of Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V and their compounds expressed as the metals
3. Non-continuous measurements are averaged over a sampling period of between 30 minutes and 8 hours. Sampling periods are generally in the order of 4 – 8 hours for such measurements.
4. Data is standardised at 11 % Oxygen, dry gas, 273K and 101.3kP
5. Dioxin and furans are calculated using the equivalence factors as in EC/2000/76
6. When comparing performance against these ranges, in all cases the following should be taken into account: the confidence value associated with determinations carried out; that the relative error of such determinations increases as measured concentrations decrease towards lower detection levels
7. The operational data supporting the above-mentioned BAT ranges were obtained according to the currently accepted codes of good monitoring practice requiring measurement equipment with instrumental scales of 0 – 3 times the WID ELV. For parameters with an emission profile of a very low baseline combined with short period peak emissions, specific attention has to be paid to the instrumental scale. For example changing the instrumental scale for the measurement of CO from 3-times the WID ELV to a 10-times higher value, has been reported in some cases, to increase the reported values of the measurement by a factor of 2 – 3. This should be taken into account when interpreting this table.
8. 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 (i.e. NO_X reduction per unit cost) of NO_X abatement (e.g. SNCR) is lower at small MSWIs (i.e. those MSWIs of capacity <6 tonnes of waste/hour).

SPLIT VIEWS:

1 BAT 35 : Based upon their knowledge of the performance of existing installations a few Member States and the Environmental NGO expressed the split view that the 24 hour NH_3 emission range associated with the use of BAT should be <5 mg/Nm^3 (in the place of <10 mg/ Nm^3)

2 BAT 35 : One Member State and the Environmental NGO expressed split views regarding the BAT ranges in table 5.2 (air). These split views were based upon their knowledge of the performance of a number of existing installations, and their interpretation of data provided by the TWG and also of that included in this BREF document (e.g. in Chapter 3). The final outcome of the TWG meeting was the ranges shown in Table 5.2, but with the following split views recorded: total dust 1/2hr average 1 - 10 mg/Nm^3; NO_X (as NO_2) using SCR 1/2hr average 30 - 200 and 24hr average 30 - 100 mg/Nm^3; Hg and its compounds (as Hg) non-continuous 0.001 - 0.03 mg/Nm^3; Total Cd + Tl non-continuous 0.005 - 0.03mg/Nm^3; Dioxins and furans non-continuous 0.01 - 0.05 ng TEQ/Nm^3. Based on the same rationale, the Environmental NGO also registered the following split views: HF 1/2hr average <1 mg/Nm^3; SO_2 1/2hr average 1 – 50 mg/Nm^3 and 24hr average 1 – 25 mg/Nm^3.

Table 5.2 Operational emission level ranges associated with the use of BAT for releases to air from waste incinerators

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)

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:

Criteria	Wet FGT (W)	Semi-wet FGT (SW)	Dry lime FGT (DL)	Dry sodium bicarbonate FGT (DS)	Comments
Air emissions performance	+	0	-	0	• in respect of HCl, HF, NH_3 & SO_2 wet systems generally give the lowest emission levels to air • each of the systems are usually combined with additional dust and PCDD/F control equipment • DL systems may reach similar emission levels as DS & SW but only with increased reagent dosing rates and associated increased residue production.
Residue production	+	0	-	0	• residue production per tonne waste is generally higher with DL systems and lower with W systems with greater concentration of pollutants in residues from W systems • material recovery from residues is possible with W systems following treatment of scrubber effluent, and with DS systems
Water consumption	-	0	+	+	• water consumption is generally higher with W systems • Dry systems use little or no water
Effluent production	-	+	+	+	• the effluents produced (if not evaporated) by W systems require treatment and usually discharge – where a suitable receptor for the salty treated effluent can be found (e.g. marine environments) the discharge itself may not be a significant disadvantage • ammonia removal from effluent may be complex
Energy consumption	-	0	0	0	• energy consumption higher with W systems due to pump demand – and is further increased where (as is common) combined with other FGT components e.g. for dust removal
Reagent consumption	+	0	-	0	• generally lowest reagent consumption with W systems • generally highest reagent consumption with DL – but may be reduced with reagent re-circulation • SW, and DL & DS systems can benefit from use of raw gas acid monitoring (see 4.4.3.9)
Ability to cope with inlet variations of pollutant	+	0	-	0	• W systems are most capable of dealing with wide ranging and fast changing inlet concentrations of HCl, HF and SO_2. • DL systems generally offer less flexibility – although this may be improved with the use of raw gas acid monitoring (see 4.4.3.9)
Plume visibility	-	0	+	+	• plume visibility is generally higher with wet systems (unless special measures used) • dry systems generally have the lowest plume visibility
Process complexity	- (highest)	0 (medium)	+ (lowest)	+ (lowest)	• W systems themselves are quite simple but other process components are required to provide an all round FGT system including a waste water treatment plant etc.
Costs - capital	Generally higher	medium	Generally lower	Generally lower	• additional cost for wet system arises from the additional costs for complementary FGT and auxiliary components – most significant at smaller plants
Costs – operational	medium	Generally lower	medium	Generally lower	• there is an additional operational cost of ETP for W systems – most significant at smaller plants • higher residue disposal costs where more residues are produced, and more reagent consumed. W systems generally produce lowest amounts of reagents and therefore may have lower reagent disposal costs. • op. costs include consumables, disposal and maintenance costs. Op. costs depend very much on local prices for consumables and residue disposal.

Note: + means that the use of the technique generally offers an advantage in respect of the assessment criteria considered
0 means that the use of the technique generally offers no significant advantage or disadvantage in respect of the assessment criteria considered
- means that the use of the technique generally offers a disadvantage in respect of the assessment criteria considered

Table 5.3: An example assessment of some IPPC relevant criteria that may be taken into account when selecting between wet/semi-wet/dry FGT options

38. to prevent the associated increased electrical consumption, to generally (i.e. 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 SO_2 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 represents 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 (i.e. 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 (i.e. NO_X reduction per unit cost) of NO_X abatement (e.g. SNCR) is lower at small MSWIs (i.e. those MSWIs of 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 where the dust abatement operational temperature has been further lowered from 250 to below 200 °C, and
   d. 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

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.

43. if re-burn of FGT residues is applied, then suitable measures should be taken to avoid the re-circulation and accumulation of Hg in the installation

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 waste water 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 potential or actual contaminated waste water streams, as described in 4.5.9. Some such waste water 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 waste water 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
    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 waste water treatment process, as described in 4.5.10
    e. the use of sulphides (e.g. 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

Parameter	BAT range in mg/l (unless stated)	Sampling and data information
Total suspended solids as defined by Directive 91/271/EEC	10 – 30 (95 %) 10 – 45 (100 %)	• based on spot daily or 24 hour flow proportional sample
Chemical oxygen demand	50 – 250	• based on spot daily, or 24 hour flow proportional sample
pH	pH 6.5 – pH 11	• continuous measurement
Hg and its compounds, expressed as Hg	0.001 – 0.03 (see split view 1)	• based on monthly measurements of a flow proportional representative sample of the discharge over a period of 24 hours with one measurement per year exceeding the values given, or no more than 5 % where more than 20 samples are assessed per year • There have been some positive experiences with continuous monitoring of Hg • Total Cr levels below 0.2 mg/l provide for control of Chromium VI • Sb, Mn, V and Sn are not included in Directive 2000/76
Cd and its compounds, expressed as Cd	0.01 – 0.05 (see split view 1&2)	
Tl and its compounds, expressed as Tl	0.01 – 0.05 (see split view 2)	
As and its compounds, expressed as As	0.01 – 0.15 (see split view 1)	
Pb and its compounds, expressed as Pb	0.01 – 0.1	
Cr and its compounds, expressed as Cr	0.01 – 0.5 (see split view 2)	
Cu and its compounds, expressed as Cu	0.01 – 0.5 (see split view 2)	
Ni and its compounds, expressed as Ni	0.01 – 0.5 (see split view 2)	
Zn and its compounds, expressed as Zn	0.01 – 1.0 (see split view 2)	
Sb and its compounds, expressed as Sb	0.005 – 0.85 (see split view 1)	
Co and its compounds, expressed as Co	0.005 – 0.05	
Mn and its compounds, expressed as Mn	0.02 – 0.2	
V and its compounds, expressed as V	0.03 – 0.5 (see split view 1)	
Sn and its compounds, expressed as Sn	0.02 – 0.5	
PCDD/F (TEQ)	0.01 – 0.1 ng TEQ/l (see split view 1&2)	• average of 6 monthly measurements of a flow proportional representative sample of the discharge over a period of 24 hours

NOTE:
1. Values are expressed in mass concentrations for unfiltered samples
2. Values relate to the discharge of treated scrubber effluents without dilution
3. BAT ranges are not the same as ELVs – see comments in introduction to Chapter 5
4. pH is one important parameter for waste water treatment process control
5. Confidence levels decrease as measured concentrations decrease towards lower detection levels

SPLIT VIEWS:

1 **BAT 48:** One Member State and the Environmental NGO expressed split views regarding the BAT ranges in table 5.4 (water). These split views were based upon their knowledge of the performance of a number of existing installations, and their interpretation of data provided by the TWG and also of that included in this BREF document (e.g. in Chapter 3). The final outcome of the TWG meeting was the ranges shown in Table 5.4, but with the following split views recorded: Hg 0.001 - 0.01 mg/l; Cd 0.001 - 0.05 mg/l; As 0.003 - 0.05 mg/l; Sb 0.005 - 0.1 mg/l; V 0.01 - 0.1 mg/l; PCDD/F <0.01 - 0.1 ng TEQ/l.

2 **BAT 48:** Based on the same rationale, the Environmental NGO also registered the following split views: Cd 0.001 - 0.02 mg/l; Tl 0.001 – 0.03 mg/l; Cr 0.003 – 0.02 mg/l; Cu 0.003 – 0.3 mg/l; Ni 0.003 – 0.2 mg/l.; Zn 0.01 – 0.05 mg/l; PCDD/F <0.01 ng TEQ/l.

Table 5.4: BAT associated operational emission levels for discharges of waste water from effluent treatment plant receiving FGT scrubber effluent

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 (e.g. 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 burn out 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.

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 4.6.6and 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 e.g. 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 (e.g. level of detail) and nature of the EMS (e.g. 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) that incorporates, as appropriate to individual circumstances, the following features: (see Chapter 4.8)

- definition of an environmental policy for the installation by top management (commitment of the top management is regarded as a precondition for a successful application of other features of the EMS)
- planning and establishing the necessary procedures
- implementation of the procedures, paying particular attention to
  - structure and responsibility
  - training, awareness and competence
  - communication
  - employee involvement
  - documentation
  - efficient process control
  - maintenance programme
  - emergency preparedness and response
  - safeguarding compliance with environmental legislation.
- checking performance and taking corrective action, paying particular attention to
  - monitoring and measurement (see also the Reference document on Monitoring of Emissions)
  - corrective and preventive action
  - maintenance of records
  - independent (where practicable) internal auditing in order to determine whether or not the environmental management system conforms to planned arrangements and has been properly implemented and maintained.
- review by top management.

Three further features, which can complement the above stepwise, are considered as supporting measures. However, their absence is generally not inconsistent with BAT. These three additional steps are:

- having the management system and audit procedure examined and validated by an accredited certification body or an external EMS verifier
- preparation and publication (and possibly external validation) of a regular environmental statement describing all the significant environmental aspects of the installation, allowing for year-by-year comparison against environmental objectives and targets as well as with sector benchmarks as appropriate
- implementation and adherence to an internationally accepted voluntary system such as EMAS and EN ISO 14001:1996. This voluntary step could give higher credibility to the EMS. In particular EMAS, which embodies all the above-mentioned features, gives higher credibility. However, non-standardised systems can in principle be equally effective provided that they are properly designed and implemented.

Specifically for this industry sector*, it is also important to consider the following potential features of the EMS:

- giving consideration to the environmental impact from the eventual decommissioning of the unit at the stage of designing a new plant
- giving consideration to the development of cleaner technologies
- where practicable, sectoral benchmarking on a regular basis, including energy efficiency and energy conservation activities, choice of input materials, emissions to air, discharges to water, consumption of water and generation of waste
- the development and use of procedures for the commissioning stages of new installations, generally including:
- the prior preparation of a detailed programme of works describing the commissioning programme
- an initial gap analysis of training requirements to identify pre-commissioning training needs
- health & safety needs which meet European and local requirements
- the availability of sufficient and up to date documentation regarding the installation
- emergency and accident prevention planning, generally include procedures for:
    - serious fire
    - major explosion
    - sabotage/bomb
    - site intruders
    - major injury/death of employee/visitor/contractor
    - traffic accident
    - theft
    - environmental incident
    - power interruption
- where the plant commissioning and tuning period may give rise to emissions outside the normal regulatory controls.

All incineration installations, and in particular for those receiving hazardous wastes, personnel training programs are considered an important part of all safety management systems, especially training for:
- explosion and fire prevention
- fire extinguishing
- knowledge of chemical risks (labelling, carcinogenic substances, toxicity, corrosion, fire) and transportation

5.2 Specific BAT for municipal waste incineration

In addition to the generic measures given in Section 5.1, for municipal waste incineration BAT is in general considered to be:

57. the storage of all waste, (with the exception of wastes specifically prepared for storage or bulk items with low pollution potential e.g. 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 Section 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. to pretreat the waste, in order to improve its homogeneity and therefore combustion characteristics and burn-out, by:
    a. mixing in the bunker (see 4.1.5.1), and
    b. the use of shredding or crushing for bulky wastes e.g. 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 (e.g. waste mixing with bulky waste crushing) whereas fluidized bed systems require greater waste selection and pretreatment, usually including full shredding of the MSW.

60. 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 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 (i.e. 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)

61. 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)

62. 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)

63. 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)

5.3 Specific BAT for pretreated or selected municipal waste incineration

In addition to the generic measures given in Section 5.1, for pretreated or selected municipal waste (including municipal refuse derived fuels) incineration BAT is in general considered to be:

64. the storage of wastes:
    a. in enclosed hoppers or,
    b. on sealed surfaces with controlled drainage inside covered and walled buildings

65. when waste is stockpiled (typically for later incineration) it should generally be baled (see Section 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

66. at new and existing installations, the generation of the greater of:
    a. an annual average of generally at least 0.6 – 1.0 MWh electricity/tonne of waste (based on an average NCV of 4.2 MWh/tonne), or
    b. the annual average electricity demand of the entire installation, including (where used) on-site waste pretreatment and on-site residue treatment operations

67. the location of new installations so that:
    a. as well as the 0.6 – 1.0 MWhe/ tonne of electricity generated, the heat and/or steam can also be utilised for CHP, so that in general an additional thermal export level of 0.5 – 1.25 MWh/tonne of waste (ref. section 3.5.4.3) can be achieved (based on an average NCV of 4.2 MWh/tonne), or
    b. where electricity is not generated, a thermal export level of 3 MWh/tonne of waste can be achieved (based on an average NCV of 4.2 MWh/tonne)

68. to reduce installation energy demand and to achieve an average installation electrical demand (excluding pretreatment or residue treatment) to generally below 0.2 MWh/tonne of waste processed (ref. Table 3.47 and section 4.3.6) based on an average NCV of 4.2 MWh/tonne of waste

5.4 Specific BAT for hazardous waste incineration

In addition to the generic measures given in Section 5.1, for hazardous waste incineration BAT is in general considered to be:

69. in addition to the quality controls outlined in BAT4, at HWI to use specific systems and procedures, using a risk based approach according to the source of the waste, for the labelling, checking, sampling and testing of waste to be stored/treated (see 4.1.3.4). Analytical procedures should be managed by suitable qualified personnel and using appropriate procedures. In general equipment is required to test:

- the calorific value
- the flashpoint
- PCBs
- Halogens (e.g. Cl, Br, F) and sulphur
- heavy metals
- waste compatibility and reactivity
- radioactivity (if not already covered by BAT3 through fixed detectors at the plant entrance.

Knowledge of the process or origin of the waste is important as certain hazardous characteristics, (for example toxicity or infectiousness) are difficult to determine analytically.

70. the mixing, blending and pretreating of the waste in order to improve its homogeneity, combustion characteristics and burn-out to a suitable degree with due regard to safety considerations. Examples are the shredding of drummed and packaged hazardous wastes, described in 4.1.5.3 and 4.1.5.6. If shredding is carried out then blanketing with an inert atmosphere should be carried out.

71. the use of a feed equalisation system for solid hazardous wastes (e.g. as described in 4.1.5.4 or other similar feeding technology) in order to improve the combustion characteristics of the fed waste and to improve the stability of flue-gas composition including the improved control of short-term CO peak emissions.

72. the direct injection of liquid and gaseous hazardous wastes, where those wastes require specific reduction of exposure, releases or odour risk, as described in 4.1.6.3

73. the use of a combustion chamber design that provides for containment, agitation and transport of the waste, for example: rotary kilns - either with or without water cooling. Water cooling for rotary kilns (see 4.2.15), may be favourable in situations where:
    a. the LHV of the fed waste is higher (e.g. >15 – 17 GJ/tonne), or
    b. higher temperatures e.g. >1100 °C are used (e.g. for ash slagging or destruction of specific wastes)

74. to reduce installation energy demand and in general, and to achieve an average installation electrical demand (excluding pretreatment or residue treatment) of generally below 0.3 – 0.5 MWh/tonne of waste processed (see 3.5.5 and 4.3.6). Smaller installations generally result in consumption levels at the upper end of this range. Weather conditions may have a significant impact on consumption owing to heating requirements etc.

75. for merchant HWI and other hazardous waste incinerators feeding wastes of highly varying composition and sources, the use of:
    a. wet FGT, as described in 4.4.3.1, is generally BAT to provide for improved control of short-term air emissions (see concluding remarks 7.4.3 ref. other systems and BAT37 regarding FGT system selection)
    b. specific techniques for the reduction of elemental iodine and bromine emissions, as described in 4.4.7.1, where such substances exist in the waste at appreciable concentrations

5.5 Specific BAT for sewage sludge incineration

In addition to the generic measures given in Section 5.1, for sewage sludge incineration BAT is in general considered to be:

76. at installations that are mainly dedicated to the incineration of sewage sludge, the use of fluidised bed technology may generally be BAT because of the higher combustion efficiency and lower flue-gas volumes that generally result from such systems. There may be a risk of bed clogging with some sewage sludge compositions.

77. the drying of the sewage sludge, preferably by using heat recovered from the incineration, to the extent that additional combustion support fuels are not generally required for the normal operation of the installation (i.e. in this case, normal operation excludes start-up, shut-down and the occasional use of support fuels for maintaining combustion temperatures)

5.6 Specific BAT for clinical waste incineration

In addition to the generic measures given in Section 5.1, for clinical waste incineration BAT is in general considered to be:

78. the use of non-manual waste handling and loading systems

79. The receipt and storage of clinical wastes in closed containers that are suitably resistant to leaks and punctures.

80. the washing out of waste containers that are to be re-used in a specifically designed, designated washing facility, with disinfection as required, and the feeding of any accumulated solids to the waste incinerator

81. where grates are used, 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 cooling flow are generally suitable for wastes of NCV of up to approx. 18 MJ/kg. Higher NCV wastes (e.g. above approx. 18 MJ/kg) may require water (or other liquid) cooling in order to prevent the need for excessive primary air levels to control grate temperature i.e. levels that result in a greater air supply than the optimum for combustion control (see section 4.2.14)

82. the use of a combustion chamber design that provides for containment, agitation and transport of the waste, for example: rotary kilns - either with or without water cooling. Water cooling for rotary kilns, as described in 4.2.15, may be favourable in situations where:
    a. the NCV of the fed waste is higher (e.g. >15 – 17 GJ/tonne), or
    b. higher temperatures e.g. >1100 °C are used (e.g. for slagging or destruction of specific wastes)